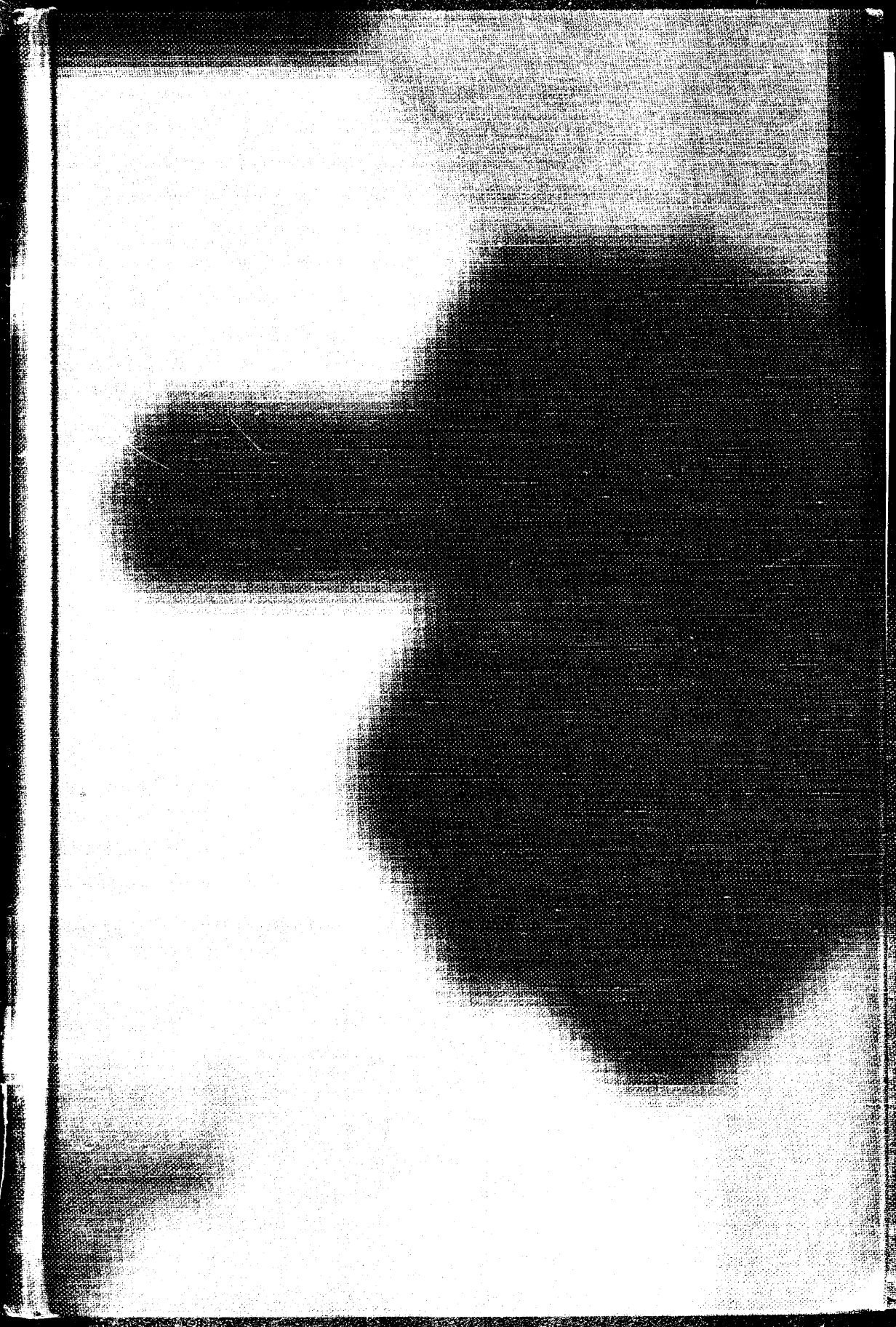


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MANUAL
OF THE RUSTS
IN
UNITED STATES AND CANADA

By

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Professor Emeritus of Botany, Purdue University

ILLUSTRATIONS AND A NEW SUPPLEMENT

BY

PROFESSOR GEORGE B. CUMMINS

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PREFACE

In the preparation of this *Manual of the Rusts in United States and Canada* two principal objects have been kept in mind. One object has been to produce a work to be serviceable in the determination of collection of rusts by the general botanist, and the other has been to present a classification showing the relationship of species and genera as consistent with the present state of knowledge as lineal arrangement permits.

The geographic area covered is that of Greenland, Newfoundland, Canada and the continental United States, including Alaska and the Aleutian islands. One hundred and twenty-eight subtropic species which invade the United States along its southern border are given less space and are indicated by asterisks.

In the use of the Manual it should be borne in mind that one of the most important factors in the determination of a rust, as a rule, is the correct name of the host. In some instances the name of the genus or the family suffices. The need for a knowledge of the host is due to structural similarity between species of rusts often distantly related, and also to variability in minute characters difficult to express in words.

After an examination with the microscope a resort to the key, with the aid of the host index, should usually direct one to the descriptive text and to the name. When the specimen in hand shows only one spore-form, or a spore-form not used in the key for that group, the index for hosts is often more helpful than the key.

A general study of the rusts has led to the conclusion that every species consists of two states of development, which may be designated the gametophytic (or haploid) state and the sporophytic (or diploid) state. Four kinds of fruiting bodies or sori are produced, each bearing its characteristic spores. These four kinds of spores, pycniospores, aeciospores, urediospores and teliospores, which are very unlike in their physiologic significance, provide the main basis for the classification of the rusts. The first two, pycniospores and aeciospores, are the product of the gametophytic state and the last two, urediospores and teliospores, of the sporophytic state.

Many rusts, however, have undergone reduction of one kind or another. The reduced forms often have become so well established that they are treated as independent species, or even genera. Thus, species in every way like those of the genus *Puccinia*, except in having only one-celled teliospores, are usually placed in the genus *Uromyces*. There are rusts of similar nature which produce no uredia and those which produce aecia resembling uredia. Rusts with the above characteristics, that is, with all spore-forms (aecia being either aecidioid or uredinoid), or with the uredia wanting (demicyclic), are considered to be macrocyclic (long cycle).

Reduction may have gone further and only teliospores, with or without pycnia, appear in the cycle. Such species are considered to be microcyclic (short cycle). Most authors treat such shortened forms as independent species, and some authors place them in separate genera. In the present work such micro-

cyclic genera as *Necium, Ameris, Polythelis, Micropuccinia,* and some others formerly kept distinct by the author, are now placed under the macrocyclic genera to which they are most closely related. Both methods of nomenclatural treatment have the same object in view, *viz.*: to identify species whether placed under one genus or another, and to some extent to indicate relationship. Specific identity is maintained in either case. In the keys the demicyclic and microcyclic species are indicated by the letters "d" and "m" respectively. Among macrocyclic rusts there are various other kinds of reduction which only occasionally lead to specific distinction. The aecia may lose their peridia, and yet retain their form, as in *Puccinia minussensis* (*P. hemisphaerica*), or the definite form of the sorus as well as the peridium may be lost, as in *Gymnoconia* and some species of *Phragmidium.*

A common kind of reduction is the formation of uredinoid in place of aecidioid aecia but of the same nature, that is, the gametophytic mycelium gives rise to spores, often called "primary uredospores" that more or less resemble true urediospores, being borne singly on pedicels instead of being catenulate as in the aecidioid aecia. Species with such aeciospores, *e.g.*, *Puccinia obtegens* (*P. suaveolens*), have been called "brachy-forms." The failure to distinguish between true aecia when uredinoid and the more or less similar uredia has led to much confusion in both morphologic and cytologic studies. The rust on *Alchemilla,* often mistakenly called *Uromyces alchemillae,* is a notable example, there being only uredinoid aecia, with true uredia wanting.

In the evolution which produces microcyclic species certain morphologic changes may usually be noted, such as more or less verrucose markings of the teliospores, while in the correlated macrocyclic species the teliospores may be nearly or quite smooth. The sori may also be either compact or pulverulent, the compact form having more elongated and thinner-walled teliospores that germinate upon maturity, while the pulverulent form shows darker and thicker-walled teliospores that have a resting stage and germinate the following spring, these being two noticeable forms that may or may not occur in the correlated macrocyclic species. The microcyclic species may also occasionally possess subepidermal paraphyses in the telial sori, while nearly or quite absent in the corresponding macrocyclic species. In these and other ways a correlated species, whether microcyclic or macrocyclic, may deviate somewhat from the species from which it is supposed to have been derived, indicative of advanced (or retrograde?) evolution.

A distinctive feature of the present work is an attempt to show degrees of relationship other than indicated by hosts. In carrying out this plan, genera are in some instances divided into sections, instead of such sections being recognized as separate genera, and species fall into varieties, when they might have been treated under separate specific names.

But the most striking method adopted to show relationship is the aggregation of the species that exhibit correlation, that is, have sufficient points of resemblance to indicate descent from a common ancestor (*cf.* Arthur *et al.*, "Plant Rusts," p. 100). This is carried out conspicuously in the genus *Puccinia,* where species showing correlation are placed under the most completely developed species known, and the reduced forms follow it under the same number, without, however, losing their generic or specific identity. Each

group of species bearing a number in the following treatise may in a way be considered to represent an ancestral species broken into more or less distinct forms, now called correlated species, during evolutionary development. By this method of grouping the key to the genus *Puccinia* now contains 332 numbered species; without this grouping it would have required 87 more numbers, not including varieties and subtropical species, an increase of over 26 per cent. Theoretically every microcyclic species should be correlated with some macrocyclic species, if such is known to be in existence, from which it is presumed to have descended. But it has not been found possible at the present time thus to connect many of the microcyclic species. In the genus *Puccinia* (*Uromyces*), which contains the largest number, there are 78 microcyclic species, or about 60 per cent of the whole number treated, that still remain unidentified as to their proper macrocyclic connection, and are consequently numbered and keyed as independent species.

The definition of specific identity employed in the work is that formulated by the American Phytopathological Society (Phytop. 15: 316. 1925), which is now generally acceptable to uredinologists and most mycologists, *viz.*: "a group of individuals which can be segregated on the basis of morphologic characters of such a nature as to be applicable and determinable by mycologists and pathologists in general, and such as will be available for general, practical taxonomic purposes." Biologic and physiologic "species" are not considered in the present treatise, chiefly to conserve space, although recognizing that together with physiologic forms and strains they have great value in economic botany.

Brief record has been made of culture work, especially that carried out by the use of aeciospores or teliospores. When ascribed to Arthur the cultures were conducted at Lafayette, Indiana, by him or his assistants, unless otherwise stated. Such cultures assist in identifying or establishing species, and in completing life histories. Research of this kind is one of the chief aids in attaining a better understanding of the rusts, and is particularly incumbent upon every earnest student of the Uredinales.

In order to keep the volume within convenient size it has been necessary to conserve space in every possible way not seriously interfering with usefulness. Many synonyms not affecting the selection of the name of the rust, have been omitted. The descriptions of sori have been greatly curtailed, especially in regard to gross appearance and in details relating to the peridium, and in a few instances the full list of hosts and localities is not given. Such omissions can largely be supplied by reference to the seventh volume of the North American Flora, for which page numbers are given. More to be regretted is the lack of space in which to show variation in the size and shape of the spores, which must be allowed for in every species and in the interpretation of each description. The illustration of aeciospores (only in *Gymnosporangium*), urediospores and teliospores for the several species is intended to depict average characteristic spores, both in surface view and optical section, all being drawn to a uniform magnification of 625 diameters, and reduced in engraving to 415 diameters.

It has been the desire of the author to abide by the International Rules of Botanical Nomenclature* as applied to both parasites and hosts. The few

* Briquet, John. Regles Internationales de la Nomenclature Botanique. 110 pp. June, 1912.

deviations in the present work among the hosts may be ascribed to convenience or oversight. Among the rusts two deviations are made in the interest of logical interpretation of facts and reasonable stability.

The date for beginning of nomenclatural priority is taken to be 1753, not 1801 as in Art. 19*c* of the Rules. This change affects no generic and only five specific names in the present work, *viz.*: those of *Tranzschelia fusca, Phragmidium disciflorum, Uromyces caryophyllinus, U. fabae* and *U. polygoni.* To follow the Rule would require the substitution of five unfamiliar names.

The second deviation, if such it can be called, is in the interpretation of the phrase "perfect state" in Art 49*bis.* There are two states in the Uredinales, the gametophytic or haploid and the sporophytic or diploid. The Rule defines the "perfect state" as that which "ends in the teleutospore or its equivalent," but does not exclude any other kind of spore that may also occur in the "perfect state." The examples cited under the Rule confuse the use of the generic names, *Aecidium, Caeoma* and *Uredo,* with these names as applied to stages in the life cycle of a species. The Rule is seemingly intended, not to apply to species under the genera named, but to aecia and uredia under any genus. If the Rule were interpreted to exclude all names under the genus *Uredo,* as has been done by some taxonomists, out of the 694 species in the present work, exclusive of those under form-genera, 18 would require substitution of other names. The alternate names would not be found more acceptable, and some less so (*e.g.,* replacing *Puccinia glumarum* Erikss. & Henn. with *P. neglecta* Westend.).

In the present work names applied to pycnia and aecia, both the products of the gametophyte, are not recognized in matters of nomenclatural priority, which is in accordance with the intent of the International Rules. In citation of synonymy such names are inclosed in parentheses. When in the few instances an aecial name is necessarily adopted (see Art. 56 of the Rules), the original authority for the specific name is shown by brackets (see Art. 43, XXV*ter* of the Rules). Names applied to the uredia and telia, both the products of the sporophytic or "perfect" state, are accorded equal standing in matters of priority.

The completeness of the present work, both as to species of rusts and hosts and their distribution is largely due to the generous assistance of friends in contributing specimens and communicating field observations. More than 300 correspondents have added to the material in the Arthur Herbarium, now the property of Purdue University, in which the data for each entry in the Manual can be found. To all who have aided directly or indirectly in the completeness and accuracy of the work the author extends his heartiest thanks. Especial recognition is due to Mr. George B. Cummins, who has provided all the illustrations, exhibiting rare skill, accuracy and discrimination, and who has rendered invaluable assistance in other ways. Finally and in large measure credit should be accorded to the botanical department of the Purdue Agricultural Experiment Station in providing facilities for carrying on the preliminary studies and in supplying all needed assistance in the preparation of the manuscript.

J. C. ARTHUR

LAFAYETTE, INDIANA
DECEMBER, 1933

CONTENTS

Abbreviations for Authors of Rust Species ix
Abbreviations for Authors of Host Plants xiii
Abbreviations for States, Provinces and Territories xiv
Explanation of Terms and Usage xiv
Glossary xv
Key to the Families and Tribes 1
Melampsoraceae 1
Pucciniastreae
1. Uredinopsis 2
2. Milesia 5
3. Hyalopsora 10
4. Pucciniastrum 12
§ Phragmopsora
§ Thecopsora
§ Calyptospora
5. Melampsorella 20
6. Melampsoridium 22
Cronartieae
7. Cronartium 24
8. Chrysomyxa 30
9. Coleosporium 36
Melampsoreae
10. Melampsora 50
11. Aplopsora 59
Phakopsoreae
12. Bubakia 59
13. Physopella 60
14. Cerotelium 61
15. Baeodromus 62
Pucciniaceae 63
Ravenelieae
1. Ravenelia 63
§ Neoravenelia
§ Euravenelia
2. Pileolaria 69
3. Tranzschelia 71
4. Cumminsiella 74
Phragmidieae
5. Uropyxis 76
6. Phragmopyxis 77
7. Phragmidium 78
§ Euphragmidium
§ Earlea

8. Xenodochus 91
9. Frommea 92
10. Kuehneola 93
11. Mainsia 95
12. Gymnoconia 95
13. Trachyspora 97
14. Triphragmium 98
15. Nyssopsora 99

Aecidieae

16. Puccinia (Uromyces) 100
§ Eupuccinia
§ Bullaria
17. Gymnosporangium 356
§ Gymnotelium
§ Eugymnosporangium

FORM-GENERA 380
1. Aecidium 380
2. Peridermium 388
3. Caeoma 390
4. Uraecium 390
5. Uredo 391

SUPPLEMENT 394
INDEX OF HOST NAMES 395
INDEX OF RUST NAMES 422

SUPPLEMENT by George B. Cummins 1A-24A

ABBREVIATIONS

of names for authors of rust species*

Adams, J. F.	**Adams,** James Fowler, 1888–.
A. & S.	**Albertini,** Johannes Baptista von, 1769–1831; **Schweinitz,** Lewis David von, 1780–1834.
A. S. S.	**Anastasia,** Giuseppe Emilio, 1870–; **Saccardo,** Pier Andrea, 1845–1920; **Splendore,** Achille, 1868–1928.
Arth.	**Arthur,** Joseph Charles, 1850–.
Arth. & Bisby.	" ; **Bisby,** Guy Richard, 1889–.
Arth. & Cumm.	" ; **Cummins,** George Baker, 1904–.
A. & F.	" ; **Fromme,** Fred Denton, 1886–.
A. & H.	" ; **Holway,** Edward Willet Dorland, 1853–1923.
A. & J.	" ; **Jackson,** Herbert Spencer, 1883–.
A. &. K.	" ; **Kern,** Frank Dunn, 1883–.
Arth. & Mains.	" ; **Mains,** Edwin Butterworth, 1890–.
Arth. & Orton.	" ; **Orton,** Clayton Roberts, 1885–.
Atk.	**Atkinson,** George Francis, 1854–1918.
Auth.	**Authors,** used for misapplied names.
Barclay.	**Barclay,** Arthur, 1852–1891.
Barth.	**Bartholomew,** Elam, 1852–.
Bell.	**Bell,** Hugh Philip, 1889–.
Bérenger.	**Bérenger,** Giuseppe Adolpho de, 1815–1895.
Berg.	**Bergamaschi,** Giuseppe, 1785–1867.
Berk.	**Berkeley,** Miles Joseph, 1803–1889.
B. & Br.	" ; **Broome,** Christopher Edmund, 1812–1886.
B. & C.	" ; **Curtis,** Moses Ashley, 1808–1872.
Berk. & Rav.	" ; **Ravenel,** Henry William, 1814–1887.
Bert.	**Bertero,** Carlo Giuseppe, 1789–1831.
Bethel.	**Bethel,** Ellsworth, 1863–1925.
Billings.	**Billings,** John Shaw, 1838–1913.
Biv.	**Bivona-Bernardi,** Antonio, 1774–1837.
Blasd.	**Blasdale,** Walter Charles, 1871–.
Blytt.	**Blytt,** Axel Gudbrand, 1843–1898.
Bon.	**Bonorden,** Hermann Friedrich, 1801–1884.
Bosc.	**Bosc,** Louis Augustin Guillaume, 1759–1828.
Br., A.	**Braun,** Alexander Carl Heinrich, 1805–1877.
Brondeau.	**Brondeau,** Louis de, 1794–1859.
Bubák.	**Bubák,** Franz, 1866–1925.
Bubák & Syd.	" ; **Sydow,** Paul, 1851–1925; **Sydow,** Hans, 1879–.
Burr.	**Burrill,** Thomas Jonathan, 1839–1916.
Butler.	**Butler,** Edwin John, 1874–.
Car. & Picc.	**Carestia,** Antonio, 1825–1908; **Piccone,** Antonio, 1844–1901.
Carl.	**Carleton,** Mark Alfred, 1866–1925.
Carm.	**Carmichael,** Dugald, 1772–1827.
Cast.	**Castagne,** Jean Louis Martin, 1785–1858.
Ces.	**Cesati,** Vincenzo de, 1806–1883.
Chev.	**Chevallier,** François Fulgis, 1796–1840.
Clint., G. W.	**Clinton,** George William, 1807–1885.
Cooke.	**Cooke,** Mordicai Cubitt, 1825–1914.
C. & E.	" ; **Ellis,** Job Bicknell, 1829–1905.
Cooke & Hark.	" ; **Harkness,** Harvey Willson, 1821–1901.
C. & P.	" ; **Peck,** Charles Horton, 1833–1917.
Cda.	**Corda,** August Carl Joseph, 1809–1849.
Cruch. & May.	**Cruchet,** Paul, 1875–; **Mayor,** Eugène, 1877–.
Curt.	**Curtis,** Moses Ashley, 1808–1872.
Davis, J. J.	**Davis,** John Jefferson, 1852–.
Davis, W. H.	**Davis,** William Harold, 1876–.
Dearn. & House.	**Dearness,** John, 1852–; **House,** Homer Doliver, 1878–.
de Bary.	**Bary,** Heinrich Anton de, 1831–1888.
DC.	**Candolle,** Augustin Pyramus de, 1778–1841.
Desmaz.	**Desmazières,** Jean Baptiste Henri Joseph, 1786–1862.
De-T.	**De-Toni,** Giovanni Battista, 1864–1924.

* Prepared with the assistance of Dr. J. H. Barnhart.

Diet.	**Dietel,** Paul, 1860–.
Diet. & Ellis.	" ; **Ellis,** Job Bicknell, 1829–1905.
D. & H.	" ; **Holway,** Edward Willet Dorland, 1853–1923.
Diet. & Neg.	" ; **Neger,** Franz Wilhelm, 1868–1923.
Dietr.	**Dietrich,** Heinrich August, ——.
Duby.	**Duby,** Jean Étienne, 1798–1885.
Dudl. & Thomp.	**Dudley,** William Russel, 1849–1911 ; **Thompson,** Charles Henry, 1870–1931.
Dur. & Mont.	**Durieu de Maisonneuve,** Michael Charles, 1797–1878 ; **Montagne,** Jean Pierre François Camille, 1784–1866.
Earle.	**Earle,** Franklin Sumner, 1856–1929.
Ehrenb.	**Ehrenberg,** Christian Gottfried, 1795–1876.
Ellis.	**Ellis,** Job Bicknell, 1829–1905.
Ellis & And.	" ; **Anderson,** Frederick William, 1866–1891.
Ellis & Barth.	" ; **Bartholomew,** Elam, 1852–.
E. & E.	" ; **Everhart,** Benjamin Matlack, 1818–1904.
Ellis & Gall.	" ; **Galloway,** Beverly Thomas, 1863–.
Ellis & Hark.	" ; **Harkness,** Harvey Willson, 1821–1901.
E. & K.	" ; **Kellerman,** William Ashbrook, 1850–1908.
Ellis & Tr.	" ; **Tracy,** Samuel Mills, 1847–1920.
Erikss.	**Eriksson,** Jakob, 1848–1931.
Erikss. & Henn.	" ; **Henning,** Ernst Johan, 1857–.
Farl.	**Farlow,** William Gilson, 1844–1919.
Faull.	**Faull,** Joseph Horace, 1870–.
Faull & Wats.	" ; **Watson,** Wade Ralph, 1903–.
Ferd. & Winge.	**Ferdinandsen,** Carl Christian Frederik, 1879– ; **Winge,** Øjvind, 1886–.
Fisch.	**Fischer,** Eduard, 1861–.
Fischer.	**Fischer,** Johann Carl, 1804–1885.
F. & L.	**Fraser,** William Pollock, 1867– ; **Ledingham,** George Aleck, 1903–.
Fries.	**Fries,** Elias Magnus, 1794–1878.
Fromme.	**Fromme,** Fred Denton, 1886–.
Fckl.	**Fuckel,** Leopold, 1821–1876.
Funck.	**Funck,** Heinrich Christian, 1771–1839.
Gall.	**Galloway,** Beverly Thomas, 1863–.
Garrett.	**Garrett,** Albert Osbun, 1870–.
Ger.	**Gerard,** William Ruggles, 1841–1914.
Gray, S. F.	**Gray,** Samuel Frederick, 1766–1836.
Grev.	**Greville,** Robert Kaye, 1794–1866.
Griff.	**Griffiths,** David, 1867–.
Grognot.	**Grognot,** Camille, 1792 ?–1869.
Grove.	**Grove,** William Bywater, 1848–.
Guep.	**Guépin,** Jean Pierre, 1779–1858.
Halst.	**Halsted,** Byron David, 1852–1918.
Hariot.	**Hariot,** Paul Auguste, 1854–1917.
Hark.	**Harkness,** Harvey Willson, 1821–1901.
Hartig.	**Hartig,** Heinrich Julius Adolph Robert, 1839–1901.
Hazsl.	**Hazslinszky,** Friedrich August, 1818–1896.
Hedgc.	**Hedgcock,** George Grant, 1863–.
Hedgc., Bethel & Hunt.	" ; **Bethel,** Ellsworth, 1863–1925 ; **Hunt,** Nicholas Rex, 1885–.
Hedgc. & Hahn.	" ; **Hahn,** Glenn Gardner, 1889–.
Hedgc. & Hunt.	" ; **Hunt,** Nicholas Rex, 1885–.
Hedgc. & Long.	" ; **Long,** William Henry, 1869–.
Hedw. f.	**Hedwig,** Romanus Adolf, 1772–1806.
Henn., P.	**Hennings,** Paul Christoph, 1841–1908.
Holw.	**Holway,** Edward Willet Dorland, 1853–1923.
Holw. & Long.	" ; **Long,** William Henry, 1869–
Hornem.	**Hornemann,** Jens Wilken, 1770–1841.
Hotson.	**Hotson,** John William, 1870–.
Howe.	**Howe,** Marshall Avery, 1867–.
Jacks.	**Jackson,** Herbert Spencer, 1883–.
Jacky.	**Jacky,** Ernst, 1874–.
Jacq.	**Jacquin,** Nicolaus Joseph von, 1727–1817.
Jacz.	**Jaczewski,** Arthur Louis de, 1863–1932.
James, J. F.	**James,** Joseph Francis, 1857–1897.
Jennings.	**Jennings,** Herbert Spencer, 1868–.
Johans.	**Johanson,** Carl Johan, 1858–1888.
Jordi.	**Jordi,** Ernst, 1877–1933.

Jørstad. **Jørstad,** Ivar, 1887–.
Juel. **Juel,** Hans Oscar, 1863–1931.

Kalchb. **Kalchbrenner,** Károly, 1807–1886.
Karst. **Karsten,** Petter Adolf, 1834–1917.
Kellerm. **Kellerman,** William Ashbrook, 1850–1908.
Kellerm. & Carl. " ; **Carleton,** Mark Alfred, 1866–1925.
Kellerm. & Sw. " ; **Swingle,** Walter Tennyson, 1871–.
Kern. **Kern,** Frank Dunn, 1883–.
Kern & Bethel. " ; **Bethel,** Ellsworth, 1863–1925.
Kern & Thurston. " ; **Thurston,** Henry Winfred, 1893–.
Kern & Whetzel. " ; **Whetzel,** Herbert Hice, 1877–.
Kirchn. **Kirchner,** Leopold Anton, –1879.
Kleb. **Klebahn,** Henrich, 1859–.
Klotzsch. **Klotzsch,** Johann Friedrich, 1805–1860.
Kom. **Komarov,** Vladimir Leontjevič, 1869–.
Körn. **Körnicke,** Friedrich August, 1828–1908.
Ktze. **Kuntze,** Carl Ernst Otto, 1843–1907.
Kühn. **Kühn,** Julius Gotthelf, 1825–1910.
Kunze. **Kunze,** Gustav, 1793–1851.

Lacroix. **Lacroix,** Louis-Sosthène Veyron de, 1818–1864.
Lagerh. **Lagerheim,** Nils Gustaf von, 1860–1926.
Lasch. **Lasch,** Wilhelm Gottfried, 1787–1863.
Lév. **Léveillé,** Joseph Henri, 1796–1870.
Lib. **Libert,** Marie Anne, 1782–1865.
Lindr. **Lindroth** (Liro), Johan Ivar, 1872–.
Link. **Link,** Johann Heinrich Friedrich, 1767–1851.
L. **Linnaeus,** Carl, 1707–1778.
Liro. **Liro** (Lindroth), Johan Ivar, 1872–.
Long. **Long,** William Henry, 1869–.
Long & Goodd. " ; **Goodding,** Leslie Newton, 1880–.
Lüdi. **Lüdi,** Werner, 1888–.
Ludwig, C. A. **Ludwig,** Clinton Albert, 1886–.

Magn. **Magnus,** Paul Wilhelm, 1844–1914.
Mains. **Mains,** Edwin Butterworth, 1890–.
Mains & And. " ; **Anderson,** Harry Warren, 1885–.
Maire. **Maire,** René Charles Joseph Ernest, 1878–.
Mart. **Martius,** Heinrich von, 1781–1831.
Mayor. **Mayor,** Eugène, 1877–.
McA. **McAlpine,** Daniel, 1849–.
Meinecke. **Meinecke,** Emilio Pepe Michael, 1869–.
Miyabe. **Miyabe,** Kingo, 1860–.
Mont. **Montagne,** Jean Pierre François Camille, 1784–1866.
Moore, J. P. **Moore,** Justin Payson, 1841–1923.
Moug. & Nestl. **Mougeot,** Jean Baptiste, 1776–1858; **Nestler,** Christian Gottfried, 1778–1832.
Müll. J. **Müller,** Julius Heinrich Hans, 1855–1912.
Müll. W. **Müller,** Wilhelm, 1884–.

Nees. **Nees von Esenbeck,** Christian Gottfried Daniel, 1776–1858.
Niels. **Nielsen,** Peter, 1829–1897.
Niessl. **Niessl,** Gustav von, 1839–1919.

Oerst. **Ørsted,** Anders Sandøe, 1816–1872.
Opiz. **Opiz,** Philipp Maximilian, 1787–1858.
Orish. **Orishimo,** Yoshinobu, 1881–.
Orton. **Orton,** Clayton Roberts, 1885–.
Orton & Adams. " ; **Adams,** James Fowler, 1888–.
Otth. **Otth,** Gustav Heinrich, 1806–1874.
Oud. **Oudemans,** Corneille Antoine Jean Abram, 1825–1906.

Palm. **Palm,** Björn Torvald, 1887–.
Pam. & Hume. **Pammel,** Louis Hermann, 1862–1931; **Hume,** Hardrada Harold, 1875–.
Pass. **Passerini,** Giovanni, 1816–1893.
Pat. **Patouillard,** Narcisse Théophile, 1854–1926.
P. & G. " ; **Gaillard,** Albert, 1858–1903.
Paz. **Pazschke,** Franz Otto, 1843–1922.
Peck. **Peck,** Charles Horton, 1833–1917.
P. &. C. " ; **Clinton,** George William, 1807–1885.
Pers. **Persoon,** Christiaan Hendrik, 1761–1836.
Plowr. **Plowright,** Charles Bagge, 1849–1910.

Rab. **Rabenhorst,** Gottlob Ludwig, 1806–1881.
Rebent. **Rebentish,** Johann Friedrich, 1772–1810.
Reess. **Reess,** Max Ferdinand Friedrich, 1845–1901.
Ricker. **Ricker,** Percy Leroy, 1878–.
Röhl. **Röhling,** Johann Christoph, 1757–1813.
Rosen & Arth. **Rosen,** Harry Robert, 1889–; **Arthur,** Joseph Charles, 1850–.
Rostr. **Rostrup,** Frederik Georg Emil, 1831–1907.
Roze. **Roze,** Ernest, 1833–1900.
Rud. **Rudolphi,** Friedrich Karl Ludwig, 1801–1849.

Sacc. **Saccardo,** Pier Andrea, 1845–1920.
Sacc. & Bizz. " ; **Bizzozero,** Giacomo, 1852–1885.
Sacc. & Trav. " ; **Traverso,** Giovanni Battista, 1878–.
Sacc. & Trott. " ; **Trotter,** Alessandro, 1874–.
Schl. **Schlechtendal,** Diederich Franz Leonhard von, 1794–1866.
Schleich. **Schleicher,** Johann Christoph, 1768–1834.
Schmidt. **Schmidt,** Johann Carl, 1793–1850.
S. & K. " ; **Kunze,** Gustav, 1793–1851.
Schneid., W. G. **Schneider,** Wilhelm Gottlieb, 1814–1889.
Schof. **Schofield,** Joseph Robert, 1868–1928.
Schr. **Schrank,** Franz von Paula von, 1747–1835.
Schroet. **Schroeter,** Joseph, 1837–1894.
Schub. **Schubert,** Carl, ———.
Schultz. **Schultz,** Karl Friedrich, 1765–1837.
Schum. **Schumacher,** Heinrich Christian Friederich, 1757–1830.
Schw. **Schweinitz,** Lewis David von, 1780–1834.
Seym. **Seymour,** Arthur Bliss, 1859–1933.
Seym. & Earle. " ; **Earle,** Franklin Sumner, 1856–1929.
Shear. **Shear,** Cornelius Lott, 1865–.
Sheldon. **Sheldon,** John Lewis, 1865–.
Sommerf. **Sommerfelt,** Søren Christian, 1794–1838.
Sow. **Sowerby,** James, 1757–1822.
Speg. **Spegazzini,** Carlos Luigi, 1858–1926.
Spreng. **Sprengel,** Curt Polycarp Joachim, 1766–1833.
Stak. & Piem. **Stakman,** Elvin Charles, 1885–; **Piemeisel,** Frank Joseph, 1891–1925.
Stone, R. E. **Stone,** Roland Elisha, 1881–.
Störmer. **Störmer,** Fredrik Carl Mülerz, 1874–.
Str. **Strauss,** Friedrich Carl Joseph von, 1787–1855.
Syd. **Sydow,** Paul, 1851–1925; **Sydow,** Hans, 1879–.
Syd. & Holw. " ; **Holway,** Edward Willet Dorland, 1853–1923.

Thaxt. **Thaxter,** Roland, 1858–1932.
Thüm. **Thümen,** Felix Karl Albert Ernst Joachim von, 1839–1892.
Tode. **Tode,** Heinrich Julius, 1733–1797.
Tracy. **Tracy,** Samuel Mills, 1847–1920.
Tr. & Earle. " ; **Earle,** Franklin Sumner, 1856–1929.
T. & G. " ; **Galloway,** Beverly Thomas, 1863–.
Tranz. **Tranzschel,** Woldemar, 1868–.
Trel. **Trelease,** William, 1857–.
Trotter. **Trotter,** Alessandro, 1874–.
Tubeuf. **Tubeuf,** Carl von, 1862–.
Tul. **Tulasne,** Charles, 1816–1884.
Tul., L. **Tulasne,** Edmond Louis René, 1815–1885.

Underw. **Underwood,** Lucien Marcus, 1853–1907.
Underw. & Earle. " ; **Earle,** Franklin Sumner, 1856–1929.
Ung. **Unger,** Franz Joseph Andreas Nicolaus, 1800–1870.

Vize. **Vize,** John Edward, 1831–1916.

Wahl. **Wahlenberg,** Göran, 1780–1851.
Wallr. **Wallroth,** Carl Friedrich Wilhelm, 1792–1857.
Webber. **Webber,** Herbert John, 1865–.
Westend. **Westendorp,** Gérard Daniel, 1813–1868.
Wettst. **Wettstein,** Richard von, 1863–1931.
Willd. **Willdenow,** Carl Ludwig, 1765–1812.
Wilson, G. W. **Wilson,** Guy West, 1877–.
Wineland. **Wineland,** Grace Odel (Mrs. Emerson Pugh), 1889–.
Wint. **Winter,** Heinrich Georg, 1848–1887.

ABBREVIATIONS

of names for authors of host plants, exclusive of those given in Rydberg's Flora of the Prairies and Plains and Rydberg's Flora of the Rocky Mountains and Adjacent Plains*

Abrams.	**Abrams,** LeRoy, 1874–.
Ag., J.	**Agardh,** Jacob Georg, 1813–1901.
Am. auth.	**American authors,** used for misapplied names.
Arech.	**Arechavaleta,** José, 1838–1912.
Arnold.	**Arnold,** ———.
Aubl.	**Aublet,** Jean Baptiste Christophe Fusée, 1720–1778.
Auth.	**Authors,** used for misapplied names.
Bartr.	**Bartram,** John, 1699–1777.
Beadle.	**Beadle,** Chauncey Delos, 1866–.
Bertol.	**Bertoloni,** Antonio, 1775–1869.
Bitter.	**Bitter,** Friedrich August Georg, 1873–1927.
Britt. & Rendle.	**Britten,** James, 1846–1924; **Rendle,** Alfred Barton, 1865–.
Buser.	**Buser,** Robert, 1857–.
Dav.	**Davenport,** George Edward, 1833–1907.
Feay.	**Feay,** William T., 1803–1879.
Ferguson.	**Ferguson,** Alexander McGowen, 1874–.
Franchet.	**Franchet,** Adrien René, 1834–1900.
Gilbert.	**Gilbert,** Benjamin Davis, 1835–1907.
H. & B.	**Humboldt,** Friedrich Heinrich Alexander von, 1769–1859; **Bonpland,** Aimé Jacques Alexandre, 1773–1858.
Hallier f.	**Hallier,** Hans Gottfried, 1868–.
Hanson.	**Hanson,** ———.
Harper.	**Harper,** Roland McMillan, 1878–.
Hartw.	**Hartweg,** Carl Theodor, 1812–1871.
Herrm.	**Herrmann,** Jean, 1738–1800.
Heuffel.	**Heuffel,** Johann, 1800–1857.
Heynh.	**Heynhold,** Gustav, ———.
Höss.	**Höss,** Franz, 1756–1840.
Johnst., I. M.	**Johnston,** Ivan Murray, 1898–.
Körn.	**Körnicke,** Friedrich August, 1828–1908.
Leicht.	**Leichtlin,** Max, 1831–1910.
Lundst.	**Lundström,** Axel Nicolas, 1847–1905.
Magn.	**Magnus,** Paul Wilhelm, 1844–1914.
McGreg.	**McGregor,** Ernest Alexander, 1880–.
Mearns.	**Mearns,** Edgar Alexander, 1856–1916.
Merr. & Davy.	**Merrill,** Elmer Drew, 1876–; **Davy,** Joseph Burtt, 1870–.
Moldenke.	**Moldenke,** Harold Norman, 1909–.
Morelet.	**Morelet,** Pierre Marie Arthur, 1809–1892.
Née.	**Née,** Luis, 17——18—.
Newb.	**Newberry,** John Strong, 1822–1892.
Otth.	**Otth,** Carl Adolph, 1803–1839.
Radius.	**Radius,** Justus Wilhelm Martin, 1797–1884.
Ramat.	**Ramatuelle,** Thomas Albin Joseph d'Audibert de, 1750–1794.
Rand & Redf.	**Rand,** Edward Lothrop, 1859–1924; **Redfield,** John Howard, 1815–1895.
Rendle.	**Rendle,** Alfred Barton, 1865–.
Rich., A.	**Richard,** Achille, 1794–1852.
Rose & Painter.	**Rose,** Joseph Nelson, 1862–1928; **Painter,** Joseph Hannum, 1879–1908.
Sabine.	**Sabine,** Joseph, 1770–1837.
Sartw.	**Sartwell,** Henry Parker, 1792–1867.

* Prepared with the assistance of Dr. J. H. Barnhart.

Simpson. **Simpson,** Joseph Herman, 1841–1918.
Sm., C. **Smith,** Christen, 1785–1816.

Thwaites. **Thwaites,** George Henry Kendrick, 1811–1882.
Trudell. **Trudell,** Harry William, 1884–.

Voigt. **Voigt,** Joachim Otto, 1798–1843.

W. & A. **Wight,** Robert, 1796–1872; **Arnott,** George Arnott Walker, 1799–1868.
Wallm. **Wallman,** Johan Haquin, 1792–1853.

Zabel. **Zabel,** Hermann, 1832–1912.

ABBREVIATIONS

of names for states, provinces and territories

Ala.	—Alabama	Neb.	—Nebraska
Alas.	—Alaska	Nev.	—Nevada
Alta.	—Alberta	N.B.	—New Brunswick
Ariz.	—Arizona	Newf.	—Newfoundland
Ark.	—Arkansas	N.H.	—New Hampshire
B.C.	—British Columbia	N.J.	—New Jersey
Calif.	—California	N.M.	—New Mexico
Colo.	—Colorado	N.Y.	—New York
Conn.	—Connecticut	N.C.	—North Carolina
Del.	—Delaware	N.D.	—North Dakota
D.C.	—District of Columbia	N.W.Terr.	—North West Territory
Fla.	—Florida	N.S.	—Nova Scotia
Ga.	—Georgia	Okla.	—Oklahoma
Greenl.	—Greenland	Ont.	—Ontario
Ida.	—Idaho	Ore.	—Oregon
Ill.	—Illinois	Pa.	—Pennsylvania
Ind.	—Indiana	P.Ed.Id.	—Prince Edward Island
Kans.	—Kansas	Queb.	—Quebec
Ky.	—Kentucky	R.I.	—Rhode Island
La.	—Louisiana	Sask.	—Saskatchewan
Labr.	—Labrador	S.C.	—South Carolina
Me.	—Maine	S.D.	—South Dakota
Man.	—Manitoba	Tenn.	—Tennessee
Md.	—Maryland	Tex.	—Texas
Mass.	—Massachusetts	Vt.	—Vermont
Mich.	—Michigan	Va.	—Virginia
Minn.	—Minnesota	Wash.	—Washington
Miss.	—Mississippi	W.Va.	—West Virginia
Mo.	—Missouri	Wis.	—Wisconsin
Mont.	—Montana	Wyo.	—Wyoming

EXPLANATION OF TERMS AND USAGE

Range: Area included between the northern limit, extending from northeast to northwest extremes, and the southern limit, extending from southeast to southwest extremes.

Eastern and western regions: Roughly separated by the foothills of the Rocky Mountains, forming a sinuous line from Yukon in the north into New Mexico in the south.

Abbreviated citations in synonymy: Initial of a genus stands for the name last given having that initial, and initial of a species stands for the species or variety name immediately preceding, while the absence of authority is to be supplied by the authority in the parenthesis of the accepted name, thus: on page 371, **Porteranthus trifoliatus** (L.) Britt. (*G. t.* Moench, *S. t.*), the synonymy is to be read: (*Gillenia trifoliata* Moench, *Spiraea trifoliata* L.).

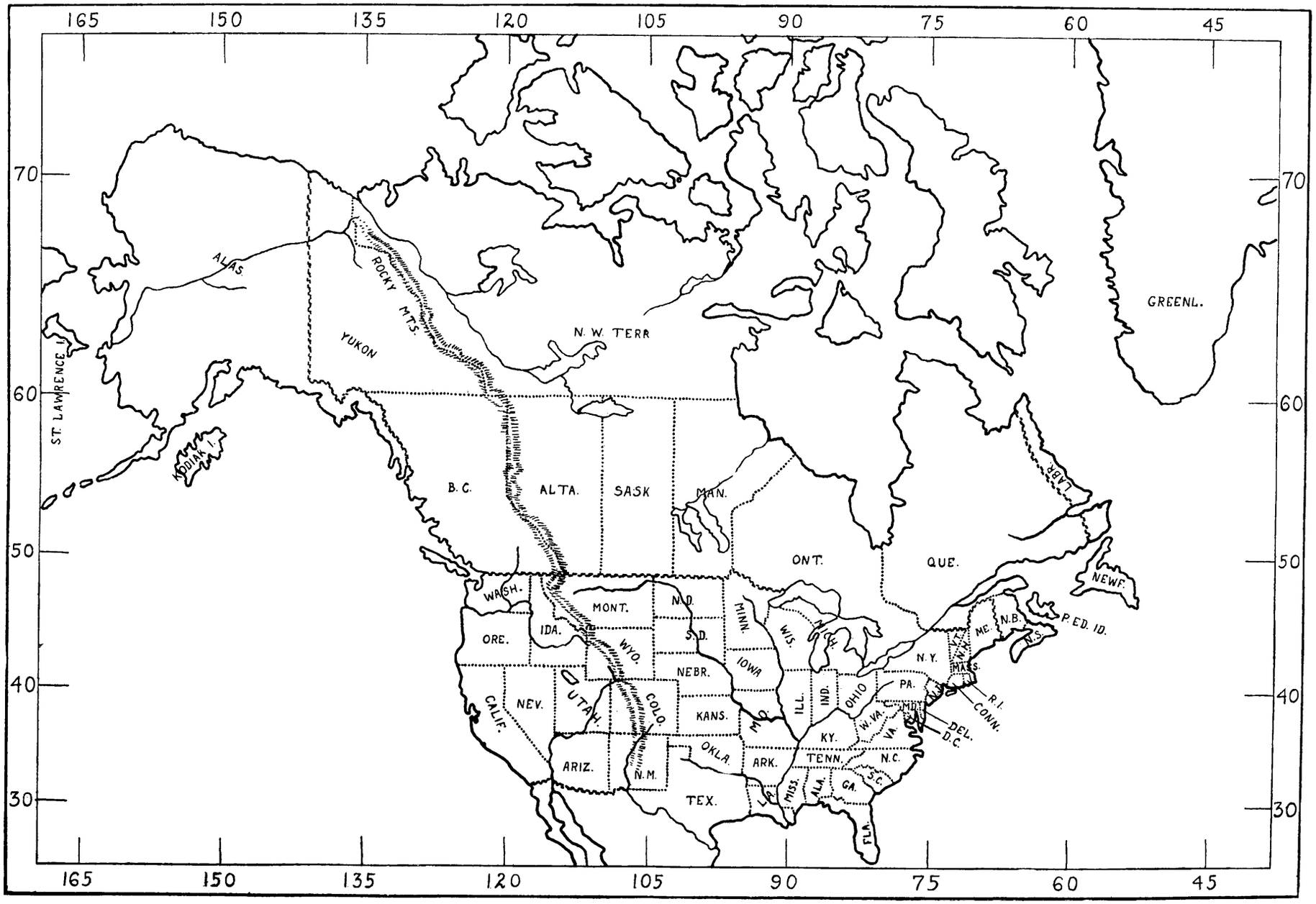
Variety: A more or less marked morphologic variant of species, associated with a different selection of hosts, and arising from aecial or telial infection.

Form: As used in this treatise form, as a lower division than variety, is equivalent to biologic or physiologic form or "species", having little or no morphologic distinction, and usually arising from uredial infection. Such a division is sometimes called a "race", a term not infrequently applied to a variety. At present there is no uniform application by different writers of the terms used in the Uredinales for subdivisions of a species.

Correlated species: Unnumbered species, following species from which they are presumably derived. The relationship is indicated by similarity of structure, of hosts and range.

GLOSSARY

Aecidioid. Resembling *Aecidium, i.e.,* a sorus with catenulate spores inclosed in a peridium. The term may apply to aecia, uredia or telia.
Amphispore. A specialized urediospore, serving as a resting spore, and differing from the urediospore of the same species by a thicker, darker-colored wall (except in fern rusts), colorless contents, and usually a change of sculpturing and sometimes in the arrangement of the pores.
Autoecious. Requiring only one host for the complete life cycle.
Caeomoid. Resembling *Caeoma, i.e.,* a sorus with catenulate spores and no peridium. The term may apply to aecia, uredia or telia.
Carrotiform. Carrot-shaped, *i.e.,* swollen and gradually tapering downward.
Catenulate. Having individual spores borne in a series or chain, without a common pedicel.
Cysts. Sterile inflated cells encircling the teliospore-head in the genus *Ravenelia.*
Demicyclic. Having pycnia, aecia and telia in the life cycle, the uredia wanting.
Discal. Intermixed among the spores in a sorus.
Episquamous. Occurring on the cone scales of gymnosperms.
Gametophyte. The state in the life cycle which bears pycnia and aecia.
Heteroecious. Requiring two not closely related hosts in the life cycle; the gametophyte and sporophyte occurring on alternating hosts.
Hilum. The scar on a spore where the pedicel was attached.
Macrocyclic. Having all spore-forms in the life cycle, or the uredia wanting (demicyclic), the aecia being aecidioid or uredinoid.
Mesospore. A one-celled teliospore associated with two-celled teliospores in the genus *Puccinia.*
Microcyclic. Having only pycnia and telia in the life cycle, or with the pycnia obsolete; the telia may sometimes be caeomoid or aecidioid.
Paraphyses. Sterile structures occurring within (discal) or around (peripheral) sori, either free, imbricated, or subepidermal and stroma-like.
Roestelioid. Resembling *Roestelia, i.e.,* horn-shaped.
Sporophyte. The state in the life cycle which bears uredia and telia.
Systemic. Having a continuous mycelium extensively distributed in the host starting with its growing point.
Uredinoid. Resembling *Uredo, i.e.,* a sorus with pedicellate spores and only rarely a peridium. The term may apply to aecia or uredia.
Verrucose. Having rounded, wart-like markings, or sometimes applied more loosely to irregular markings.



MAP OF AREA INCLUDED IN THE MANUAL
(exclusive of a few very northern localities). Mercator's projection. For abbreviations of states and provinces see page xiv.

UREDINALES

PLANT RUSTS

Microscopic, obligately parasitic fungi with branched, septate mycelium developing between the cells of the host-tissue and penetrating within the cells by means of haustoria; of various life-cycles, due to suppression of one or more spore forms, but always producing the diploid or sporophytic, sometimes called the "perfect" state, bearing characteristic teliospores and frequently also urediospores.

KEY TO THE FAMILIES AND TRIBES

Teliospores sessile, single or grouped within the host tissue or united laterally into layers or columns.	I. MELAMPSORACEAE.
Teliospores vertically septate or 1-celled, single in the host tissue or in indefinite crusts; aecia with cylindric peridium.	i. *Pucciniastreae.*
Teliospores 1-celled, united into columns or in gelatinous crusts; aecia with bullate peridium.	ii. *Cronartieae.*
Teliospores 1-celled, in indefinite crusts one cell thick; aecia with rudimentary peridium or none.	iii. *Melampsoreae.*
Teliospores 1-celled, in crusts more than 1-cell thick; aecia where known cupulate.	iv. *Phakopsoreae.*
Teliospores pedicellate or sessile, free or fascicled but not united laterally except when borne on a compound stalk.	II. PUCCINIACEAE.
Teliospores 1- or 2-celled, borne on fascicled pedicels or singly on simple pedicels; when 2-celled the cells not inclosed in a common membrane; aecia aecidioid or uredinoid with subcuticular or subepidermal pycnia; urediospore-wall brown.	i. *Ravenelieae.*
Teliospores 1–several-celled, borne singly on simple pedicels, when more than 1-celled the cells inclosed in a common membrane; aecia caeomoid or uredinoid with subcuticular pycnia; urediospore-wall pale-yellow or nearly colorless.	ii. *Phragmidieae.*
Teliospores 1- or 2-celled, rarely more, borne singly on simple pedicels, the cells inclosed in a common membrane; aecia aecidioid or uredinoid with subepidermal pycnia; urediospore-wall brown, rarely pale-yellowish.	iii. *Aecidieae.*
Teliospores unknown and generic position uncertain; species represented only by aecia or uredia.	III. FORM-GENERA.

MELAMPSORACEAE

Telia more or less indefinite; teliospores sessile, single or grouped within the tissues of the host, or compacted laterally and united into columns or layers.

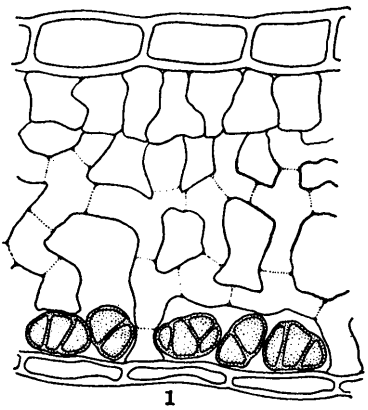
Teliospores divided by vertical septa, rarely 1-celled; aecia with cylindric peridium: PUCCINIASTREAE.	
Uredia and telia on ferns.	
All spores colorless.	
Urediospores pointed-fusiform; teliospores subepidermal.	1. *Uredinopsis.*
Urediospores obovate or lanceolate; teliospores in epidermal cells.	2. *Milesia.*
Aeciospores and urediospores with yellow contents.	3. *Hyalopsora.*

Uredia and telia on seed-plants.	
Urediospores echinulate throughout.	
Urediospores obovate or wedge-shape; teliospore-wall brown.	4. *Pucciniastrum.*
Urediospores ellipsoid or globoid; teliospore-wall colorless.	5. *Melampsorella.*
Urediospores echinulate, except apex.	6. *Melampsoridium.*
Teliospores 1-celled, catenulate, adhering laterally, the wall colorless; aecia with prominent peridium; CRONARTIEAE.	
Telia erumpent, long-filiform; urediospores pedicellate.	7. *Cronartium.*
Telia indehiscent, forming cushion-like masses; urediospores catenulate.	
Teliospores catenulate, with firm wall.	8. *Chrysomyxa.*
Teliospores imperfectly catenulate, with gelatinous wall.	9. *Coleosporium.*
Teliospores 1-celled, compressed laterally into crusts of one cell thickness; aecia with rudimentary peridium or none: MELAMPSOREAE.	
Teliospore-wall colored.	10. *Melampsora.*
Teliospore-wall colorless.	11. *Aplopsora.*
Teliospores 1-celled, compressed laterally into crusts of more than one cell thickness: PHAKOPSOREAE.	
Telia applanate, indehiscent.	
Uredia without paraphyses.	12. *Bubakia.*
Uredia with imbricated paraphyses.	13. *Physopella.*
Telia pustular, erumpent.	
Teliospore-wall colorless.	14. *Cerotelium.*
Teliospore-wall colored.	15. *Baeodromus.*

1. UREDINOPSIS Magn., 1893.

Heteroecious fern rusts with pycnia and aecia on *Abies*. All spores are colorless. The classification of the species is contingent largely upon the urediospores, the other spore-forms having much uniformity. Most of the species, and possibly all, produce more or less well-formed amphispores, which serve as a resting stage. Pycnia subcuticular, other sori subepidermal.

Pycnia without paraphyses, often sunken into the tissues beneath the cuticle. Aecia white, cylindric, fragile; aeciospores broadly ellipsoid or globoid, with colorless contents and verrucose wall. Uredia bullate, with a delicate inconspicuous peridium, dehiscent by a central pore; urediospores varying from narrowly fusiform to ovoid-fusiform, with a slender beak 3–32 μ long, exuded in white vermiform threads, the wall entirely smooth, or usually with two longitudinal ridges, the pores indistinct; the amphispores when present angularly obovate, with verrucose wall. Telia imperfectly formed; teliospores (Fig. 1) in a subepidermal layer, or occasionally scattered in the mesophyll, globoid or ellipsoid, usually 4-celled, the wall colorless, uniformly 1–1.5 μ thick, smooth.



1

Urediospores with long slender beaks.	
Beaks 8–20 μ long; ridges finely ciliate.	1. *U. osmundae.*
Beaks 3–12 μ long; ridges indistinctly echinulate.	2. *U. mirabilis.*
Beaks 5–15 μ long; ridges minutely serrate.	3. *U. struthiopteridis.*
Beaks 12–32 μ long; ridges indistinct or wanting.	4. *U. phegopteridis.*
Urediospores with short blunt beaks.	5. *U. macrosperma.*

The pores in the urediospores usually can be seen only after prolonged boiling in lactic acid, or by means of some similar technic. As far as known they appear to be two much above and two much below the equator. The amphispores, being resting spores, are produced more abundantly toward the end of the season or as the supporting frond matures.

Four other species of *Uredinopsis* have been described, one each from South America, Europe, eastern Asia and Japan.

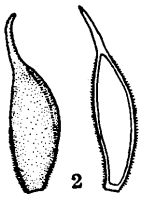
1. UREDINOPSIS OSMUNDAE. Fig. 2.

(N. A. F. 7: 115, 683, 819.)

(*Peridermium balsameum* Peck, Ann. Rep. N. Y. State Mus. **27:** 104, in part. 1875.)
Uredinopsis osmundae Magn., Hedw. **43:** 123. 1904.

Pycnia hypophyllous, few, inconspicuous. Aecia hypophyllous, on leaves of the current season, white both before and after spores are discharged, cylindric, on discolored usually yellow spots; aeciospores broadly ellipsoid or globoid, 16–26 by 19–29 μ, with colorless contents; wall colorless, 1–2 μ thick, coarsely and closely verrucose.

On Pinaceae: **Abies balsamea** (L.)Mill., Iowa, Mich., N.H., N.Y., Wis.; N.S.


2

Uredia hypophyllous, bullate; urediospores fusiform, 10–18 by 27–57 μ, with beak 8–20 μ long, the two ridges delicately ciliated or smooth; amphispores not seen. Telia as described for the genus.

On Osmundaceae: **Osmunda cinnamomea** L., Ala., Me., Mass., N.H., N.Y., Vt., Wis.—**O. claytoniana** L., Conn., Me., Minn., N.H., N.Y., Vt.; N.S.—**O. spectabilis** Willd.(*O. regalis* L., in part), Me., N.Y., Wis.; N.S.

Range: Nova Scotia to Minnesota, southward to Alabama and Iowa; also in Bermuda.

Successful cultures were conducted in 1912 by Fraser (Mycol. **5:** 235. 1913), using teliospores from *Osmunda claytoniana* on *Abies balsamea,* similar cultures are reported by Faull (Proc. Intern. Congr. Pl. Sci. **2:** 1736, 1743. 1929), as made by Faull & Watson in 1924, Faull & Moss in 1925 and Faull & Bensley in 1926, each using *Osmunda spectabilis,* but without details.

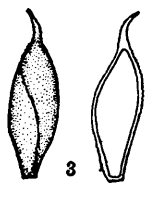
2. UREDINOPSIS MIRABILIS. Fig. 3.

(N. A. F. 7: 115, 683, 819.)

Septoria mirabilis Peck, Ann. Rep. N. Y. State Mus. **25:** 87. 1873.
(*Peridermium balsameum* Peck, Ann. Rep. N. Y. State Mus. **27:** 104, in part. 1875.)
(*Aecidium pseudo-columnare* Kühn, Hedw. **23:** 168, in part. 1884.)
Uredinopsis americana Syd., Ann. Myc. **1:** 325. 1903.
Uredinopsis mirabilis (Peck) Magn., Hedw. **43:** 121. 1904.

Pycnia and aecia differing little if any from those described for *Uredinopsis osmundae.*

On Pinaceae: **Abies balsamea** (L.)Mill., Conn., Me., Mass., Mich., Minn., N.Y., Vt., W.Va., Wis.; Newf.; N.S., Ont.—**A. fraseri** (Pursh) Lindl., W.Va.


3

Uredia hypophyllous, bullate; urediospores fusiform, 12–17 by 35–50 μ, with beak 3–12 μ long, the two ridges indistinctly echinulate; amphispores irregularly obovate or polyhedral, 15–20 by 24–36 μ, the wall 2–3 μ thick, verrucose. Telia as described for the genus.

On Polypodiaceae (tribe *Asplenieae*): **Lorinseria areolata** (L.)Presl(*Woodwardia a.* Moore), Me., N.J., N.Y.; (tribe *Woodsieae*): **Onoclea sensibilis** L., Conn., Del., Ill., Ind., Me., Md., Mass., Mich., Neb., N.H., N.Y., Pa., Vt., Va., W.Va., Wis.; N.S., Ont., Queb.

Range: Nova Scotia to Wisconsin, southward to Virginia and Nebraska.

Cultures were made in 1912 and 1913 by Fraser (Mycol. **5:** 236. 1913; same **6:** 25. 1914), using aeciospores from *Abies balsamea* and teliospores from *Onoclea sensibilis.* The aeciospores employed were obtained by a culture with the teliospores from *Onoclea.* The aeciospores were also sown at three different dates on *Osmunda claytoniana, O. regalis, Asplenium filix-foemina, Aspidium thelypteris* and *Phegopteris dryopteris,* but with negative results (*l.c.,* p. 26). Similar results are said by Faull (*l.c.*) to have been obtained in 1926 by Faull & Bensley, but no details are given.

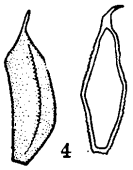
3. UREDINOPSIS STRUTHIOPTERIDIS. Fig. 4.

(N. A. F. 7: 116, 117, 684, 685, 819.)

(*Peridermium balsameum* Peck, Ann. Rep. N. Y. State Mus. **27:** 104, in part. 1875.)
Uredinopsis struthiopteridis Störmer, Bot. Notiser **1895:** 81. 1895.
Uredinopsis copelandi Syd., Ann. Myc. **2:** 30. 1904.
Uredinopsis atkinsonii Magn., Hedw. **43:** 123. 1904.

Pycnia and aecia differing little from those of *Uredinopsis osmundae.*

On Pinaceae: **Abies balsamea** (L.)Mill., Mich.; N.S.—**A. grandis** Lindl., Ida., Ore., Wash.—**A. lasiocarpa** (Hook.)Nutt. (*A. subalpina* Engelm.), Ida., Wash.—**A. nobilis** Lindl., Wash.


4

Uredia hypophyllous, bullate; urediospores fusiform or lanceolate, variable, 12–16 by 35–45 μ, with beak 5–15 μ long, the two ridges minutely serrate; amphispores common at close of season, obovate, angular, 13–24 by 19–35 μ, the wall 2–3.5 μ thick, finely verrucose, appearing smooth when wet. Telia as described for the genus.

On Polypodiaceae (tribe *Asplenieae*): **Anchistea virginica** (L.)Presl(*Woodwardia v.* J.E.Sm.), Conn., Ind., Mass., Mich., N.Y., Vt.—**Athyrium cyclosorum** Rupr.(*Asplenium filix-foemina* Bernh.), Calif., Conn., Ida., Me., Mass., Mont., N.H., N.Y., Ore., Pa., Vt., Wash., Wis.; N.S., Ont.; (tribe *Woodsieae*): **Filix bulbifera** (L.)Underw.(*Cystopteris b.* Bernh.), Ind., N.Y., Wis.; Ont.—**Pteretis nodulosa** (Michx.)Nieuwl.(*Matteuccia struthiopteris* Am. auth., not Tod.; *Struthiopteris germanica* Am. auth., not Willd.), Wis.; Newf.; Alta., N.S., Queb.; (tribe *Aspidieae*): **Dryopteris filix-mas** (L.)Sw.(*Aspidium f.* Sw.), Mont.—**D. thelypteris** (L.)Gray(*A. t.* Sw.) Conn., Del., Ind., Mass., Mich., Neb., N.Y., N.D., Va., Wis.; N.S., Ont.

Range: Newfoundland to Wisconsin, southward to Connecticut and Indiana and from western Montana and Alberta to Washington, southward to northern California; also in Bermuda, Europe and Japan.

In Europe cultures were conducted with success by Klebahn (Zeits. Pflanzenkr. **26:** 259. 1916), using both aeciospores from *Abies pectinata* and teliospores from *Struthiopteris germanica.*

Successful cultures on *Matteuccia struthiopteris* were made in 1912 by Fraser (Mycol. **5:** 234. 1913), using aeciospores from *Abies balsamea,* while sowings at the same time on *Osmunda claytoniana, Onoclea sensibilis* and *Phegopteris dryopteris* were unsuccessful. Sowing teliospores from *O. struthiopteris* on *Abies balsamea* was also successful (*l.c.,* p. 234). Cultures are reported by Faull (*l.c.*), as successfully made by Faull & Bensley in 1926, using aeciospores from *Abies balsamea* and teliospores from both *Matteuccia struthiopteris* and *Asplenium filix-foemina,* but without details.

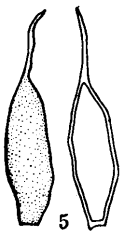
4. UREDINOPSIS PHEGOPTERIDIS. Fig. 5.

(N. A. F. 7: 117, 685.)

(*Peridermium balsameum* Peck, Ann. Rep. N. Y. State Mus. **27:** 104, in part. 1875.)
Uredinopsis phegopteridis Arth., N. Am. Flora **7:** 117. 1907.

Pycnia and aecia differing little if any from those described for *Uredinopsis osmundae.*

ON PINACEAE: **Abies balsamea** (L.)Mill., N.S.


5

Uredia hypophyllous, bullate; urediospores fusiform, 10–16 by 29–58 μ, with beak 12–32 μ long, the two ridges indistinctly roughened or wanting; amphispores not seen. Telia as described for the genus.

ON POLYPODIACEAE (tribe *Aspidieae*): **Phegopteris dryopteris** (L.)Fée(*Dryopteris d.* Britt., *Polypodium d.*), Wis.; Alta., N.S.

Range: Local in Nova Scotia, Alberta and northern Wisconsin.

Successful cultures were made in 1912 by Fraser (Mycol. **5:** 236. 1913) by sowing teliospores from *Phegopteris dryopteris* on *Abies balsamea.*

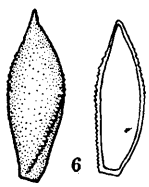
5. UREDINOPSIS MACROSPERMA. Fig. 6.

(N. A. F. 7: 116, 684.)

Uredo macrospermum Cooke, Grev. **8:** 71. 1879.
Uredo pteridis D. & H.; Diet., Erythea **2:** 127. 1894.
Uredinopsis pteridis D. & H.; Diet., Ber. Deuts. Bot. Ges. **13:** 331. 1895.
(*Aecidium pseudo-balsameum* D. & H.; Holw., Erythea **7:** 98. 1899.)
Uredinopsis macrosperma (Cooke) Magn., Hedw. **43:** 122. 1904.
Milesina pteridis Syd., Monog. Ured. **3:** 481. 1915.

Pycnia hypophyllous, moderately abundant, inconspicuous, sparingly on first year leaves, abundant on second year leaves with the aecia. Aecia hypophyllous, usually on leaves more than one year old, cylindric, white; aeciospores broadly ellipsoid or globoid, 16–22 by 20–32 μ, with colorless contents; wall colorless, 1.5–2.5 μ thick, strongly and closely verrucose.

ON PINACEAE: **Abies amabilis** (Loud.)Forbes, Wash.—**A. grandis** Lindl., Calif., Ida., Mont., Ore., Wash.—**A. nobilis** Lindl., Ore.


6

Uredia hypophyllous, bullate, dehiscent by a central pore; urediospores broadly fusiform, 14–19 by 30–55 μ, acute with short beak, 4–7 μ long; wall colorless, 1 μ thick, smooth except two longitudinal lines of prominent serrations; amphispores angularly obovate or ellipsoid, 18–24 by 23–40 μ, the wall 2–3 μ thick, uniformly verrucose. Telia as described for the genus.

ON POLYPODIACEAE (tribe *Pterideae*): **Pteridium aquilinum** (L.)Kühn(*Pteris a.*), Ark., Ga., Ky., Md., Miss., N.J., N.Y., N.C., S.C., Tenn., Va.—**P. aquilinum pubescens** Underw., Calif., Mont., N.M., Ore., Wash.; B.C.—**P. caudatum** (L.)Maxon, Fla., Ga.

Range: New Jersey to Tennessee, southward to central Florida and New Mexico, and western Montana to British Columbia, southward to southern California; also in Central and South America, Africa, eastern Asia and Japan.

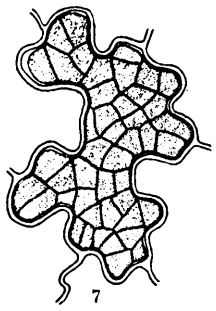
Cultures of the western form were made in 1916 by Weir and Hubert (Am. Jour. Bot. **4:** 330. 1917) by using aeciospores from *Abies grandis.* Cultures were made in Japan by Kamei (Ann. Phytop. Soc. Japan **2:** 207–228. 1930) with teliospores sown on *Abies mayriana,* and with aeciospores sown on *Pteridium.* In the Japanese experiments, made in the greenhouse, both pycnia and aecia appeared on leaves of the current season.

2. MILESIA F. B. White, 1877.*

Heteroecious fern rusts with pycnia and aecia on *Abies.* All spores colorless. The classification of the species is contingent largely upon the urediospores.

* The treatment of the genus and its species, as given here, is condensed from Faull's monograph of the genus *Milesia* (with changes approved by the author), in Contr. Arnold Arb. No. 2. 1932.

Pycnia without paraphyses, hemispheric, subcuticular, or in one species globoid and subepidermal. Aecia hypophyllous, subepidermal, erumpent, colorless, cylindric; aeciospores ellipsoid or globoid; wall thin, finely and closely verrucose, or with short, irregularly disposed papillate ridges. Uredia hypophyllous, subepidermal, pustular or immersed, dehiscent by a central slit or pore; peridium delicate, more or less hemispheric, with cells often elongate at sides and polygonal above; urediospores white in mass, obscurely pedicellate, globoid, obovoid or lanceolate, with colorless content; wall colorless, spinulose, echinulate, inconspicuously verrucose, or smooth, the pores obscure. Telia imperfectly formed; teliospores within the epidermal cells, one (Fig. 7) to few in each cell, few- to many-celled, vertically septate, forming a layer one-cell thick; wall thin, colorless, smooth, one pore in upper wall of each cell.



7

Urediospores smooth, fusiform.	1. *M. polypodophila.*
Urediospores smooth, obovoid or ellipsoid.	
Urediospores of very irregular form; peridial cell-walls 1.5–9 μ thick.	2. *M. laeviuscula.*
Urediospores of slightly irregular form; peridial cell-walls 1 μ or less thick.	
Urediospores averaging 15 by 30 μ.	4. *M. dilatata.*
Urediospores averaging 18 by 36 μ.	3. *M. vogesiaca.*
Urediospores averaging 17 by 50 μ.	8. *M. darkeri.*
Urediospores minutely verrucose.	5. *M. fructuosa.*
Urediospores distinctly echinulate or spinulose.	
Urediospores averaging 19–36 μ, walls 1 μ thick; peridium delicate.	6. *M. marginalis.*
Urediospores averaging 17 by 28 μ, walls 1.5–2.5 μ thick; peridium firm.	7. *M. polystichi.*

"The uredospores of *Milesia* exhibit unusual, distinctive, morphological versatility, so much so that species ordinarily can be recognized from them alone without reference to other organs or structures" (Faull, "Taxonomy and Geographical Distribution of the Genus *Milesia*," Contr. Arnold Arb. No. 2, p. 10. 1932). Characters derived from the urediospores have been the deciding factors for both genus and species in all instances up to the present time, although the teliospores have supplied confirmatory characters as to the genus. Commonly only one teliospore occurs in each epidermal cell, but by repeated septation nearly or quite filling the cell, and taking the same form and outline as the cell (see Fig. 7).

Thirty-three species and two varieties of *Milesia* are known, widely distributed throughout the world, but pycnia and aecia have been found only in north-temperate regions.

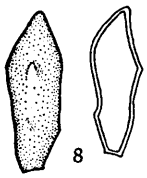
1. MILESIA POLYPODOPHILA. Fig. 8.

(N. A. F. 7: 685.)

(*Peridermium pycnogrande* Bell, Bot. Gaz. **77**: 24. 1924.)
Uredinopsis polypodophila Bell, Bot. Gaz. **77**: 25. 1924.
Milesia pycnograndis Arth., N. Am. Flora **7**: 685. 1925.
Milesina polypodophila Faull, Proc. Intern. Congr. Pl. Sci. **2**: 1735. 1929.
Milesia polypodophila (Bell) Faull, Contr. Arnold Arb. No. 2, p. 89. 1932.

Pycnia hypophyllous, on leaves three to nine years old, few, subepidermal, deep-seated, inconspicuous. Aecia hypophyllous, on leaves three to nine years old, forming loose witches' brooms, cylindric, 0.4–1 mm. high; aeciospores globoid or broadly ellipsoid, 18–27 by 21–30 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

ON PINACEAE: **Abies balsamea** (L.)Mill., Me., N.H., N.Y., Vt.; N.S., Ont., Queb.


8

Uredia hypophyllous, scattered or loosely grouped on greenish or brownish spots, bullate, dehiscent by a central pore; urediospores fusiform-obovoid or lanceolate, acute or acuminate above, narrowed below, 13–21 by 38–68 μ, average 18–52 μ; wall colorless, about 1 μ thick, smooth, or with a few inconspicuous points. Telia hypophyllous, on overwintered fronds, inducing extensive brownish areas; teliospores in epidermal cells, vertically septate, 3–50-celled; wall colorless, about 1 μ thick, smooth.

ON POLYPODIACEAE (tribe *Polypodieae*): **Polypodium virginianum** L.(*P. vulgare* Am.auth.), Conn., Me., Mass., N.H., N.Y., Pa., Tenn., Vt.; N.S., Ont., Queb.

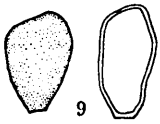
Range: Nova Scotia to northeastern Ontario, southward to Connecticut and Tennessee.

A very distinctive species. Cultures are reported by Faull (Proc. Intern. Congr. Pl. Sci. **2:** 1736, 1743. 1929; Contr. Arnold Arb. No. 2., p. 92. 1932), as made by Faull & Watson in 1924, using both aeciospores and teliospores, but without details.

2. MILESIA LAEVIUSCULA. Fig. 9.

(N. A. F. 7: 113, 819.)

Uredo laeviuscula D. & H.; Diet., Erythea **2:** 127. 1894.
Thecopsora laeviuscula Diet., Ann. Myc. **1:** 416. 1903.
Hyalopsora laeviuscula Arth., N. Am. Flora **7:** 113. 1907.
Milesia laeviuscula (D. & H.) Faull, Contr. Arnold Arb. No. 2, p. 95. 1932.


9

Pycnia and aecia unknown. Uredia hypophyllous, loosely grouped on greenish or brownish areas, bullate, dehiscent by irregular rupture or slit, peridial cell-walls 1.5–9 μ thick; urediospores irregularly obovoid or ellipsoid, 14–22 by 23–48 μ, average 17 by 33 μ; wall colorless, about 1 μ thick, smooth. Telia hypophyllous, on overwintered fronds; teliospores in epidermal cells, vertically septate, 1–40-celled; wall colorless, about 1 μ thick, smooth.

ON POLYPODIACEAE (tribe *Polypodieae*): **Polypodium californicum** Kaulf., Calif.—**P. glycyrrhiza** Eaton(*P. falcatum* Kellogg, not L.), Alas., Calif., Ore., Wash. **Range:** Southeastern Alaska, southward to southern California.

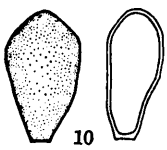
The color of the spores has generally been overlooked, hence the early indecision as to the genus. Faull finds a difference on the two hosts in the urediospores and peridial cells, that he designates as *forma typica* on *P. californicum* and *forma glycyrrhiza* on *P. glycyrrhiza*.

3. MILESIA VOGESIACA. Fig. 10.

(N. A. F. 7: 682.)

Milesina vogesiaca Syd., Ann. Myc. **8:** 491. 1910.
Uredo vogesiaca Sacc. & Trott., in Sacc., Syll. Fung. **21:** 812. 1912.
Milesia vogesiaca (Syd.) Faull, Contr. Arnold Arb. No. 2, p. 103. 1932.

Pycnia and aecia unknown. Uredia hypophyllous, loosely grouped on greenish or brownish areas, bullate, dehiscent by a central pore, peridial cell-walls 1 μ thick; urediospores obovoid or ellipsoid, 14–23 by 29–44 μ, average 18 by 36 μ; wall colorless, less than 1 μ thick, smooth. Telia chiefly hypophyllous, on overwintered fronds; teliospores in epidermal cells, vertically septate, 1–50-celled; wall colorless, about 1 μ thick, smooth.

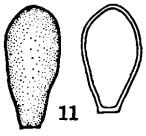

10

ON POLYPODIACEAE (tribe *Aspidieae*): **Polystichum munitum** (Kaulf.) Presl(*Aspidium m.*), Ore. **Range:** Western Oregon; also in Europe, northern Africa and Japan.

4. MILESIA DILATATA. Fig. 11.

Milesia dilatata Faull, Contr. Arnold Arb. No. 2, p. 49. 1932.

Pycnia and aecia unknown. Uredia hypophyllous, scattered or grouped on greenish or brown areas, bullate, dehiscent by central rupture, peridial cell-walls 1 μ thick; urediospores obovoid or ellipsoid, 13–19 by 24–40 μ, average 15 by 30 μ; wall colorless, 1 μ thick or less, smooth. Telia chiefly hypophyllous, on overwintered fronds; teliospores in epidermal cells, vertically septate, 1–many-celled; wall colorless, smooth.


11

On Polypodiaceae (tribe *Aspidieae*): **Dryopteris dilatata** (Hoffm.)Underw., Ore. **Range:** Northern Oregon, in the vicinity of Mt. Hood.

5. MILESIA FRUCTUOSA. Fig. 12.

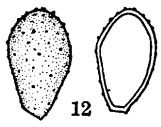
(N. A. F. 7: 686.)

(*Peridermium balsameum* Peck, Ann. Rep. N. Y. State Mus. **27:** 104, in part. 1875.)
Milesia fructuosa Faull, Contr. Arnold Arb. No. 2, p. 51. 1932.
Milesia intermedia Faull, Contr. Arnold Arb. No. 2, p. 64. 1932.

Pycnia hypophyllous, on leaves of current season, subcuticular, inconspicuous, very abundant. Aecia hypophyllous, on leaves of current season, cylindric, or slightly flattened laterally, 0.2–1 mm. high; aeciospores globoid or ellipsoid, 19–23 by 21–31 μ; wall colorless, 1–1.5 μ thick, finely verrucose, except smooth spot on one side.

On Pinaceae: **Abies balsamea** (L.)Mill., Me., N.H., N.Y.; N.S., Ont., Queb.

Uredia hypophyllous, scattered on greenish or brownish spots, inconspicuous, sunken or bullate, dehiscent by a central pore; urediospores irregularly obovoid or ellipsoid, 14–22 by 20–34 μ, average 16 by 28 μ; wall colorless, less than 1 μ thick, very minutely and sparsely verrucose, almost smooth. Telia hypophyllous, abundant on maturing fronds in autumn or spring, inducing large, dark-brown, clearly defined spots; teliospores in epidermal cells, vertically septate, 1–many-celled; wall colorless, about 1 μ thick, smooth.


12

On Polypodiaceae (tribe *Aspidieae*): **Dryopteris intermedia** (Muhl.) Gray, Me., Mass., N.H., N.Y., Vt.; N.S., Ont., Queb.—**D. spinulosa** (Müll.) Ktze., Que.—**D. spinulosa americana** (Fisch.)Fern., Mass., N.Y., Vt.—**D. spinulosa fructuosa** (Gilbert)Trudell, Mass., Vt.

Range: Nova Scotia to northeastern Ontario, southward to Massachusetts and eastern New York.

This species was confused with the European *M. kriegeriana*, in the North American Flora **7:** 686. Cultures are reported by Faull (Proc. Intern. Congr. Pl. Sci. **2:** 1736, 1743. 1929), as made by Faull & Watson in 1924–5, using aecia from *Abies balsamea* and telia from *"Aspidium spinulosum,"* but without details. Usually when the fronds mature in the fall the uredia are abundant, when they mature in the spring the uredia are few.

6. MILESIA MARGINALIS. Fig. 13.

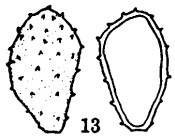
(N. A. F. 7: 686.)

Milesia kriegeriana Arth., not Magn., Mycol. **7:** 176. 1915.
Milesia marginalis Faull & Wats.; Faull, Contr. Arnold Arb. No. 2, p. 69. 1932.

Pycnia amphigenous, on leaves of current season, not especially abundant, subcuticular, inconspicuous. Aecia hypophyllous, on leaves of current season, cylindric or somewhat flattened laterally, 0.4–1 mm. high; aeciospores globoid or ellipsoid, about 24 by 28 μ; wall colorless, less than 2 μ thick, finely verrucose, except smooth spot on one side.

On Pinaceae: **Abies balsamea** (L.)Mill., Ont.

Uredia hypophyllous, scattered or loosely grouped on greenish or brownish spots, abundant, inconspicuous, dehiscent by central, slightly beaked pore, peridium delicate; urediospores irregularly obovoid or ellipsoid, 15–27 by 27–51 μ, average 19 by 36 μ; wall colorless, less than 1 μ thick, spinose-verrucose or with short spines. Telia chiefly hypophyllous, abundant on overwintered fronds, inducing extensive brown areas; teliospores in epidermal cells, vertically septate, 1–many-celled; wall colorless, about 1 μ thick, smooth.


13

On Polypodiaceae (tribe *Aspidieae*): **Dryopteris marginalis** (L.)Gray (*Aspidium m.* Sw.), Mass., N.H., N.Y.; Ont., Queb.

Range: Northeastern Ontario, southward to Massachusetts and northern New York.

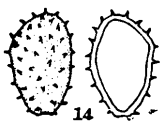
This species was confused with the European *M. kriegeriana,* in the North American Flora **7:** 686. Cultures are reported by Faull (Proc. Intern. Congr. Pl. Sc. **2:** 1736, 1743. 1929), as made by Faull & Watson in 1924, using aecia from *Abies balsamea* and telia from *Aspidium marginale,* but without details.

7. MILESIA POLYSTICHI. Fig. 14.

(N. A. F. 7: 686.)

Milesia polystichi Wineland ; Jacks., Mem. Brooklyn Bot. Gard. **1:** 214. 1918.

Pycnia and aecia unknown. Uredia usually abundant, hypophyllous, scattered or loosely grouped on greenish or brownish areas, bullate, firm, dehiscent by a central pore, peridium firm; urediospores obovoid or ellipsoid, 15–20 by 20–35 μ, average 17 by 28 μ; wall colorless, 1.5–2.5 μ thick, strongly echinulate. Telia chiefly hypophyllous, on overwintered fronds; teliospores in epidermal cells, vertically septate, 1–many-celled; wall colorless, about 1 μ thick, smooth.

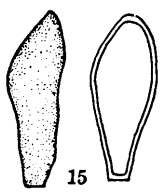

14

On Polypodiaceae (tribe *Aspidieae*): **Polystichum munitum** (Kaulf.) Presl(*Aspidium m.*), Calif., Ida., Mont., Ore., Wash. **Range:** Western Montana to Washington, southward to central California.

8. MILESIA DARKERI. Fig. 15.

Milesia darkeri Faull, Contr. Arnold Arb. No. 2, p. 46. 1932.

Pycnia and aecia unknown. Uredia hypophyllous, on indefinite brown areas, bullate, dehiscent by a central pore, peridial cell-walls 1 μ thick; urediospores obovoid or ellipsoid, 15–20 by 36–64 μ, average 17 by 50 μ; wall colorless, about 1 μ thick, smooth. Telia on overwintered fronds, chiefly hypophyllous; teliospores in epidermal cells, vertically septate, 1–25-celled; wall colorless, smooth.


15

On Polypodiaceae (tribe *Pterideae*): **Cryptogramma acrostichoides** R.Br., Calif., Ore.; B.C. **Range:** Southern British Columbia to western Montana and northwestern California.

3. HYALOPSORA Magn., 1901.

Heteroecious species, readily distinguished from other fern rusts by the abundant production of golden-yellow, pulverulent urediospores. There are seemingly two forms of these spores differing somewhat in size, thickness of wall and arrangement of pores, possibly indicating to some extent an active and a resting condition. The pycnia and aecia occur on the coniferous genus *Abies*. Pycnia, aecia and uredia subepidermal, telia intracellular.

Pycnia hypophyllous, more or less lenticular, without paraphyses. Aecia hypophyllous, erumpent, cylindric; aeciospores globoid or ellipsoid, with bright-yellow contents when fresh; wall thin, colorless, minutely verrucose or smooth. Uredia usually hypophyllous, bullate, dehiscent by irregular rupture; peridium delicate, rarely observable when dry; urediospores obovate, with colored contents; wall colorless, minutely verrucose or smooth; amphispores larger, with thicker walls. Telia indehiscent, with teliospores within the cells of the epidermis and vertically septate, the walls colorless.

Urediospores regular in form, usually ellipsoid.	
Urediospores large, 16–24 by 25–37 μ.	1. *H. aspidiotus.*
Urediospores small, 14–20 by 19–30 μ.	2. *H. polypodii.*
Urediospores irregular in form, usually globoid.	3. *H. cheilanthis.*

The pores of the urediospores are not easily detected. In the active form they are usually 4, and equatorial, while in the resting (amphisporic) form the pores are about 6 to 8, and scattered. All gradations occur between the active and resting forms in size, thickness of wall, and number of pores. While the two forms are usually in separate sori yet they may occur in the same sorus.

One other species occurs in Europe and four others in Japan.

1. HYALOPSORA ASPIDIOTUS. Fig. 16.

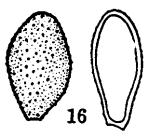
(N. A. F. 7: 112, 681, 819.)

Uredo polypodii β polypodii-dryopteridis Moug. & Nestl.; DC., Fl. Fr. **6:** 81. 1815.
Uredo aspidiotus Peck, Ann. Rep. N. Y. State Mus. **24:** 88. 1872.
Hyalopsora aspidiotus (Peck) Magn., Ber. Deuts. Bot. Ges. **19:** 582. 1901.
Hyalopsora polypodii-dryopteridis Magn., Hedw. Beibl. **41:** 224. 1902.
(*Peridermium pycnoconspicuum* Bell, Bot. Gaz. **77:** 25. 1924.)

Pycnia hypophyllous, on leaves of the second season previous. Aecia hypophyllous, on leaves of the second season previous, cylindric; aeciospores with bright-yellow contents, globoid or broadly ellipsoid, 16–19 by 21–25 μ; wall 1 μ thick, very finely and closely verrucose, appearing smooth.

On Pinaceae: **Abies balsamea** (L.)Mill., Ont., Queb.

Uredia chiefly hypophyllous, on discolored areas, scattered, round, bullate, irregularly ruptured, pulverulent; urediospores with golden-yellow contents, ellipsoid or oval, 16–24 by 25–37 μ; wall colorless, 1–2 μ thick, minutely verrucose, the pores usually 4, equatorial, indistinct; amphispores in smaller, mostly indehiscent sori, obovate, 30–40 by 36–70 μ; wall colorless, 2.5–3.5 μ thick, very faintly verrucose, the pores 6–8, scattered, obscure. Teliospores within the epidermal cells, globoid or irregular, 21–35 μ broad by 25 μ high, about 4-celled by vertical septa; wall colorless, uniformly 1 μ thick, smooth.


16

On Polypodiaceae (tribe *Aspidieae*): **Phegopteris dryopteris** (L.)Fée (*Dryopteris d.* Britt., *Polypodium d.*), Alas., Ida., Mich., Mont., N.H., N.Y., Ore., Wash.; B.C., Ont., Queb.

Range: New Hampshire to Oregon and northward; also in Europe, western Asia and Japan.

"I have come to the conclusion that infection takes place in young balsam needles at the time of their emergence from the bud or soon after, and that a year ensues before the pycnia are formed, and the aecia emerge at the beginning of the season following." J. H. Faull *in litt.*

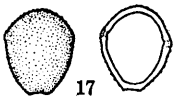
Successful cultures were made in 1922 by Bell (Bot. Gaz. **77:** 21. 1924), using aeciospores from *Abies balsamea,* and confirmed in 1923 by Faull & Darker (Phytop. **14:** 350. 1924). In Europe cultures have been made by Mayor (Bull. Soc. Neuch. **50:** 82. 1925), using aeciospores from *Abies pectinata,* and teliospores from *Dryopteris linnaeana* (*P. dryopteris*).

2. HYALOPSORA POLYPODII. Fig. 17.

(N. A. F. 7: 112, 682, 819.)

Uredo linearis β polypodii Pers., Syn. Fung. 217. 1801.
Uredo polypodii DC., Fl. Fr. **6:** 81. 1815.
Hyalopsora polypodii (Pers.) Magn., Ber. Deuts. Bot. Ges. **19:** 582. 1901.

Pycnia and aecia unknown. Uredia hypophyllous, scattered, bullate, irregularly ruptured, somewhat pulverulent; urediospores globoid or ellipsoid, 14–20 by 19–30 μ, with golden-yellow contents; wall colorless, 1–1.5 μ thick, very faintly verrucose, the pores 4, equatorial; amphispores similar but larger, 18–29 by 22–35 μ; wall 2–3 μ thick, the pores 6–8, scattered, obscure. Teliospores within the epidermal cells, globoid, 14–18 μ in diameter, 2–4-celled; wall colorless, uniformly 1 μ thick, the pore apical.


17

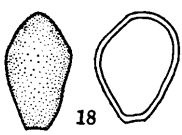
On Polypodiaceae (tribe *Woodsieae*): **Filix fragilis** (L.)Underw.(*Cystopteris f.* Bernh.), Alas., Calif., Colo., Conn., Del., Ill., Ind., Iowa, Mass., Mich., Miss., Mont., N.Y., Ohio, Pa., Utah, Wash., Wis., Wyo.; B.C., Ont., Sask.—**Woodsia glabella** R.Br., Mich. **Range:** Massachusetts to southeastern Alaska, southward to northern Mississippi and northern California; also in Europe and Japan.

3. HYALOPSORA CHEILANTHIS. Fig. 18.

(N. A. F. 7: 113, 682, 819.)

Caeoma cheilanthis Peck, Bull. Torrey Club **10:** 62. 1883.
Uredo pellaeae Diet. & Neg., Bot. Jahrb. **27:** 15. 1899.
Hyalopsora cheilanthis (Peck) Arth., N. Am. Flora **7:** 113. 1907.

Pycnia and aecia unknown. Uredia chiefly hypophyllous, bullate, dehiscent by apical rupture; urediospores irregularly globoid or obovate, 15–22 by 20–30 μ, with golden-yellow contents; walls colorless, 1 μ thick, often seemingly much thicker, minutely verrucose, the pores equatorial, obscure; amphispores unknown. Teliospores more or less crowded in the epidermal cells, globoid, 15–20 μ in diameter, 4-celled; wall colorless, uniformly 1 μ thick, smooth.


18

On Polypodiaceae (tribe *Pterideae*): **Cheilanthes pringlei** Dav., Ariz.—**Cryptogramma stelleri** (S.G.Gmel.)Prantl(*Pellaea gracilis* Hook.), Iowa, Mich., Mont., Wis.—**Notholaena sinuata** (Sw.)Kaulf., N.M.—**Pellaea andromedaefolia** (Kaulf.)Fée, Calif.—**P. flexuosa** (Kaulf.)Link, Tex.—**P. glabella** Mett., Calif. —**Pityrogramma triangularis** (Kaulf.)Maxon(*Ceropteris t.* Underw., *Gymnogramma t.*), Calif. **Range:** Michigan to western Montana, west-central California southward, and from southern Texas to southern California; also in western South America.

4. PUCCINIASTRUM Otth, 1861.

Heteroecious rusts, with yellow aeciospores and urediospores. The pycnia and aecia occur on various coniferous genera of the solitary-leaved *Abieteae*. Pycnia subcuticular, other sori subepidermal, or the telia sometimes intraepidermal.

Pycnia often much sunken into the tissues of the host, without paraphyses. Aecia cylindric, with delicate peridium; aeciospores ellipsoid, finely verrucose, in some species with a small smooth spot. Uredia when present bullate, barely protruding through the epidermis, with a delicate peridium opening by a central pore, the cells surrounding the orifice larger and sometimes roughened; urediospores borne singly on very short pedicels, obovate or ellipsoid, the wall thin and echinulate. Telia indehiscent, formed in layers either within or beneath the cells of the epidermis; teliospores vertically septate, the walls colored.

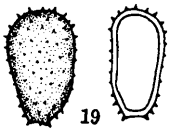
Teliospores formed in layers beneath the epidermis (§ *Phragmopsora* Magn., 1875).	
Uredia and telia on monocotyledonous hosts.	1. *P. goodyerae.*
Uredia and telia on dicotyledonous hosts.	
Host belonging to family Rosaceae.	
Uredial peridium conspicuous above epidermis.	2. *P. americanum.*
Uredial peridium scarcely protruding above epidermis.	
Ostiolar cells conspicuously aculeate.	3. *P. arcticum.*
Ostiolar cells smooth or nearly so.	
Urediospores 14–19 μ long.	4. *P. potentillae.*
Urediospores 15–24 μ long.	5. *P. agrimoniae.*
Host belonging to family Onagraceae.	6. *P. pustulatum.*
Host belonging to family Pyrolaceae.	7. *P. pyrolae.*
Teliospores formed in the epidermal cells, without hypertrophy (§ *Thecopsora* Magn., 1875).	
Host belonging to family Hydrangeaceae.	8. *P. hydrangeae.*
Host belonging to families Ericaceae and Vacciniaceae.	
Urediospores long, 26–45 μ.	9. *P. sparsum.*
Urediospores short, 16–24 μ.	10. *P. myrtilli.*
Host belonging to family Rubiaceae.	11. *P. galii.*
Teliospores formed in epidermal cells, causing hypertrophy (§ *Calyptospora* Kühn, 1869).	12. *P. goeppertianum* (d).

Two species not occurring in America have been described from Europe, one of them extending to Siberia and the other to Japan, and eleven others are known from eastern Asia and Japan.

1. PUCCINIASTRUM GOODYERAE. Fig. 19.

(N. A. F. 7: 105, 818.)

Uredo goodyerae Tranz., Trudi S. Petersb. Obshch. Est. Otd. Bot. **23:** 28. 1893.
Pucciniastrum goodyerae (Tranz.) Arth., N. Am. Flora **7:** 105. 1907.


19

Pycnia and aecia unknown. Uredia amphigenous, indefinitely scattered, bullate, dehiscent by central pore; urediospores oblong-clavate or obovate, 13–19 by 26–36 μ; wall yellowish, 1.5–2 μ thick, finely echinulate. Telia unknown.

On Orchidaceae: **Goodyera decipiens** (Hook.) Hubbard (*G. menziesii* Lindl., *Peramium d.* Piper), Calif., Colo., N.M., Ore., Wash. **Range:** Central Washington to northern New Mexico; also in European Russia and Japan.

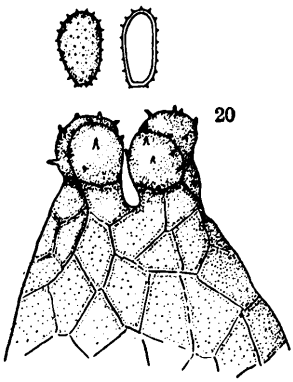
2. PUCCINIASTRUM AMERICANUM. Fig. 20.

(N. A. F. 7: 677, 814.)

Pucciniastrum arcticum americanum Farl., Rhodora **10:** 16. 1908.
Pucciniastrum americanum (Farl.) Arth., Bull. Torrey Club **47:** 468. 1920.

Pycnia hypophyllous, inconspicuous. Aecia hypophyllous, nearly cylindric, fragile; aeciospores globoid or broadly ellipsoid, 17–21 by 20–28 μ; wall colorless, 2–3 μ thick, with closely set tubercles.

On Pinaceae: **Picea canadensis** (Mill.)B.S.P.(*P. glauca* Voss., *P. alba* Link, *Abies c.*), Ont.



20

Uredia hypophyllous, thickly scattered over large areas, small, the peridium protruding beyond the epidermis in cone-form, dehiscent by a central pore, the 4 to 6 ostiolar cells knob-like and strongly aculeate; urediospores obovate or oblong-ellipsoid, 10–18 by 15–26 μ, the contents bright-yellow; wall colorless, 1–1.5 μ thick, echinulate. Telia hypophyllous, small; teliospores ellipsoid, 24–28 μ in diameter; wall brownish, uniformly 1 μ thick, smooth.

On Rosaceae: **Rubus leucodermis** Dougl., Md.—**R. melanolasius** Focke, Ida., Mont.; B.C.—**R. neglectus** Peck, Mass.—**R. strigosus** Michx.(*R. idaeus aculeatissimus* Rob.&Fern, *R. idaeus canadensis* Rich.), Conn., Iowa, Me., Md., Mass., N.H., N.J., N.Y., N.D., Ohio, Vt., W.Va., Wis.; N.S., Ont., Queb.

Range: Nova Scotia to British Columbia, southward to West Virginia, Ohio and Idaho.

Successful cultures were conducted by Darker (Jour. Arnold Arboretum **10:** 158. 1929) in 1927 using aeciospores from *Picea canadensis* sown on *Rubus strigosus.* A sowing at the same time was made on *R. triflorus* without infection. These results were verified by a repetition in 1928. Reverse experiments in 1928 (*l.c.*) by using teliosporic material gave aecia in 13–17 days on *Picea canadensis,* but no infection on *Abies balsamea* or *Tsuga canadensis.*

The host for the sporophyte of this species has sometimes been erroneously determined as *Rubus occidentalis.* The characters of the uredial peridium for this and the following species have been clearly contrasted by Moss (Ann. Bot. **40:** 833–834. 1926).

3. PUCCINIASTRUM ARCTICUM. Fig. 21.

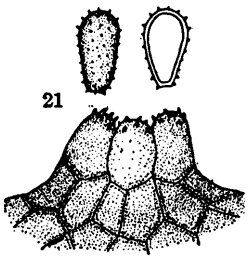
(N. A. F. 7: 107, 677.)

Uredo arcticus Lagerh., Hedw. **28:** 109. 1889.
Pucciniastrum arcticum (Lagerh.) Tranz., Scripta Bot. Hort. Univ. Petrop. **4:** 300. 1895.
(*Aecidium ingenuum* Arth., Bull. Torrey Club **11:** 124. 1919.)

Pycnia hypophyllous, inconspicuous. Aecia hypophyllous, nearly cylindric, fragile; aeciospores globoid or broadly ellipsoid, 14–18 by 17–25 μ; wall colorless, 2–3 μ thick, half the thickness being due to the close, rather fine and somewhat deciduous tubercles.

On Pinaceae: **Picea canadensis** (Mill.)B.S.P.(*P. glauca* Voss., *P. alba* Link, *Abies c.*), S.D., Vt., Wis.; Alta., Ont.

Uredia hypophyllous, thickly scattered over more or less definite areas, small, bullate, dehiscent by a central pore, the ostiolar cells conspicuously


21

aculeate; urediospores obovate or obovate-oblong, 13–16 by 19–26 μ, with orange-yellow contents fading to pale-yellow; wall colorless, 1–2 μ thick, noticeably echinulate. Telia hypophyllous, brownish, inconspicuous; teliospores subepidermal, globoid or cuboid, 19–25 μ in diameter; wall brownish, uniformly 1 μ thick, smooth.

On Rosaceae: **Rubus acaulis** Michx., Alas.—**R. chamaemorus** L., Alas.—**R. pubescens** Raf.(*R. triflorus* Richards.), Conn., Mich., Minn., N.H., Vt., Wis.; Alta., Man., N.B., Ont.—**R. stellatus** Smith, Alas.

Range: New Brunswick to Alberta, southward to northern Connecticut and northern Minnesota, and in Alaska; also in northern Europe and Japan.

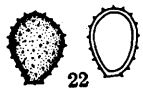
Inoculation experiments were conducted successfully by Darker (Jour. Arnold Arboretum **10:** 158. 1929) in 1928 by using overwintered teliospores from *Rubus triflorus*, with sowings on *Picea canadensis*, the aecia appearing in 15–18 days. Aeciospores from this experiment were sown on *Rubus triflorus* and *R. strigosus* with infection only on the former.

The results obtained from cultures, and the measurements of pycniospores and aeciospores, clearly indicate that this species is distinct from *P. americanum*.

4. PUCCINIASTRUM POTENTILLAE. Fig. 22.

(N. A. F. 7: 676.)

Pucciniastrum potentillae Kom., in Jacz.-Kom.-Tranz., Fungi Rossiae *327*. 1900.


22

Pycnia and aecia unknown. Uredia hypophyllous, scattered, bullate, dehiscent by a central pore; urediospores broadly obovate or globoid, small, 12–15 by 14–19 μ; wall colorless, 1.5 μ thick, finely echinulate. Telia hypophyllous, minute, subepidermal, reddish-brown; teliospores intercellular, globoid, 14–22 by 16–26 μ; wall cinnamon-brown, smooth.

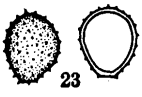
On Rosaceae: **Sibbaldiopsis tridentata** (Sol.)Rydb.(*Potentilla t.*), Me., Minn., N.H., N.Y., Wis.; Man., N.B., Ont. **Range:** Southern Maine to northern Manitoba and Minnesota; also in eastern Asia and Japan.

The telia are rarely collected; only uredia have been reported for North America.

5. PUCCINIASTRUM AGRIMONIAE. Fig. 23.

(N. A. F. 7: 106, 676, 818.)

Caeoma (*Uredo*) *agrimoniae* Schw., Trans. Am. Phil. Soc. II. **4:** 291. 1832.
Coleosporium ochraceum Bon., Coniom. 20. 1860.
Thecopsora agrimoniae Diet., Hedw. **29:** 153. 1890.
Pucciniastrum agrimoniae (Schw.) Tranz., Scripta Bot. Hort. Univ. Petrop. **4:** 301. 1895.


23

Pycnia and aecia unknown. Uredia hypophyllous, thickly scattered over more or less definite areas, bullate, dehiscent by a central pore, somewhat pulverulent; urediospores broadly obovate or globoid, 12–17 by 15–24 μ, with orange-yellow contents; wall colorless, 1 μ thick, minutely echinulate. Telia hypophyllous, pale-yellow, diffused, inconspicuous; teliospores subepidermal, oblong or cuneate, vertically septate, 15–30 by 18–30 μ; wall brownish-yellow, uniformly 1 μ thick, smooth.

On Rosaceae: **Agrimonia gryposepala** Wallr.(*A. hirsuta* Bickn.), Conn., Del., Ill., Ind., Iowa, Md., Minn., Neb., N.Y., N.D., Pa., S.D., Vt., W.Va.; Alta., Man., N.S.—**A. incisa** T.&G., N.C.—**A. microcarpa** Wallr.(*A. pumila* Muhl.),

Fla., Kans., La., Mo.—**A. parviflora** Ait., Ala., Ark., Del., Ill., Ind., Ky., Md., Mich., Miss., N.J., N.Y., N.C., Ohio, Pa., Tenn., Va., W.Va.—**A. pubescens** Wallr.(*A. mollis* Britt.), Ark., Ind., Ill., Iowa, Mass., Mich., Mo., Neb., N.M., N.Y., Ohio, Va., W.Va.; Ont.—**A. rostellata** Wallr., Ind., N.Y.—**A. striata** Michx.(*A. brittoniana* Bickn.), Colo., Me., Neb., N.M., N.Y., N.D., Pa., S.D., Vt., Va., W.Va., Wis.; Alta. **Range:** Nova Scotia to Alberta, southward east of the Rocky Mountains to Florida and Arkansas; also in West Indies, Mexico, Central and South America, Europe, Asia, Japan and Africa.

One of the most widely distributed rusts, and usually abundant. The telia are inconspicuous, and not often observed, although generally to be found near the close of the growing season. No successful cultures have yet been conducted, yet the alternate host is likely to be some species of *Tsuga* or a nearly related genus.

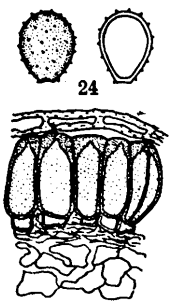
6. PUCCINIASTRUM PUSTULATUM. Fig. 24.

(N. A. F. 7: 107, 677, 814, 818.)

Uredo pustulata (*a epilobii*) Pers., Syn. Fung. 219. 1801.
Uredo epilobii DC., Fl. Fr. **6:** 73. 1815.
Pucciniastrum epilobii Otth, Mitth. Nat. Ges. Bern **1861:** 72. 1861.
Pucciniastrum pustulatum (Pers.) Diet., in E. & P. Nat. Pfl. **1**^{1**}: 47. 1897.
Pucciniastrum abieti-chamaenerii Kleb., Jahr. Wiss. Bot. **34:** 387. 1900.

Pycnia hypophyllous, abundant. Aecia hypophyllous, cylindric; on leaves of the current season; aeciospores obovate or irregularly globoid, 10–14 by 13–21 μ; wall colorless, finely verrucose except an elongate smooth spot on one side, about 1 μ thick on smooth side, slightly thicker on opposite side.

On Pinaceae: **Abies amabilis** (Loud.)Forbes, Wash.; B.C.—**A. arizonica** Merr., Colo.—**A. balsamea** (L.)Mill., Mich., N.Y., Wis.; Alta., N.S.—**A. concolor** Lindl.&Gord., Colo.—**A. grandis** Lindl., Ida., Mont., Wash.—**A. lasiocarpa** (Hook.)Nutt.(*A. subalpina* Engelm.), Alas., Colo., Ida., Mont., Ore., Wash.; B.C.—**A. nobilis** Lindl., Ore.


24

Uredia hypophyllous, scattered or in small groups on discolored areas, bullate, small, conspicuous, dehiscent by a central pore; urediospores obovate or oval, 10–14 by 13–23 μ, with orange-yellow contents; wall colorless, 1 μ thick, sparsely and finely echinulate. Telia hypophyllous, flat, small, confluent into extended crusts, indehiscent, conspicuous, reddish-brown becoming blackish-brown; teliospores subepidermal, usually in a single layer, oblong or angular by pressure, 10–14 by 17–35 μ; wall chestnut-brown, 1 μ thick at sides, thicker above, 2–3 μ, smooth.

On Onagraceae: **Chamaenerion latifolium** (L.)Sweet (*Epilobium l.*), Alas.—**C. spicatum** (Lam.)S.F.Gray(*E. angustifolium* L.), Alas., Calif., Colo., Ida., Me., Mich., Mont., N.H., N.J., N.M., N.Y., N.D., Ore., S.D., Vt., Wash., W.Va., Wis.; Alta., B.C., Man., N.B., N.W.Terr., N.S., Sask.; Newf.—**C. exaltatum** Rydb., Alas.—**Clarkia elagans** Dougl., Alas.—**C. superba** Nels.&Macbr.(*Godetia grandiflora* Lindl.), Alas.—**Epilobium adenocaulon** Haussk., Alas., Calif., Colo., Ida., Iowa, Me., Mont., Neb., N.Y., N.D., Ore., Pa., S.D., Utah, Va., Wash., W.Va., Wis., Wyo.; B.C., Man., Sask.—**E. alpinum** L., Alas., Colo., Mont., Utah.—**E. brevistylum** Barbey, Calif., Ore.—**E. californicum** Haussk., Calif.—**E. coloratum** Muhl., Calif., Del., Iowa, Neb., N.Y., Pa., Tenn.; Ont.—**E. franciscanum** Barbey, Calif.—**E. glandulosum** Lehm., Alas.—**E. hirsutum** L., Mass., N.Y.; Ont.—**E.**

holosericeum Trel., Calif.—**E. lineare** Muhl.(*E. densum* Raf.), Minn., N.Y., Wis.—**E. novomexicanum** Haussk., N.M.—**E. occidentale** (Trel.)Rydb.(*E. adenocaulon o.*), Calif., Wyo.—**E. palustre** L., Alas.—**E. paniculatum** Nutt., Mont.—**E. platyphyllum** Rydb., Mont.

Range: Nova Scotia to North West Territory and Alaska, southward to Tennessee, northern New Mexico and California; also in Europe, Siberia, Japan and New Zealand.

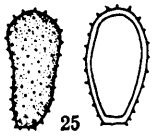
Successful cultures have been made between *Abies* and *Chamaenerion*, but not with the other onagraceous genera. Klebahn in 1898 (Zeits. Pflanzenkr. **9:** 23. 1899) first demonstrated the genetic connection, using *Abies pectinata* and *C. angustifolium*. In the following year (Jahrb. Wiss. Bot. **34:** 386. 1900) he sowed aeciospores on *Chamaenerion* and three species of *Epilobium* with infection only on the former, which led him to think two biologic forms were present, and to give the name *P. abieti-chamaenerii* to the one whose alternate host had been found. The next year (same **35:** 694. 1901) he confirmed his former conclusions. Reciprocal cultures were made by Fischer (Ber. Schweiz. Bot. Ges. **10:** (7). 1900), and cultures with aeciospores by Tubeuf (Centr. Bakt. II. **9:** 241. 1902), both confirming the work by Klebahn. In 1911 reciprocal cultures were made by Fraser in America (Mycol. **4:** 176. 1912), using teliospores from *C. angustifolium* and aeciospores from *Abies balsamea*, and later Weir & Hubert (Phytop. **6:** 373. 1916; same **7:** 109. 1917) made reciprocal cultures with spores from *C. angustifolium* and *Abies lasiocarpa*. Cultures with teliospores from *C. angustifolium*, sown on *Abies mayriana*, were made in Japan by Hiratsuka in 1926 (Jap. Jour. Bot. **6:** 23. 1932).

From the results of cultures it is highly probable that two biologic forms exist, or it may be two varieties, with some slight morphologic differences in the size and prominence of the telia, and according to Sydow (Monog. Ured. **3:** 442) in the thickness of the walls of both urediospores and teliospores. Possibly a third variety may exist on *Clarkia* and *Godetia*. It does not seem best at the present time to dignify these distinctions by calling them species, as has been done by Klebahn, Sydow, and others, although they might be separated as varieties.

7. PUCCINIASTRUM PYROLAE. Fig. 25.

(N. A. F. 7: 108, 678, 818.)

Aecidium pyrolae Pers.; Gmel., Syst. Nat. **2:** 1473. 1791.
Uredo pyrolae Mart., Fl. Mosq. 229. 1812.
Thecopsora pyrolae Karst., Bidr. Finl. Nat. Folk **31:** 59. 1879.
Pucciniastrum pyrolae (Pers.) Schroet., Jahresb. Schles. Ges. Vaterl. Kult. **58:** 167. 1880.
Uredo chimaphilae Peck, Ann. Rep. N. Y. State Mus. **46:** 33. 1893.


25

Pycnia and aecia unknown. Uredia chiefly hypophyllous, small, bullate, densely grouped or widely scattered, dehiscent by a central pore; urediospores clavate-oblong or ellipsoid, 13–18 by 26–39 μ, the contents reddish-orange; wall colorless, 1.5–2 μ thick, minutely echinulate. Telia inconspicuous, flat, subepidermal; teliospores oblong or columnar, 10–12 by 24–28 μ; wall colorless, uniformly 1 μ thick, smooth.

On Pyrolaceae: **Chimaphila corymbosa** Pursh, Wis.—**C. maculata** (L.) Pursh, Del., Md., N.J., N.Y., Tenn., Wis.—**C. occidentalis** Rydb., Mont., Ore.—**Moneses uniflora** (L.)Gray(*Pyrola u., M. grandiflora* S.F.Gray), Alta.—**Pyrola americana** Sweet(*P. rotundifolia* Michx.), N.D., S.D.—**P. asarifolia** Michx., Alas., Calif., Colo., Mont., Wash.; Alta., Man.—**P. chlorantha** Sw., Mont., Wyo.; Alta., Man.—**P. elliptica** Nutt., Conn., Iowa, N.H., N.Y., Pa., Wis.; Alta., N.S., Ont., Sask.—**P. minor** L.(*Erxlebenia m.* Rydb.), Colo., Ida., Mont.; Alta.—**P. picta** Smith, Calif.—**P. secunda** L.(*Ramischia s.* Garcke), Calif., Colo., Mont., Ore., Wash., Wis.; Alta., Ont. **Range:** Nova Scotia to Manitoba and Alaska, southward to Tennessee, Colorado and northern California; also in Europe and Japan.

The grouping and general appearance of the uredia are much like aecia, and hence the error of placing this stage under the genus *Aecidium* by Persoon. As originally printed the name read *A. pyronae,* clearly indicating a typographical error.

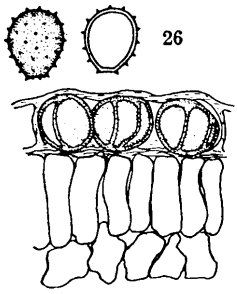
8. PUCCINIASTRUM HYDRANGEAE. Fig. 26.

(N. A. F. 7: 106, 676, 818.)

Uredo hydrangeae B. & C.; Seym., Bot. Gaz. **9:** 191. 1884.
Thecopsora hydrangeae Magn.; Vesterg., Micr. Rar. Sel. 571. 1902.
Pucciniastrum hydrangeae (B. & C.) Arth., Rés. Sci. Congr. Bot. Vienne 337. 1906.
(*Peridermium hydrangeae* J. F. Adams, Mycol. **12:** 34. 1920.)

Pycnia chiefly hypophyllous, inconspicuous. Aecia hypophyllous, on leaves of the current season, cylindric; aeciospores broadly ellipsoid or ovoid, 14–20 by 19–26 μ, with orange-yellow contents; wall colorless, finely verrucose except an elongate smooth spot on one side, about 1 μ thick on smooth side, slightly thicker on opposite side.

On Pinaceae: **Tsuga canadensis** (L.)Carr.(*Abies c.* Michx.), Ind., Pa., Tenn., W.Va.—**T. caroliniana** Engelm., N.C.


26

Uredia hypophyllous, scattered on indefinite yellowish areas, bullate, small, ruptured by apical pore; urediospores broadly ellipsoid or obovate, 12–18 by 16–24 μ, with orange-yellow contents; wall nearly colorless, 1–1.5 μ thick, sparsely and strongly echinulate. Telia amphigenous, often chiefly epiphyllous, effused or forming small angular groups, not raised, reddish-brown; teliospores in a single layer within the epidermal cells or immediately beneath the epidermis; globoid, 22–24 μ in diameter; wall dark cinnamon-brown, uniformly 1.5–2 μ thick, smooth.

On Hydrangeaceae: **Hydrangea arborescens** L., Ark., D.C., Ill., Ind., Ky., Md., N.C., Ohio, Pa., Tenn., Va., W.Va.

Range: District of Columbia to Illinois, southward to North Carolina and Arkansas.

Successful cultures were conducted by Adams (Mycol. **12:** 33. 1920), using aeciospores from *Tsuga canadensis* sown on *Hydrangea arborescens.*

9. PUCCINIASTRUM SPARSUM. Fig. 27.

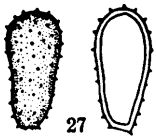
(N. A. F. 7: 108, 678, 814, 818.)

Melampsora sparsa Wint., in Rab., Krypt. Fl. **1:** 245. 1881.
Uredo arbuti D. & H., Bot. Gaz. **18:** 256. 1893.
Pucciniastrum arbuti D. & H.; Diet., E. & P. Nat. Pfl. **1**^{1**}: 47. 1897.
Uredo copelandi Syd., Ann. Myc. **2:** 31. 1904.
Pucciniastrum sparsum (Wint.) Fisch., Beitr. Krypt. Schweiz **2**^{2}: 469. 1904.
Thekopsora sparsa Magn., in Dalla Torre & Sarnth., Fl. Tirol **3:** 118. 1905.

Pycnia amphigenous, inconspicuous. Aecia hypophyllous, on slightly discolored spots, cylindric; aeciospores globoid or broadly ellipsoid, 18–25 by 21–32 μ; wall colorless, 1 μ thick, finely verrucose except a small smooth spot on one side.

On Pinaceae: **Picea excelsa** (Lam.)Link(*P. abies* Karst., *P. vulgaris* Link), Europe, not yet found in America.

Uredia chiefly hypophyllous, gregarious on discolored spots or scattered, bullate, dehiscent by central pore; urediospores clavate-oblong or ellipsoid, 12–20 by 26–45 μ, the contents orange-yellow; wall colorless, 1–2 μ thick, finely and


27

sparsely echinulate. Telia chiefly hypophyllous; teliospores in the epidermal cells, singly or in a layer, ellipsoid, 18–35 by 24–35 μ, vertically septate; wall cinnamon-brown, 2 μ thick at sides, much thicker above, 6 μ, smooth, with one apical pore in each cell.

On Ericaceae: **Arbutus menziesii** Pursh, Calif., Ore., Wash.—**Arctostaphylos hookeri** G.Don, Calif.—**A. nevadensis** Gray, Calif., Ore.—**A. patula** Greene, Calif., Ore.—**Mairania alpina** (L.)Desv.(*Arctostaphylos a.*), Alas.; B.C.

Range: Alaska to southern California; also in Mexico, Europe and Japan.

Successful cultures were made by Ed. Fischer (Centr. Bakt. II. **46:** 333. 1916) in Switzerland, sowing teliospores from *Arctostaphylos alpina* on *Picea excelsa.* At the same time a sowing on *Abies pectinata* failed to produce an infection.

10. PUCCINIASTRUM MYRTILLI. Fig. 28.

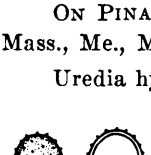
(N. A. F. **7:** 109, 678, 818.)

Aecidium? myrtilli Schum., Enum. Pl. Saell. **2:** 227. 1803.
Uredo vacciniorum DC., Fl. Fr. **6:** 85. 1815.
Uredo minima Schw., Schr. Nat. Ges. Leipzig **1:** 70. 1822.
Caeoma (*Uredo*) *azaleae* Schw., Trans. Am. Phil. Soc. II. **4:** 291. 1832.
Thecopsora? vacciniorum Karst., Bidr. Finl. Nat. Folk **31:** 58. 1879.
(*Peridermium peckii* Thüm., Mitt. Forstl. Vers. Oest. **2:** 320. 1881.)
Uredo andromedae Cooke; De-T., in Sacc., Syll. Fung. **7:** 853. 1888.
Pucciniastrum vacciniorum Lagerh., Tromsø Mus. Aarsh. **17:** 93. 1895.
Pucciniastrum minimum Arth., Rés. Sci. Congr. Bot. Vienne 337. 1906.
Pucciniastrum myrtilli (Schum.) Arth., Rés. Sci. Congr. Bot. Vienne 337. 1906.

Pycnia hypophyllous, numerous, inconspicuous. Aecia hypophyllous, on yellow spots, cylindric; aeciospores globoid or broadly ellipsoid, 15–21 by 18–27 μ; wall colorless, 1–1.5 μ thick, finely and evenly verrucose.

On Pinaceae: **Tsuga canadensis** (L.)Carr.(*Abies c.* Michx.), Ala., Conn., Mass., Me., Mich., N.H., N.Y., N.C., Pa., S.C., Va., W.Va., Wis.; N.S.

Uredia hypophyllous, scattered or somewhat gregarious, on discolored spots, bullate, dehiscent by central pore; urediospores broadly obovate or ellipsoid, 12–19 by 16–24 μ, the contents orange-yellow; wall colorless, 1–1.5 μ thick, minutely echinulate. Telia hypophyllous; teliospores within the epidermal cells, oblong or columnar, 7–10 by 14–17 μ; wall nearly colorless, uniformly 1 μ thick, smooth.


28

On Ericaceae: **Azalea canescens** Michx.(*Rhododendron c.* Porter), Vt.—**A. nudiflora** L.(*R. n.* T.&G.), Ala., Conn., Ga., N.C., N.Y., Pa., S.C.—**A. viscosa** L.(*R. v.* Torr.), Ala., Conn., Del., Mass., N.J., N.Y.—**Menziesia pilosa** (Michx.) Pers., W.Va.—**Neopieris mariana** (L.)Britt.(*Pieris m.* B.&H., *Lyonia m.* D. Don), Del.—**N. nitida** (Bartr.)Britt.(*P. n.* B.&H., *L. n.* Fern.), Ga.—**Rhodora canadensis** L., Me., N.H.; N.S.—**Xolisma ligustrina** (L.)Britt.(*L. l.* DC.), Ala., Ark., Del.; on Vacciniaceae: **Gaylussacia baccata** (Wang.)K.Koch(*G. resinosa* T.&G.), Conn., Me., Mass., Mich., N.Y., Vt., Wis.; Queb.—**Oxycoccus macrocarpus** (Ait.)Pursh(*Vaccinium m.*), Ore.—**Vaccinium alaskense** Howell, Alas.—**V. caespitosum** Michx., Alas., Mont., Ore., Wash.—**V. canadense** Rich., Wis.—**V. corymbosum** L., Ala., Del., Me., N.Y.; Ont.—**V. erythrocarpon** Michx., W.Va.—**V. globulare** Rydb., Ida., Mont.—**V. macrophyllum** (Hook.) Piper, Ida., Ore.—**V. membranaceum** Dougl.(*V. myrtilloides* Hook.), Ida.,

Mont., Ore., Wash., Wyo.—**V. myrsinites** Lam., Fla.—**V. myrtillus** L.(*V. scoparium* Leiberg), Colo., Ida., Wyo.; Alta.—**V. oreophilum** Rydb., Colo., Mont., N.M.—**V. ovalifolium** J.E.Sm., Alas., Ore., Wash.—**V. parvifolium** J.E.Sm., Calif., Wash.—**V. pennsylvanicum** Lam., Conn., Me., Mich., N.H., Wis.; N.S.—**V. uliginosum** L., N.H.—**V. vacillans** Kalm, Ark., Del., Conn., N.C.—**V. virgatum** Ait., Va.—**V. vitis-idaea** L., N.H.

Range: Nova Scotia to Wisconsin, southward to Florida and Arkansas and from Alaska to New Mexico; also in South America, Europe, Asia and Japan.

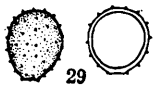
The aecial stage has not yet been collected in the western part of the territory. The first successful cultures were made by Clinton (Rep. Conn. Agr. Exp. Sta. **1909–10:** 719. 1911) and repeated in 1922 (same **47:** 499. 1924), sowing aeciospores from *Tsuga canadensis* on *Gaylussacia baccata*. These results were extended later by Fraser (Mycol. **5:** 237. 1913), who obtained aecia on *Tsuga canadensis* by using teliosporic material from *Vaccinium canadense*, and (Mycol. **6:** 27. 1914) from *Gaylussacia baccata*. In 1910 Fraser (Mycol. **4:** 184. 1912) made reciprocal cultures in both laboratory and field between the ericaceous host *Rhodora canadensis* and leaves and cones of *Tsuga canadensis*.

11. PUCCINIASTRUM GALII. Fig. 29.

(N. A. F. 7: 679.)

Caeoma galii Link, in Willd., Sp. Pl. 6^2: 21. 1825.
Melampsora guttata Schroet., Abh. Schles. Ges. Cultur **1869–72:** 26. 1872.
Thekopsora galii De-T., in Sacc., Syll. Fung. **7:** 765. 1888.
Pucciniastrum galii (Link) Fisch., Beitr. Krypt. Schweiz 2^2: 471. 1904.
Thekopsora guttata Syd., Monog. Ured. **3:** 467. 1915.

Pycnia and aecia unknown. Uredia hypophyllous, scattered or grouped, bullate, dehiscent by central pore; urediospores globoid or broadly ellipsoid, 11–16 by 16–24 μ, the contents yellow; wall colorless, 1–1.5 μ thick, sparsely and finely echinulate. Telia amphigenous, teliospores forming a single layer within the epidermal cells, globoid, 20–26 by 22–30 μ; wall cinnamon-brown, 1.5–2 μ thick, sometimes slightly thicker above, smooth.


29

On Rubiaceae: **Galium triflorum** Michx., Calif., Colo., Ida., N.Y., Ore., Pa., Utah, Wis.; B.C. **Range:** Vancouver Island southward to central California and eastward to central Colorado, with one locality each in eastern Wisconsin, central New York and western Pennsylvania; also in Europe and Japan.

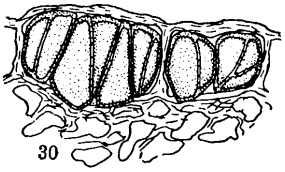
12. PUCCINIASTRUM GOEPPERTIANUM. Fig. 30.

(N. A. F. 7: 114, 646, 682, 819.)

(*Aecidium columnare* A. & S., Consp. Fung. 121. 1805.)
Calyptospora goeppertiana Kühn, Hedw. **8:** 81. 1869.
Calyptospora columnaris Kühn, in Rab.-Wint. Fungi Eur. *3521*. 1886.
(*Peridermium ornamentale* Arth., Bull. Torrey Club **28:** 665. 1901.)
(*Peridermium holwayi* Syd., Ann. Myc. **1:** 19. 1903.)
Pucciniastrum goeppertianum (Kühn) Kleb., Wirtsw. Rostp. 391. 1904.

Pycnia epiphyllous, inconspicuous. Aecia chiefly hypophyllous, on yellowish spots, cylindric or somewhat flattened; aeciospores broadly ellipsoid, 10–18 by 18–30 μ, the contents reddish-orange; wall colorless, 1–1.5 μ thick, finely verrucose.

On Pinaceae: **Abies amabilis** (Loud.)Forbes, Wash.—**A. balsamea** (L.) Mill., Wis.; N.S., Queb., Sask.—**A. concolor** Lindl.&Gord., Calif., Ore.—**A. lasiocarpa** (Hook.)Nutt.(*A. subalpina* Engelm.), Colo., Ida., Mont., Ore., Wash., Wyo.; Alta., B.C.—**A. magnifica** Murr., Calif., Ore.


30

Uredia wanting. Telia caulicolous, systemic, producing witches' brooms, forming a continuous layer around the stems, with polished, reddish-brown surface, becoming dull; teliospores in the epidermal cells, in a single, closely pressed layer, prismatic, usually 4-celled by vertical septa, oblong or ellipsoid, 10–14 by 18–30 μ; wall golden-brown, 0.5–0.8 μ thick at sides, 1–1.5 μ thick above, smooth.

On Vacciniaceae: **Vaccinium caespitosum** Michx., Calif., Mont., Utah.—**V. canadense** Rich., Me., Mass., Wis.—**V. chandleri** Jepson, Calif.—**V. corymbosum** L., Mass., Pa.—**V. membranaceum** Dougl.(*V. myrtilloides* Hook.), Mont., Ore., Wyo.—**V. myrtillus** L.(*V. scoparium* Leiberg), Colo., Mont., N.M., Ore.; Alta.—**V. oreophilum** Rydb., Colo., Mont., Wash.; Alta.—**V. ovalifolium** J.E.Sm., Alas., Calif., Ore.—**V. ovatum** Pursh, Calif., Ore., Wash.—**V. parvifolium** J.E.Sm., Ore., Wash.—**V. pennsylvanicum** Lam., Me., Mass., N.H., Vt., Wis.; N.S.; Newf.—**V. vitis-idaea** L., Alas., N.H.; Sask.

Range: Newfoundland to southeastern Alaska southward to Pennsylvania, Colorado and northern California; also in Mexico, Europe and Japan.

The first successful cultures were made by Hartig (Allg. Forst. Jadgz. **1880:** 289), using teliospores from *Vaccinium vitis-idaea,* and sowing on *Abies pectinata.* These results were confirmed in like manner by Kühn (Hedw. **24:** 108. 1885) and Bubák (Ann. Myc. **2:** 361. 1904; Centr. Bakt. II. **16:** 154. 1906). In America Arthur (Mycol. **2:** 231. 1910) in 1909 was successful with teliospores from *V. pennsylvanicum* sown on *Abies fraseri,* and later in the same year Fraser (Science **30:** 814. 1909) reported success with teliospores from the same host sown on *A. balsamea,* repeating the same in 1911 and 1913 (Mycol. **4:** 177. 1912; same **6:** 27. 1914).

5. MELAMPSORELLA Schroet., 1874.

A heteroecious genus, whose cycle of development includes pycnia and aecia on the coniferous genera *Abies* and *Picea,* and uredia and telia on dicotyledonous hosts. Pycnia subcuticular, aecia and uredia subepidermal, telia intraepidermal.

Pycnia inconspicuous, without paraphyses. Aecia hypophyllous, conspicuous, bullate or short-cylindric, dehiscent by irregular rupture, the aeciospores ellipsoid, with orange-yellow contents, and thin, verrucose wall. Uredia hypophyllous, somewhat bullate, opening by central pore, the peridium very delicate and scarcely noticeable, with ellipsoid or obovate urediospores, having bright-yellow contents and thin, sparsely echinulate walls. Telia hypophyllous, forming large whitish or pinkish areas, the teliospores loosely grouped within the epidermal cells, globoid, usually 1-celled, with thin, colorless walls.

Only one species known in North America, and only one other in Europe. The American species is systemic in both gametophytic and sporophytic states, but the other is systemic only in the sporophytic state.

1. MELAMPSORELLA CERASTII. Fig. 31.

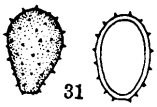
(N. A. F. 7: 111, 647, 681, 814, 819.)

Uredo pustulata β cerastii Pers., Syn. Fung. 219. 1801.
(*Aecidium elatinum* A. & S., Consp. Fung. 121. 1805.)
Uredo cerastii Mart., Fl. Mosq. 231. 1812.
(*Peridermium elatinum* S. & K., Deuts. Schämme **6:** 4. *141.* 1817.)
Caeoma caryophyllacearum Link, in Willd., Sp. Pl. **6²:** 26. 1825.
Melampsorella caryophyllacearum Schroet., Hedw. **13:** 85. 1874.
Melampsorella cerastii (Pers.) Schroet., Krypt. Fl. Schles. **3¹:** 366. 1887.

(*Aecidium coloradense* Diet., in E. & P., Nat. Pfl. **1**1**: 78. 1897.)
(*Peridermium boreale* A. & K., Bull. Torrey Club **33:** 425. 1906.)
(*Peridermium coloradense* A. & K., Bull. Torrey Club **33:** 426. 1906.)
Melampsorella elatina Arth., N. Am. Flora **7:** 111. 1907.

Pycnia chiefly epiphyllous. Aecia hypophyllous, systemic, forming etiolated witches' brooms; aeciospores globoid or ellipsoid, 14–18 by 16–28 μ (on *Abies*), 16–25 by 23–35 μ (on *Picea*); wall colorless, 1.5–2 μ thick (on *Abies*), 2–3 μ thick (on *Picea*), finely verrucose.

On Pinaceae: **Abies amabilis** (Loud.)Forbes, Wash.—**A. balsamea** (L.) Mill., Me., Mass., Mich., N.H., N.Y., Vt., Wis.; Man., N.B., N.S., Ont., Pr.Edw. Id.; Newf.—**A. concolor** Lindl.&Gord., Ore., Utah.—**A. grandis** Lindl., Ida., Ore.; B.C.—**A. lasiocarpa** (Hook.)Nutt.(*A. subalpina* Engelm.), Colo., Mont., N.M., Ore., Utah, Wash., Wyo.; B.C.—**A. magnifica** Murr., Calif.—**Picea albertiana** S.Brown, Alta., B.C.—**P. canadensis** (Mill.)B.S.P.(*P. alba* Link, *Abies c., P. glauca* Voss), Mich., S.D., Wash.; Alta., Sask., Yukon.—**P. engelmanni** (Parry)Engelm., Colo., Ida., Mont., Ore., Utah., Wash., Wyo.; Sask.—**P. excelsa** (Lam.)Link(*P. vulgaris* Link., *P. abies* Karst.) Mont., Wash.; Man.—**P. mariana** (Mill.)B.S.P.(*P. nigra* Ait.), Me., Mich., Wis.; Alta., Queb.; Newf.—**P. pungens** Engelm., Colo., N.M., S.D., Wyo.—**P. rubens** Sarg.(*P. rubra* Dietr.), Me., N.Y.—**P. sitchensis** (Bong.)Carr., Alas.


31

Uredia amphigenous, dehiscent by central pore; urediospores ellipsoid or obovate, 12–18 by 16–30 μ, reddish-orange when fresh; wall colorless, 1–1.5 μ thick, sparsely echinulate. Telia hypophyllous, on discolored spots; teliospores within the epidermal cells, mostly 1-celled; short-cylindric or polygonal, 13–20 μ broad; wall colorless, uniformly 1 μ thick, smooth.

On Caryophyllaceae: **Cerastium alpinum** L., B.C.—**C. arvense** L., Alas., Mont.; Alta., Sask.—**C. beeringianum** C.&S., Colo., Mont., Utah, Wyo.; B.C.—**C. campestre** Greene, Colo., Mont., S.D.—**C. occidentale** Greene, Colo., Mont.—**C. oreophilum** Greene, Colo., S.D.—**C. scopulorum** Greene, Utah.—**C. vulgatum** L., Neb., Ore.; Man.—**Stellaria borealis** Bigel.(*Alsine b.* Britt.), Mont., N.Y., Ore., Utah, Wash.—**S. brachypetala** Bong.(*A. b.* Howell), Wash.—**S. longifolia** Muhl.(*A. l.* Britt.), Mich., N.Y., Pa.—**S. longipes** Goldie(*A. l.* Cov.), Alas., Calif.; Alta.—**S. media** (L.)Cyrill(*A. m.*), Me., N.H.—**S. umbellata** Turcz.(*A. baicalensis* Cov.), Wyo.

Range: Newfoundland, Manitoba and Alberta southward to Pennsylvania and South Dakota, and in the mountains from western Yukon, southward to northern New Mexico; also in Mexico, Europe, Siberia and Japan.

The aecial witches' brooms, because of their pale color and usually large size, are conspicuous objects. Those on *Abies* are reddish, and those on *Picea* yellowish. The pycnia on *Abies* are less conspicuous and fewer than on *Picea*. The latter have erroneously been taken to be subepidermal, which consequently obscured the true relationship of the forms on the two host-genera.

Ed. Fischer (Zeits. Pflanzenkr. **11:** 321. 1901) was the first to detect the alternate hosts of this species by cultures. He sowed aeciospores from *Abies pectinata* on *Stellaria nemora*, and in the following year (same **12:** 193. 1902) performed the reverse culture. These were followed by successful cultures with aeciospores from *Abies* on various hosts by Tubeuf (Deuts. Bot. Ges. **19:** 433. 1901), Klebahn (Zeits. Pflanzenkr. **12:** 139. 1902) and Fischer (same **12:** 199. 1902). Cultures with American material were made in 1912 by Arthur (Mycol. **4:** 58. 1912), sowing aeciospores from *Abies lasiocarpa* on *Cerastium oreophilum*, and in 1917 by Weir & Hubert (Phytop. **8:** 114. 1918), with aeciospores from *Picea engelmanni* on *Stellaria longifolia* and *S. borealis*. Open air cultures were made by Bethel in 1921 from *P. engelmanni* on *Cerastium*, but the only record is a notation on a packet in the Arthur Herbarium. There is much cultural and observational evidence to indicate a considerable degree of specialization.

6. MELAMPSORIDIUM Kleb., 1899.

A heteroecious genus, whose cycle of development includes pycnia and aecia on the coniferous genus *Larix*, and uredia and telia on dicotyledonous shrubs or trees. Pycnia subcuticular, other sori subepidermal.

Pycnia inconspicuous, without paraphyses. Aecia erumpent, subcylindric, irregularly dehiscent, the peridium delicate, the aeciospores ellipsoid, with reddish-orange contents when fresh, and thin walls that are verrucose except for a smooth spot. Uredia hypophyllous, bullate, opening by central pore surrounded by long-pointed ostiolar cells, with elongate-ellipsoid urediospores, having bright yellow contents when fresh, and thin, sparsely echinulate walls, usually smooth above. Telia hypophyllous, forming an extended layer beneath the epidermis, the teliospores nonseptate, with thin, colored walls.

Inner wall of uredial peridium thick, 6–8 μ.	1. *M. betulinum.*
Inner wall of uredial peridium thin, 2–4 μ.	
Urediospores 25–50 μ long, without smooth spot.	2. *M. alni.*
Urediospores 18–28 μ long, with smooth spot.	3. *M. carpini.*

Only three species known, all being widely distributed through Europe, Asia and America, especially in mountainous regions.

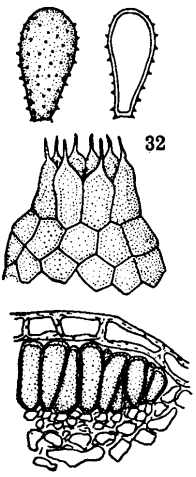
1. MELAMPSORIDIUM BETULINUM. Fig. 32.

(N. A. F. 7: 110, 680, 818.)

Uredo populina β betulina Pers., Syn. Fung. 219. 1801.
Uredo betulae Schum., Enum. Pl. Saell. **2:** 228. 1803.
(*Aecidium laricis* Kleb., Zeits. Pflanzenkr. **9:** 18. 1899.)
Melampsoridium betulinum (Pers.) Kleb., Zeits. Pflanzenkr. **9:** 21. 1899.
(*Peridermium laricis* Kleb., Wirtsw. Rostp. 402. 1904.)
Melampsoridium betulae Arth., N. Am. Flora **7:** 110. 1907.

Pycnia amphigenous, scattered, inconspicuous. Aecia hypophyllous, on scarcely discolored areas, conspicuous, subcylindric or flattened laterally; aeciospores globoid or broadly ellipsoid, 12–18 by 16–25 μ, the contents reddish-orange; wall colorless, 1–1.5 μ thick, closely verrucose, except a small area on one side which is smooth and slightly thinner.

On Pinaceae: **Larix laricina** (DuRoi)Koch(*L. americana* Michx.), Conn., Wis.



32

Uredia hypophyllous, closely grouped or scattered, dehiscent by central pore, the inner wall of peridium thick, 4–8 μ; urediospores elongate-elliptic or obovoid, 8–14 by 22–38 μ, the contents reddish-yellow; wall colorless, less than 1 μ thick, strongly and sparsely echinulate, except the apex, which is smooth. Telia hypophyllous, scattered, forming a slightly raised crust, noticeable, at first waxy-yellow becoming brown and finally blackish, indehiscent; teliospores in a palisade-like layer beneath the epidermis, prismatic, somewhat rounded at each end, 7–16 by 30–50 μ; wall nearly colorless, scarcely 1 μ thick, slightly thicker above, smooth.

On Betulaceae: **Betula glandulosa** Michx., Ida., Mont., Wash.—**B. kanaica** W.H.Evans, Alas.—**B. lutea** Michx., Ind., Me., N.H., Vt.—**B. occidentalis** Hook., Ida., Mont.—**B. papyrifera** Marsh., Conn., Me., N.H.—**B. populifolia** Marsh., Conn., Me., Mass., N.H., N.J., N.Y.; N.S.—**B. pumila** L., Mass., Mich.; Newf.

Range: Newfoundland to Wisconsin, southward to New Jersey and Indiana in eastern section, southeastern Alaska, southward to western Montana and Washington in western section; also in Europe, Siberia, Japan and New Zealand.

The alternate stages were established by Plowright (Zeits. Pflanzenkr. **1:** 130. 1891), who made reciprocal sowings in 1890 with spores from *Betula alba* and *Larix europaea*. The experiments were repeated by Klebahn (Zeits. Pflanzenkr. **9:** 17. 1899; Jahrb. Wiss. Bot. **34:** 387. 1900).

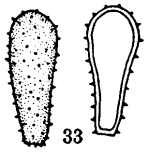
2. MELAMPSORIDIUM ALNI. Fig. 33.

(N. A. F. 7: 680, 814.)

Melampsora alni Thüm., Bull. Soc. Nat. Mosc. **53:** 226. 1878.
Melampsoridium alni (Thüm.) Diet., in E. & P., Nat. Pfl. 1^{1**}: 551. 1900.

Pycnia chiefly hypophyllous, minute. Aecia hypophyllous, cylindric; aeciospores ellipsoid, 15–20 by 19–26 μ, the contents orange colored; wall colorless, 1.5–2.5 μ thick, finely verrucose, with a smooth spot on some spores.

On Pinaceae: **Larix** sp., not yet found in America.


33

Uredia hypophyllous, loosely grouped on yellow spots, dehiscent by apical pore, the peridial cells with inner walls moderately thin, 2–3 μ; urediospores ovate-oblong or oblong-clavate, 9–15 by 25–50 μ; wall colorless, about 1.5 μ thick, sparsely and finely echinulate, without smooth spot. Telia hypophyllous, scattered or grouped, small, purplish or blackish-brown; teliospores oblong, prismatic or clavate, forming a palisade-like layer beneath the epidermis, 8–15 by 30–45 μ, rounded at each end; wall pale cinnamon-brown, 1 μ thick, smooth.

On Betulaceae: **Alnus rhombifolia** Nutt., Calif.—**A. rubra** Bong.(*A. oregana* Nutt.), Calif.

Range: Central to southern California; also in Mexico, Central and South America, eastern Asia, and Japan.

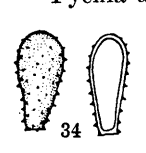
Cultures were made in Japan in 1926, 1927 and 1931 (Jap. Jour. Bot. **6:** 16. 1932), by Hiratsuka, who sowed teliospores from *Alnus maximowiczii, A. hirsuta* and *A. pendula* on three species of *Larix,* and in 1927 aeciospores from *L. kaempferi* on two species of *Alnus*.

3. MELAMPSORIDIUM CARPINI. Fig. 34.

(N. A. F. 7: 680.)

Caeoma carpini Nees, Syst. Pilze 16. 1816.
Uredo carpini Desmaz., Pl. Crypt. 674. 1834.
Melampsora carpini Fckl., Jahrb. Nassau Ver. Nat. **23–24:** 44. 1870.
Melampsoridium carpini (Nees) Diet., in E. & P., Nat. Pfl. 1^{1**}: 551. 1900.

Pycnia and aecia unknown. Uredia hypophyllous, loosely grouped on yellow spots, dehiscent by apical pore, the peridial cells with inner wall moderately thin, 3–4 μ; urediospores ovate-oblong or oblong-clavate, 8–14 by 18–28 μ, the contents yellow; wall colorless, 1–1.5 μ thick, sparsely and finely echinulate, except the apex which is smooth. Telia hypophyllous, scattered, yellow becoming yellowish-brown; teliospores subepidermal, oblong or clavate, 8–16 by 28–50 μ, rounded at each end; wall pale golden-brown, 1 μ thick, smooth.


34

On Corylaceae: **Ostrya virginiana** (Mill.)K.Koch(*Carpinus v.*), N.Y.

Range: Adirondack Mountains in northern New York; also in Europe and Japan.

This species is closely related to the preceding one.

7. CRONARTIUM Fries, 1815.

Heteroecious rusts, whose cycle of development includes pycnia and aecia on the trunk and branches of the coniferous genus *Pinus,* and uredia and telia on various herbaceous and woody dicotyledonous plants.

Pycnia caulicolous, caeomoid, forming blisters beneath the cortical layer of the host, dehiscent by longitudinal slits in the bark, without paraphyses. Aecia caulicolous, erumpent, with peridium sometimes dehiscent at apex but more often by circumscissile or irregular rupture at sides, the aeciospores ellipsoid, with coarsely verrucose walls, except sometimes a smooth spot on one side, the tubercles often deciduous. Uredia hypophyllous or on herbaceous hosts also caulicolous, with delicate peridium, dehiscent at first by central pore, the urediospores borne singly on pedicels, ellipsoid, with echinulate walls. Telia erumpent, often arising out of the uredia, the catenulate, 1-celled teliospores forming a much extended, cylindric or filiform column, horny when dry.

Telial hosts ligneous.	
Belonging to family Myricaceae.	1. *C. comptoniae.*
Belonging to family Fagaceae.	2. *C. quercuum.*
Belonging to family Grossulariaceae.	
Species introduced, aecia on *Pinus* (*Strobus*).	3. *C. ribicola.*
Species native, aecia on *Pinus* (*Caryopitys*).	4. *C. occidentale.*
Telial hosts herbaceous.	
Belonging to family Santalaceae.	5. *C. comandrae.*
Belonging to family Scrophulariaceae.	6. *C. coleosporioides.*
Belonging to family Balsaminaceae.	7. *C. flaccidum.*

The genus is remarkable for the production in many instances of extraordinarily large woody aecial galls, and for the capacity of some species to transmit the rust from one aecial host to another without intervention of an alternate host. It is the only genus of heteroecious rusts in which this mode of propagation is known. The first demonstration of the unpredicted habit of forming secondary aecia (aecidioid uredia) was by Haack (Zeits. Forst- Jagdw. 46: 3. 1914), who sowed aeciospores of *Peridermium pini* from *Pinus sylvestris* on the same species of host, and obtained aecia. The alternate host of this European rust is not known. The work by Haack was confirmed by Klebahn (Flora 111–112: 194. 1918). Another rust on *P. sylvestris,* distinct from the European rust, recently discovered in northern New York and called "Woodgate Rust," now referred to *C. quercuum,* has the same behavior according to cultures by York, but not published. The same habit of forming secondary aecia was detected by Meinecke (Phytop. 6: 225. 1916) in California and fully confirmed (same 10: 279. 1920), for *Cronartium harknessii* (*C. coleosporioides*), and doubtfully so for *C. quercuum.* The secondary aecia, as in autoecious rusts of the genus *Puccinia* with similar habit, are unaccompanied by pycnia. Many problems in this connection are yet to be solved.

Sydow in the third volume of the "Monographia Uredinearum" credits the genus with 22 species known in 1915. Of these only 8 can be included in the genus as here defined, while 5 would now be referred to *Crossopsora* and 9 to *Cionothrix.*

1. CRONARTIUM COMPTONIAE. Fig. 35.

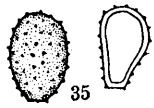
(N. A. F. 7: 121, 691, 814, 820.)

Cronartium comptoniae Arth., Bull. Torrey Club **33:** 29. 1906.
(*Peridermium comptoniae* Orton & Adams, Phytop. **4:** 24. 1914.)

Pycnia caulicolous, subcortical, blister-like. Aecia caulicolous, producing slight fusiform swellings, small, 1–2 mm. across, the peridium rupturing along the sides; aeciospores ellipsoid or obovate, 16–24 by 24–33 μ; wall 2.5–4 μ

thick, coarsely verrucose, except a smooth area at base, often extending up one side.

On Pinaceae: **Pinus banksiana** Lamb.(P. *sylvestris divaricata* Ait., *P. divaricata* Sudw.), Me., Mich., Minn., N.H., N.Y., Wis.—**P. contorta** Dougl. (*P. murrayana* Balf.), Calif., Mass., Mich., N.H., Pa.—**P. jeffreyi** Murr.(*P. contorta jeffreyi* Vasey), Mass., N.Y.—**P. montana** Mill., Conn., N.Y.—**P. montana mughus** Willk., Mass., N.Y., R.I.—**P. nigra** Arnold(*P. austriaca* Höss.), N.J., Pa.—**P. nigra austriaca** Asch.&Graebn., Mich., N.Y., Ohio, Pa., Wis.—**P. ponderosa** Dougl., Calif., Conn., Mass., Mich., N.Y., Ohio, Pa., Wis.—**P. resinosa** Ait., Me., N.H.—**P. rigida** Mill., Conn., Me., Md., Mass., N.J., N.Y., Pa., R.I., Vt.—**P. sylvestris** L., Conn., Me., Mass., Mich., Mo., N.H., N.J., N.Y., Vt.—**P. taeda** L., N.J.—**P. virginiana** Mill.(*P. inops* Ait.), Md., N.J., Pa.


35

Uredia hypophyllous, bullate, small, dehiscent by central pore; urediospores oval or obovate, 16–21 by 23–31 μ; wall colorless, 2.5 μ thick, sparsely and finely echinulate. Telia hypophyllous, the telial columns filiform, 0.4–1 mm. long; teliospores fusiform-oblong, 13–17 by 28–56 μ; wall colorless, uniformly 1–1.5 μ thick, smooth.

On Myricaceae: **Comptonia peregrina** (L.)Coult.(*C. asplenifolia* Gaertn., *Myrica a.* L.), Conn., Me., Mass., Mich., N.H., N.J., N.Y., Pa., N.C., R.I., Vt., Va., Wis.—**Myrica gale** L., Alas., Me., N.H.; B.C., N.S., Ont.

Range: Nova Scotia to Wisconsin, southward to North Carolina and Missouri, and from Alaska to northern California.

Successful cultures were conducted by Clinton (Ann. Rep. Conn. Agric. Exp. Sta. **31–32:** 380. 1908; same **47:** 484. 1924), Spaulding (Phytop. **3:** 62, 308. 1913; same **4:** 409. 1914; same **7:** 49. 1917) and Weir and Hubert (Phytop. **7:** 107. 1917), using aeciospores from different species of *Pinus*.

2. CRONARTIUM QUERCUUM. Fig. 36.

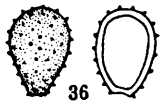
(N. A. F. 7: 122, 691, 820.)

(*Peridermium cerebrum* Peck, Bull. Buffalo Soc. Nat. Sci. **1:** 68. 1873.)
Cronartium asclepiadeum quercium Berk., Grev. **3:** 59. 1874.
(*Peridermium giganteum* Tubeuf, Pflanzenkr. **5:** 429. 1895.)
(*Caeoma conigenum* Pat., Jour. de Bot. **10:** 386. 1896.)
Cronartium quercuum (Berk.) Miyabe; Shirai, Bot. Mag. Tokyo **13:** 74. 1899.
(*Peridermium fusiforme* A. & K., Bull. Torrey Club **33:** 421. 1906.)
(*Caeoma strobilinum* Arth., Bull. Torrey Club **33:** 519. 1906.)
Cronartium cerebrum Hedgc. & Long, Jour. Agr. Res. **2:** 247. 1914.
Cronartium fusiforme Hedgc. & Hunt, Phytop. **8:** 316. 1918.
Cronartium strobilinum Hedgc. & Hahn, Phytop. **12:** 109. 1922.
Cronartium conigenum Hedgc. & Hunt, Phytop. **12:** 116. 1922.

Pycnia caulicolous or conicolous, subcortical, on globoid or fusiform galls, blister-like. Aecia caulicolous, on globoid or fusiform galls, arranged in tortuous lines or cerebroid, or conicolous, fusing the cone into one mass, large, the peridium rupturing along the sides; aeciospores obovoid or ellipsoid, often narrowed below, 15–23 by 25–50 μ; wall colorless, 2–3.5 μ thick, coarsely verrucose, except usually a smooth area at base, extending up one side.

On Pinaceae: **Pinus banksiana** Lamb.(*P. divaricata* Sudw., *P. sylvestris divaricata* Ait.), Conn., Mich., Wis.; Alta., N.B.—**P. caribaea** Morelet(*P. elliottii* Engelm., *P. heterophylla* Sudw.), Fla., Miss.—**P. chihuahuana** Engelm., Ariz.—**P. echinata** Mill.(*P. mitis* Michx.), Ark., Tenn.—**P. palustris** Mill.(*P. australis* Michx.), Fla., Tex.—**P. pungens** Lamb., Tenn.—**P. rigida** Mill., Conn., Ky., N.J., N.Y., Pa.—**P. scopulorum** (Engelm.)Lemm.(*P. ponderosa scopu-*

lorum Engelm.), Neb., S.D.—**P. sylvestris** L., Mich., N.Y., Pa.; Ont.—**P. taeda** L., Ala., Fla., Miss., Va.—**P. virginiana** Mill.(*P. inops* Ait.), Del., D.C., Md., N.C., S.C., Pa., Tenn., Va.


36

Uredia hypophyllous, bullate, small, dehiscent by central pore; urediospores broadly obovoid or ellipsoid, 15–20 by 20–32 μ; wall colorless, 2–3 μ thick, evenly and sharply echinulate. Telia hypophyllous, the telial columns filiform, 2–3 mm. long; teliospores fusiform or fusiform-oblong, 15–20 by 30–40 μ; wall nearly colorless, uniformly 2–3 μ thick, smooth.

ON FAGACEAE: **Pasania densiflora** Oerst., Calif.—**Quercus agrifolia** Née, Calif.—**Q. alba** L., Ala., Ark., Miss., Mo., N.J., N.C., S.C.—**Q. chrysolepis** Liebm., Calif.—**Q. coccinea** Wang., Del., Minn., N.J., Va.—**Q. digitata** (Marsh.)Sudw.(*Q. falcata* Michx.), Del., N.J., N.C.—**Q. dumosa** Nutt., Calif.—**Q. emoryi** Torr., Ariz.—**Q. garryana** Dougl., Calif.—**Q. geminata** Small, Fla.—**Q. grisea** Liebm., Ariz.—**Q. hypoleuca** Engelm., Ariz.—**Q. ilicifolia** Wang., N.J.—**Q. imbricaria marylandica** Sarg.(*Q. tridentata* Engelm.), Ala.—**Q. kelloggii** Newb., Calif.—**Q. macrocarpa** Michx., Iowa, Kans., Mo., Miss., Wis.—**Q. marylandica** Moench., Ala., Ark., Del., Md., Miss., Tenn., Va.—**Q. minor** (Marsh.)Sarg., Ala., Tex.—**Q. nana** (Marsh.)Sarg., N.J.—**Q. nigra** L., Ala., Del.—**Q. prinoides** Willd., Kans.—**Q. prinus** L., Md., Tex., Va.—**Q. reticulata** H.&B., Ariz.—**Q. rubra** L., Va.—**Q. velutina** Lam.(*Q. tinctoria* Michx.), Conn., Md., Minn., Miss., N.J., Pa., Va., W.Va., Wis.—**Q. virginiana** Mill., Fla., Ga., Miss., Tex.—**Q. wislizenii** A.DC., Calif.

Range: Throughout the United States east of the Rocky Mountains, in eastern Alberta and eastern Ontario, and from central California southward to Arizona and southern California; also in Mexico, Central America, Cuba, China and Japan.

The globoid form of Japan was cultured by Shirai (Bot. Mag. Tokyo **13:** 74), in 1899, being the first heteroecious culture made in Japan. Similar cultures were made by Hiratsuka in 1927, 1929 and 1931 (Jap. Jour. Bot. **6:** 25. 1932) with *Pasania sieboldi, Castanea bungeana,* and ten species of *Quercus.* The globoid form of the eastern states was cultured first by Shear (Jour. Myc. **12:** 89. 1906) in 1902 in the open, followed by Arthur in 1907 and 1912 (Jour. Myc. **13:** 194. 1907; Mycol. **4:** 26. 1912), and in 1908–1910 by Hedgcock (Phytop. **1:** 131. 1911). The fusiform form was cultured by Arthur and Kern (Mycol. **6:** 135; same **7:** 79) in 1913, and by Hedgcock and Long (Jour. Agric. Res. **2:** 248) in 1914. A form found on the Pacific Coast, especially on *Pinus radiata,* was attested in cultures by Hedgcock (Phytop. **8:** 316. 1918), using aeciospores from *Pinus radiata* sown on *Quercus velutina,* but later (Phytop. **19:** 228. 1929) the validity of these results was questioned. The status of the various Pacific Coast aecia on *Pinus* remains uncertain, but they are here placed under *C. coleosporioides.* The aecial globoid galls on *Pinus sylvestris* probably belong here. Aeciospores of this form have been shown to infect the same host (York, Science II. **64:** 500. 1926). The same repeating characteristic also has been demonstrated for *Peridermium pini,* a distinct species of Europe also on *P. sylvestris* (Haack, 1914, Klebahn, 1918). All cultures have been made by using aeciospores.

In England, Switzerland and southern France there occurs a species of *Uredo* on oaks (*U. quercus* Brondeau), which differs but little from the uredia on oaks in America and Japan, the urediospores being slightly smaller. As no aecia or telia have been observed in connection with it, and the relationship is uncertain, it is excluded from the present synonymy.

3. CRONARTIUM RIBICOLA. Fig. 37.

(N. A. F. **7:** 122, 692, 814.)

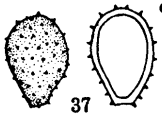
Cronartium ribicola Dietr., Archiv. Nat. Liv. Esth. Kurlands II **1:** 287, hyponym. 1856.

Cronartium ribicola Fischer, in Rab. Fungi Eur. *1595.* 1872; Hedw. **11:** 182. 1872.

(*Peridermium strobi* Kleb., Abh. Nat. Ver. Bremen **10:** 153. 1887.)

Pycnia caulicolous, subcortical, forming small blisters. Aecia caulicolous, on globoid galls, the peridium rupturing along the sides; aeciospores ellipsoid, 18–20 by 22–31 μ; wall colorless, coarsely verrucose, except a smooth area at base, extending up one side, 1–1.5 μ thick, somewhat thicker over smooth area.

On Pinaceae: **Pinus monticola** Dougl.(*Strobus m.* Rydb.), Wash.; B.C.—**P. strobus** L.(*S. s.* Small), Conn., Me., Mass., Mich., Minn., N.H., N.J., N.Y., Pa., R.I., Vt., Wash., Wis.


37

Uredia hypophyllous, scattered or somewhat grouped, bullate, small, dehiscent by central pore; urediospores ellipsoid or obovoid, 14–22 by 19–35 μ, the contents yellow; wall colorless, 2–3 μ thick, sparsely and sharply echinulate. Telia hypophyllous, the telial columns filiform, up to 2 mm. long; teliospores oblong or cylindric, 8–12 by 30–60 μ, rounded or obtuse at both ends; wall nearly colorless, uniformly 2–3 μ thick, smooth.

On Grossulariaceae: **Grossularia cynosbati** (L.)Mill.(*Ribes c., R. gracile* Michx.), Md., N.H., Ohio, Pa.; Ont.—**G. divaricata** (Dougl.)Cov.&Britt.(*R. d.*), Wash.; B.C.—**G. inermis** (Rydb.)Cov.&Britt.(*R. i., R. vallicola* Greene), Ida.—**G. irrigua** (Dougl.)Cov.&Britt., Ida.—**G. missouriensis** (Nutt.)Cov.&Britt.(*R. m., R. gracile* Pursh, not Michx.), Minn.—**G. oxyacanthoides** (L.)Mill.(*R. o.*), Minn.—**G. reclinata** (L.)Mill.(*R. grossularia* L., *R. uva-crispa* L.), Vt.—**G. rotundifolia** (Michx.)Cov.&Britt.(*R. r.*), Md., N.Y., Pa., Va., W.Va.—**G. setosa** (Lindl.)Cov.&Britt.(*R. s.*), Wis.—**Ribes americanum** Mill.(*R. floridum* L'Her.), Me.—**R. bracteosum** Dougl., Ore., Wash.; B.C.—**R. echinatum** Lindl. (*Lymnobotrya e.* Rydb.), Ida., Wash.; B.C.—**R. glandulosum** Weber(*R. prostratum* L'Her.), Conn., Me., N.H.—**R. lacustre** (Pers.)Poir.(*L. l.* Rydb.), N.H.—**R. nigrum** L., Md., Mass., N.Y., Ohio, Pa., R.I., Wash.; B.C., Ont.—**R. odoratum** Wendl.(*R. longiflorum* Nutt., *Chrysobotrya o.* Rydb.), Md., Mass., N.H., N.Y., Vt.—**R. petiolare** Dougl., Ida., Mont., Ore., Wash.—**R. sanguineum** Dougl., Ore.—**R. triste** Pall.(*R. rubrum* Gray, not L.), N.H.—**R. viscosissimum** Pursh, Ida.—**R. vulgare** Lam., Md., N.Y., Wash.

Range: Locally from Maine and Virginia to Minnesota, and from western Montana to Oregon, Washington and British Columbia, sometimes exterminated upon discovery; also in Europe, Asia, and Japan.

Cultures were made first by Klebahn (Ber. Deuts. Bot. Ges. **6:** XLVIII) by using aeciospores in 1888 and also by using teliospores (Zeits. Pflanzenkr. **15:** 86. 1903) in 1903. In 1899 aeciospores were used by Plowright (Gard. Chron. **26:** 94. 1899). Teliospores were used successfully by Tubeuf (Nat. Zeits. Land-Forstw. **15:** 274) in 1914. In America the first to use teliospores successfully was Spaulding (Science II. **35:** 147) in 1910, followed by Clinton (Ann. Rep. Conn. Agric. Exper. Sta. **42:** 434) in 1916–18, and York and Snell (Phytop. **12:** 149. 1922) in 1921. The economic interest connected with the appearance and spread of this rust in America has resulted in much study and a large literature.

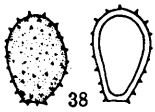
4. CRONARTIUM OCCIDENTALE. Fig. 38.

(N. A. F. 7: 693.)

Cronartium occidentale Hedgc., Bethel & Hunt, Jour. Agr. Res. **14:** 413. 1918.
(*Peridermium occidentale* Hedgc., Bethel & Hunt, Jour. Agr. Res. **14:** 415. 1918.)

Pycnia caulicolous, subcortical, forming minute blisters. Aecia caulicolous, on slightly or not hypertrophied branches, often hidden by the bark; aeciospores obovoid or ellipsoid, 12–28 by 22–38 μ; wall colorless, 1–1.5 μ thick, coarsely verrucose.

On Pinaceae: **Pinus edulis** Engelm.(*Caryopitys e.* Small), Colo.—**P. monophylla** Torr.&Frem.(*C. m.* Rydb.), Ariz., Calif., Nev.


38

Uredia hypophyllous, bullate, small, dehiscent by central pore; urediospores ellipsoid or obovoid, 13–18 by 18–32 μ; wall colorless, 2–3 μ thick, sparsely and sharply echinulate. Telia hypophyllous, the telial columns filiform, up to 4 mm. long; teliospores oblong or cylindric, 9–10 by 27–56 μ, rounded or obtuse at both ends; wall nearly colorless, 0.5–2 μ thick, smooth.

On Grossulariaceae: **Grossularia divaricata** (Dougl.)Cov.&Britt.(*Ribes d.*), Calif.—**G. inermis** (Rydb.)Cov.&Britt.(*R. i., R. vallicola* Greene), Wyo.—**G. leptantha** (Gray)Cov.&Britt.(*R. l.*), Colo., Utah.—**G. velutina** (Greene)Cov.&Britt.(*R. v.*), Calif., Nev.—**Ribes aureum** Pursh(*Chrysobotrya a.* Rydb.), Ariz., Calif., Colo., Ida., Utah, Wash.—**R. gracillimum** Cov.&Britt., Calif.—**R. inebrians** Lindl.(*R. pumilum* Nutt.), Colo., Utah.—**R. odoratum** Wendl.(*R. longiflorum* Nutt., *C. o.* Rydb.), Colo., Kans.

Range: Washington to northwestern Kansas and central Nevada.

This native rust is very much like the preceding introduced species, but the aecial hosts are different. It inhabits only the one- and two-leaved pines. Successful cultures were made in 1917 by Hunt (Jour. Agric. Res. **14:** 418. 1918), and again in 1920 by Clinton (Ann. Rep. Conn. Agric. Exper. Sta. **47:** 484. 1924), both using aeciospores.

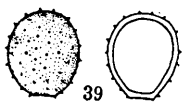
5. CRONARTIUM COMANDRAE. Fig. 39.

(N. A. F. 7: 123, 693, 820.)

Cronartium asclepiadeum thesii Berk., Jour. Bot. **4:** 311. 1845.
(*Peridermium pyriforme* Peck, Bull. Torrey Club **6:** 13. 1875.)
Cronartium comandrae Peck, Bot. Gaz. **4:** 128. 1879.
Cronartium thesii Lagerh., Tromsø Mus. Aarsh. **17:** 94. 1895.
(*Peridermium bethęli* Hedgc. & Long, Phytop. **3:** 251. 1913.)
Cronartium pyriforme Hedgc. & Long, Alternate Stage of *Peridermium pyriforme*, June, 1914.

Pycnia caulicolous, forming minute blister-like swellings. Aecia caulicolous, on branches or trunks, causing no or only slight fusiform swellings, scattered, usually distinct; peridium not much exserted, delicate, evanescent by lateral rupture; aeciospores pyriform, oblong-pyriform, or ovate, 19–24 by 32–66 μ, usually acuminate above, often conspicuously so; wall colorless, 2–3 μ thick, finely verrucose.

On Pinaceae: **Pinus banksiana** Lamb. (*P. sylvestris divaricata* Ait., *P. divaricata* Sudw.), Mich., Wis.; Alta., Sask.—**P. contorta** Dougl.(*P. murrayana* Balf.), Colo., Ida., Wyo.; Alta.—**P. ponderosa** Dougl., Calif., Colo., Mont., Ore., Utah, Wash.; B.C.—**P. pungens** Lamb., Pa.—**P. scopulorum** (Engelm.)Lemm. (*P. ponderosa scopulorum* Engelm.), Colo., S.D., Utah.


39

Uredia hypophyllous and caulicolous, scattered or aggregate, round, small, dehiscent by central pore; urediospores globoid, 20–23 by 22–28 μ; wall nearly colorless, 1.5–2 μ thick, sparsely and minutely echinulate. Telial columns hypophyllous and caulicolous, cylindric, about 1 mm. long; teliospores oblong or cylindric, 12–15 by 32–44 μ; wall nearly colorless, uniformly 2–3 μ thick, smooth.

On Santalaceae: **Buckleya distichophylla** (Nutt.)Torr., Tenn.—**Comandra livida** Richards., Wis.; Man., Queb.—**C. pallida** A.DC., Ariz., Colo.,

Ida., Iowa, Minn., Mo., Mont., N.D., N.M., Ore., S.D., Wash., Wyo., Utah; Alta., B.C., N.W.Terr., Sask.—**C. umbellata** (L.)Nutt., Calif., Del., Ill., Ind., Iowa, Mass., Mich., Miss., N.H., N.J., N.Y., Ohio, Ore., Pa., Wash., Wis.; Ont., Queb.

Range: Quebec to North West Territory and British Columbia, and sparingly southward to northern Mississippi and New Mexico.

The aecia of this species are distinguished readily from those of all other species on pines by the strikingly pointed spores. Cultures establishing the connection of the alternate stages were made by Hedgcock and Long in 1914, by using aeciospores from *Pinus ponderosa* and sowing on *Comandra umbellata*. The data were published in a privately printed, 3-page leaflet, dated June 12, 1914.

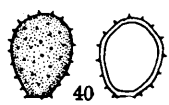
6. CRONARTIUM COLEOSPORIOIDES. Fig. 40.

(N. A. F. 7: 123, 694, 814, 820.)

(*Peridermium harknessii* J. P. Moore, Mo. Micr. Jour. **16:** 164. 1876.)
(*Peridermium filamentosum* Peck, Bot. Gaz. **7:** 56. 1882.)
Uredo coleosporioides D. & H., Erythea **1:** 247. 1893.
(*Peridermium stalactiforme* A. & K., Bull. Torrey Club **33:** 419. 1906.)
Cronartium coleosporioides (D. & H.) Arth., N. Am. Flora **7:** 123. 1907.
Cronartium filamentosum Hedgc., Phytop. **2:** 177. 1912.
(*Peridermium cerebroides* Meinecke, Phytop. **19:** 328. 1918.)
Cronartium harknessii Meinecke, Phytop. **10:** 282. 1920.
Cronartium stalactiforme A. & K., Bull. Torrey Club **49:** 191. 1922.

Pycnia caulicolous, scattered irregularly over large areas, forming minute blister-like swellings. Aecia caulicolous, scattered over large areas, causing no swelling of the host, the peridia cylindric, with filament-like strands extending lengthwise through the spore-mass (*Per. filamentosum*), or causing moderate swelling, the peridia flattened, with strands extending part way into the spore-mass from above and below (*Per. stalactiforme*), or causing large, round or annular swellings, the peridia flattened, with very short or no strands (*Per. harknessii*); aeciospores oblong, obovate-oblong, or ellipsoid, 14–24 by 23–35 μ; wall colorless, 2.5–4 μ thick, coarsely verrucose, some spores showing a smooth area on one side toward the base.

On Pinaceae: **Pinus attenuata** Lemm.(*P. tuberculata* Gordon, not D.Don), Calif.—**P. contorta** Dougl.(*P. murrayana* Balf.), Alas., Calif., Colo., Ida., Mont., Ore., Wash.; B.C.—**P. coulteri** Lamb., Calif.—**P. jeffreyi** Murr.(*P. contorta jeffreyi* Vasey), Calif., Nev.—**P. ponderosa** Dougl., Ariz., Calif., Colo., N.M., Ore., Wash.; B.C.—**P. radiata** D.Don(*P. insignis* Dougl.), Calif.—**P. sabiniana** Dougl., Calif.—**P. scopulorum** (Engelm.)Lemm.(*P. ponderosa scopulorum* Engelm.), Colo., Neb., N.M., Utah.


40

Uredia hypophyllous and caulicolous, minute, round, dehiscent by central pore; urediospores globoid or broadly ellipsoid, 14–22 by 17–27 μ; wall nearly colorless, 1–1.5 μ thick, sparsely and very minutely echinulate. Telial columns hypophyllous, cylindric, short, 0.5–1 mm. long; teliospores oblong or fusiform-oblong, 12–17 by 30–52 μ, obtuse at both ends; wall nearly colorless, uniformly 1 μ thick, smooth.

On Scrophulariaceae: **Cordylanthus rigidus** (Benth.)Jepson(*Adenostegia r.*), Calif.—**C. tenuis** Gray(*A. t.* Greene), Calif.—**Castilleja christo-galli** Rydb., Colo.—**C. confusa** Greene, Colo., N.M.—**C. crispula** Piper, Ore.—**C. douglasii** Benth., Calif.—**C. foliolosa** H.&A., Calif.—**C. integra** Gray, N.M.—**C. latifolia**

H.&A., Calif.—**C. linariaefolia** Benth., Colo., N.M., Utah, Wyo.—**C. miniata** Dougl., Calif., Wash.—**C. pallida** (L.)Kunth, Colo.—**C. sulphurea** Rydb., Colo., N.M., S.D.—**Orthocarpus luteus** Nutt., Colo.—**Pedicularis grayi** Nels. (*P. procera* Gray), N.M.—**P. groenlandica** Retz.(*Elephantella g.* Rydb.), Ida., Wash.—**P. semibarbata** Gray, Calif.—**P. surrecta** Benth., Wash.

Range: The Rocky Mountain region from Alaska to the Mexican boundary, and eastward as far as the western edge of Nebraska; also in Central and South America..

The aecia of this species assume three fairly distinguishable forms, which have been shown by cultures to produce uredia and telia of identical appearance on the same species of *Castilleja*. Hedgcock (Phytop. **2:** 176. 1912) made successful cultures with *P. filamentosum*. Meinecke (Phytop. **3:** 167. 1913), Hedgcock and Long (same p. 250) and Weir and Hubert (Phytop. **7:** 106. 1917) used aecia of *P. stalactiforme*. Cultures in the open of *P. harknessii* were made by Bethel in 1909-13 (Phytop. **8:** 317. 1918), and in 1915 in the greenhouse by Weir and Hubert (Jour. Agric. Res. **5:** 782. 1915), and again in 1916 (Phytop. **7:** 107. 1917). The three forms may be treated as distinct species (Arthur, Bull. Torrey Club **49:** 194. 1922; N. Am. Flora **7:** 695. 1925), or as varieties under the names: *C. coleosporioides filamentosum, C. c. stalactiforme,* and *C. c. harknessii.*

The form on *Pinus radiata* and *P. attenuata,* sometimes referred to *C. quercuum,* has been shown by Meinecke (Phytop. **6:** 232. 1916; same **10:** 286. 1920; same **19:** 331. 1929) in many cultures to form repeating aecia on *P. radiata.* Similar cultures also were made by Meinecke (same **19:** 29. 1929) with aecia from *Pinus contorta* and *P. sabiniana* sown on *P. contorta, P. radiata, P. jeffreyi* and *P. coulteri.*

7. **Cronartium flaccidum** (A. & S.) Wint., a European species with aecia on *Pinus sylvestris* and uredia and telia on *Asclepias, Peonia, Pedicularis, Ruellia, Tropaeolum, Verbena, Vincetoxicum,* and many other genera, has been reported once from America. Uredia were found on the garden balsam, **Impatiens balsamea** L., at the Experimental Farm, Charlottetown, Prince Edward Island, in October, 1925.

8. CHRYSOMYXA Unger, 1840.

Heteroecious rusts whose cycle of development includes pycnia and aecia on the leaves and cones of the coniferous genus *Picea,* and uredia and telia on the leaves of various dicotyledonous herbs and shrubs. All sori subepidermal.

Pycnia when present amphigenous or episquamous, paraphysate. Aecia when present hypophyllous, erumpent, the peridium usually rupturing above, the aeciospores ellipsoid or globoid, with verrucose walls. Uredia when present round, pulverulent, with an inconspicuous peridium, the yellow urediospores catenulate, largely ellipsoid, with verrucose or tuberculate walls. Telia erumpent, flattened, waxy, the teliospores catenulate, one-celled, with smooth, colorless walls.

Telial host belonging to family Empetraceae.	1. *C. empetri.*
Telial host belonging to family Ilicaceae.	2. *C. ilicina.*
Telial host belonging to family Pyrolaceae.	3. *C. pyrolae.*
	C. weirii(m).
Telial host belonging to family Vacciniaceae.	4. *C. chiogenis.*
Telial host belonging to family Ericaceae.	
Uredia and telia epiphyllous.	5. *C. ledicola.*
Uredia and telia hypophyllous.	
Urediospores ellipsoid.	

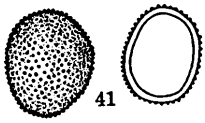
Telia inconspicuous; teliospores 11–16 μ broad. 6. *C. cassandrae.*
Telia noticeable; teliospores 10–15 μ broad. 7. *C. ledi.*
Telia large; teliospores 16–20 μ broad. 8. *C. roanensis.*
Urediospores lanceolate. 9. *C. piperiana.*
Uredia wanting, telia hypophyllous. 10. *C. arctostaphyli*(m).

The name *Chrysomyxa* was founded on the European microcyclic species *C. abietis.* Later the genus *Melampsoropsis* was established to segregate macrocyclic species. As the two forms are here brought together under one genus, the older name is employed. The combined genera contain 16 species in Sydows' "Monographia Uredinearum," of which at least 4 are microcyclic.

1. CHRYSOMYXA EMPETRI. Fig. 41.

(N. A. F. 7: 118, 688, 819.)

Uredo empetri Pers.; DC., Fl. Fr. **6:** 87. 1815.
Thecopsora empetri Karst., Bidr. Finl. Nat. Folk **31:** 143. 1879.
Chrysomyxa empetri (Pers.) Schroet., Krypt. Fl. Schles. **3**[1]**:** 372. 1887.
Melampsoropsis empetri Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.


41

Pycnia and aecia unknown. Uredia epiphyllous, round or oblong, at first covered by the bladdery epidermis, finally naked and pulverulent, orange-yellow when fresh; urediospores obovoid or ellipsoid, 18–28 by 26–37 μ; wall colorless, 2–3 μ thick, verrucose. Telia not available for description.

On Empetraceae: **Empetrum nigrum** L., Me., N.H., N.Y.; B.C., Queb.; Greenl. **Range:** Greenland southward to Maine along the coast, on the higher mountains in New England, and in British Columbia; also in Europe and Japan.

The uredia are frequently abundant, and due to their bright color are readily seen. The telia are rare, and have only been recorded from Greenland and northern Norway, but no description has been published.

2. CHRYSOMYXA ILICINA. Fig. 42.

(N. A. F. 7: 688.)

Aecidium ilicinum E. & E., Bull. Torrey Club **24:** 284. 1897.
Melampsoropsis ilicina Arth., N. Am. Flora **7:** 688. 1925.
Chrysomyxa ilicina (E. & E.) n. comb.


42

Pycnia and aecia unknown. Uredia hypophyllous, scattered, round or irregular, golden- or cinnamon-brown, pulverulent, ruptured epidermis prominent; urediospores broadly ellipsoid, 19–21 by 23–29 μ; wall colorless, 1–1.5 μ thick, finely and closely verrucose. Telia hypophyllous; teliospores arising in the uredia or separately, irregularly ellipsoid or oblong, 13–23 by 23–32 μ, in a series 112–160 μ long; wall colorless, about 1 μ thick, smooth.

On Ilicaceae: **Ilex opaca** Ait., W.Va. **Range:** Central West Virginia.

All collections of this species known until recently were made in 1896 in the vicinity of Nuttallsburg, in central West Virginia. The original assignment to the genus *Aecidium* was based on gross appearance. The description, especially of the telia, and the present generic assignment are somewhat uncertain. Further collections and study are needed.

3. CHRYSOMYXA PYROLAE. Fig. 43.

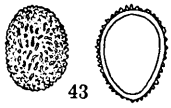
(N. A. F. 7: 118, 688, 814, 819.)

Aecidium ? pyrolae DC., Fl. Fr. **6:** 99. 1815.
Caeoma (*Aecidium*) *pyrolatum* Schw., Trans. Am. Phil. Soc. II. **4:** 294. 1832.
(*Aecidium conorum-piceae* Reess, Abh. Nat. Ges. Halle **11:** 102. 1869.)
Uredo pirolatum Körn., Hedw. **16:** 28. 1877.
(*Peridermium conorum* Thüm., Mitth. Forstl. Vers. Oest. **2:** 313. 1880.)
Chrysomyxa pyrolae (DC.) Rostr., Bot. Centr. **5:** 126. 1881.
Chrysomyxa pirolatum Wint., Rab., Krypt. Fl. **1:** 250. 1881.

(*Peridermium conorum-piceae* A. & K., Bull. Torrey Club **33:** 431. 1906.)
Melampsoropsis pyrolae Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.
Chrysomyxa ramischiae Lagerh., Sv. Bot. Tidskr. **3:** 26. 1909.

Pycnia episquamous, numerous, forming continuous layers 600–900 μ broad, inconspicuous, not noticeably elevated above the surface. Aecia chiefly episquamous, bullate, large, crowded, with convex and largely evanescent peridium, pulverulent; aeciospores broadly ellipsoid or obovoid, variable in size, 20–27 by 25–40 μ; wall colorless, 4–5 μ thick including the tubercles, very coarsely and closely tuberculate, tesselate with depressed warts 3–4 μ across.

On Pinaceae: **Picea canadensis** (Mill.)B.S.P.(*P. alba* Link, *Abies c., P. glauca* Voss.), Me.; Man.—**P. engelmanni** (Parry)Engelm., Colo., Mont., Ore. —**P. excelsa** (Lam.)Link(*P. abies* Karst., *P. vulgaris* Link), Mass.—**P. mariana** (Mill.)B.S.P.(*P. nigra* Ait.), Me., N.H.—**P. rubens** Sarg.(*P. rubra* Dietr.), Me., N.Y., Vt.; N.S.


43

Uredia hypophyllous, systemic, round, evenly distributed, yellowish-red, pulverulent; urediospores ellipsoid or obovate, 16–23 by 20–30 μ; wall colorless, 1.5–2 μ thick, prominently verrucose. Telia hypophyllous, prominent, flat, waxy, yellowish-red turning to blood-red; teliospores irregularly oblong or ellipsoid, 7–10 by 14–26 μ, in a series 100–130 μ long; wall colorless, uniformly 1 μ thick or less, smooth.

On Pyrolaceae: **Moneses reticulata** Nutt., Alas.—**M. uniflora** (L.)Gray (*Pyrola u., M. grandiflora* S.F.Gray), Alas., Colo., Me., Mont., N.M., Wash.; Alta., Queb.—**Pyrola americana** Sweet(*P. rotundifolia* Michx.), Mass., N.H., N.Y.; N.S.—**P. asarifolia** Michx., Colo., Ida., Mont., N.M., Pa.; B.C., Sask.—**P. bracteata** Hook., Alas.; B.C.—**P. chlorantha** Sw., Colo., Mont., N.Y., Wyo.; Alta.—**P. elliptica** Nutt., Conn., Iowa, Me., Minn., N.H., N.Y., Ohio, Pa.; Alta.—**P. grandifolia** Radius (*P. groenlandica* Hornem.), Greenl.—**P. minor** L. (*Erxlebenia m.* Rydb.), Wyo.; Greenl.—**P. picta** Smith, N.M.—**P. secunda** L.(*Ramischia s.* Garcke), Alas., Colo., Mich., Mont., N.M., N.Y., Ore., Pa., Utah; Newf.; Queb.—**P. uliginosa** T.&G., Alas., Calif., Colo., Conn., D.C., Md., Mass., Mont., N.H., N.J., N.Y., Utah, Wis.; N.S.

Range: Greenland, southern Canada, and the northern half of the United States southward in the western mountains to New Mexico; also in Europe, Siberia and Japan.

The systemic mycelium produces, over the under surface of coriaceous leaves, large and closely associated uredia, but on thinner leaves, which appear later in the season, as in *Pyrola secunda, Moneses uniflora* and *M. reticulata,* the sori are farther apart and have somewhat smaller urediospores, being a form which has received the name of *Chrysomyxa ramischiae* (*l. c.*), although this form was described and named by DeCandolle in 1815 (*l. c.*) and by him doubtfully referred to *Aecidium.* It has since been generally accepted as the type of the inclusive species.

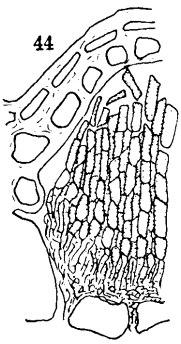
The alternate host on *Picea excelsa* was predicted by Rostrup (Bot. Centr. **5:** 127. 1881), but cultures to demonstrate the connection were not made until 1911, when Fraser (Mycol. **4:** 183. 1912) sowed teliospores on the cones of *Picea mariana* in Nova Scotia, and again in 1924 (Mycol. **17:** 84. 1925) on *P. canadensis* in Saskatchewan.

Chrysomyxa weirii. Fig. 44.

(N. A. F. 7: 690.)

Chrysomyxa weirii Jacks., Phytop. **7:** 353. 1917.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia foliicolous, prominent, dehiscent by longitudinal slit, waxy, dull-orange or


44

orange-brown; teliospores oblong or fusiform-oblong, 5–8 by 16–28 μ, truncate or obliquely attenuate at both ends, readily falling apart; wall as in *Chrysomyxa pyrolae.*

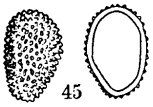
On Pinaceae: **Picea engelmanni** (Parry)Engelm., Ida., Mont., Ore.; B.C.—**P. rubens** Sarg.(*P. rubra* Dietr.), Tenn., W.Va. **Range:** Western Montana to British Columbia and northern Oregon and in mountains of Tennessee and West Virginia.

The narrow teliospores, and also the distribution, ally this rust closely with the macrocyclic species, *Chrysomyxa pyrolae.* The pulverulent telia simulate an aecial character.

4. CHRYSOMYXA CHIOGENIS. Fig. 45.

(N. A. F. 7: 121, 820.)

Chrysomyxa chiogenis Diet., Bot. Gaz. **19:** 303. 1894.
Melampsoropsis chiogenis Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.


45

Pycnia and aecia unknown. Uredia hypophyllous, flat, honey-yellow; urediospores oblong or linear-oblong, 14–21 by 22–40 μ; wall colorless, 2–3 μ thick, coarsely verrucose. Telia hypophyllous, small, at first orange-yellow; teliospores broadly oblong or squarish, 7–10 by 13–16 μ, in a series 50–80 μ long; wall colorless, uniformly 1 μ thick, smooth.

On Vacciniaceae: **Chiogenes hispidula** (L.)T.&G.(*C. serpyllifolia* Salisb.), N.Y., Wis.; Newf. **Range:** Newfoundland, and in northern New York and Wisconsin.

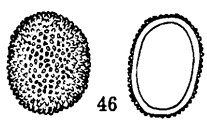
5. CHRYSOMYXA LEDICOLA. Fig. 46.

(N. A. F. 7: 119, 689, 820.)

Uredo ledicola Peck, Ann. Rep. N. Y. State Mus. **25:** 90. 1873.
(*Peridermium decolorans* Peck, Ann. Rep. N. Y. State Mus. **27:** 104. 1875.)
Chrysomyxa ledicola (Peck) Lagerh., Tromsø Mus. Aarsh. **16:** 119. 1893.
Melampsoropsis ledicola Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.

Pycnia amphigenous, punctiform, prominent. Aecia hypophyllous, with compressed, fragile peridium, the cells abutted or slightly overlapping; aeciospores broadly ellipsoid or globoid, very large, 22–40 by 27–55 μ; wall colorless, 3–6 μ thick, coarsely verrucose.

On Pinaceae: **Picea canadensis** (Mill.)B.S.P.(*P. alba* Link, *Abies c., P. glauca* Voss.), Alas.; Alta., N.B., N.S., Queb., Sask.—**P. engelmanni** (Parry) Engelm., Alta.—**P. mariana** (Mill.)B.S.P.(*P. nigra* Ait.), Me., N.H., N.Y., Wis.; Alta., Man., N.S., Queb.; Newf.—**P. pungens** Engelm., Me.; Ont.—**P. rubens** Sarg.(*P. rubra* Dietr.), N.H., N.Y.; N.S., Pr. Edw. Id.—**P. sitchensis** (Bong.)Carr, Alas., Wash.


46

Uredia epiphyllous, on reddish-brown spots, small, pale-yellowish or reddish; urediospores broadly ellipsoid or globoid, 18–29 by 26–36 μ; wall colorless, 2.5–3 μ thick, closely verrucose. Telia epiphyllous, flat, small, at first blood-red; teliospores oblong or cuboid, 10–14 by 13–18 μ, in a series 65–80 μ long; wall colorless, uniformly 1 μ thick, smooth.

On Ericaceae: **Ledum decumbens** (Ait.)Lodd.(*L. palustre angustifolium* Hook.), Alas.; Labr.—**L. groenlandicum** Oeder(*L. latifolium* Ait.), Alas., Me., N.H., N.Y., Wash., Wis.; Alta., B.C., Man., N.S., Sask., Yukon; Newf.; Greenl.

Range: Northern border of the United States and far northward into Canada, along the Atlantic coast to Greenland, and in Alaska; also in Japan.

Successful cultures were made in 1910 by Fraser (Mycol. **3:** 70. 1911), and again in 1911 (same **4:** 177. 1912) with teliospores from *Ledum groenlandicum* sown on *Picea canadensis*.

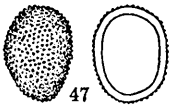
6. CHRYSOMYXA CASSANDRAE. Fig. 47.

(N. A. F. 7: 119, 689, 820.)

Uredo cassandrae P. & C.; Peck, Ann. Rep. N. Y. State Mus. **30:** 54. 1879.
Chrysomyxa cassandrae (P. & C.) Tranz., Trudi S. Petersb. Obshch. Est. Otd. Bot. **23:** 28. 1893.
(*Peridermium consimile* A. & K., Bull. Torrey Club **33:** 427. 1906.)
Melampsoropsis cassandrae Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.

Pycnia amphigenous, punctiform, prominent. Aecia chiefly hypophyllous, with compressed, delicate peridium, the cells abutted or slightly overlapping; aeciospores broadly ellipsoid or globoid, 16–30 by 24–35 μ; wall colorless, 1.5–2 μ thick, finely verrucose.

On Pinaceae: **Picea mariana** (Mill.)B.S.P.(*P. nigra* Ait.), Conn., Me., Mich., Minn., N.Y., Vt., Wis.; N.S., Ont.—**P. pungens** Engelm., N.H.; Ont.—**P. rubens** Sarg.(*P. rubra* Dietr.), Mich., N.Y.; Ont.


47

Uredia hypophyllous, small; urediospores broadly ellipsoid, 15–18 by 19–32 μ; wall colorless, 1–2 μ thick, closely verrucose. Telia hypophyllous, very small and inconspicuous; teliospores oblong, 11–16 μ broad, in a series 60–70 μ long; wall colorless, uniformly 0.5 μ thick, smooth.

On Ericaceae: **Chamaedaphne calyculata** (L.)Moench.(*Cassandra c.* D.Don), Conn., Me., Mich., N.J., N.Y., Pa., Wis.; Man., N.S., Ont.

Range: Nova Scotia to Manitoba and Minnesota, southward to Pennsylvania; also in northern Europe, Siberia and Japan.

Cultures were made in 1908 by Clinton (Ann. Rep. Conn. Agric. Exp. Sta. **31–32:** 387. 1908) with aeciospores from *Picea nigra*, and again in 1919 (same **47:** 495. 1924), using teliospores, and also by Fraser (Mycol. **3:** 68. 1911) in 1909, and again in 1911 (Mycol. **4:** 178. 1912), using teliospores in both instances.

7. CHRYSOMYXA LEDI. Fig. 48.

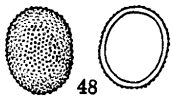
(N. A. F. 7: 119, 690, 814, 820.)

(*Aecidium abietinum* A. & S., Consp. Fung. 120. 1805.)
Uredo ledi A. & S., Consp. Fung. 125. 1805.
Chrysomyxa ledi (A. & S.) de Bary, Bot. Zeit. **37:** 809. 1879.
(*Peridermium abietinum* Thüm., Mitth. Forstl. Vers. Oest. **2:** 320. 1880.)
Melampsoropsis ledi Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.
Melampsoropsis abietina Arth., N. Am. Flora **7:** 119. 1907.

Pycnia amphigenous, punctiform, conspicuous. Aecia hypophyllous, flattened at sides, bullate, sometimes confluent, the peridium firm, with cells abutted (not overlapping); aeciospores broadly ellipsoid, 15–23 by 20–34 μ; wall colorless, 1.5–2.5 μ thick, moderately verrucose.

On Pinaceae; **Picea mariana** (Mill.)B.S.P.(*P. nigra* Ait.), N.H.; Sask.—**P. rubens** Sarg.(*P. rubra* Dietr.), N.S.

Uredia hypophyllous, pustular, scattered or grouped and coalescent, yellowish-red; urediospores broadly ellipsoid or nearly globoid, 14–22 by 20–30 μ; wall colorless, 1.5–2.5 μ thick, closely verrucose. Telia hypophyllous, on discolored spots, small, flat, at first blood-red; teliospores oblong or cuboid, 10–15 by 13–20 μ, in a series 70–90 μ long, separating easily; wall colorless, uniformly 1 μ thick or less, smooth.


48

On Ericaceae: **Ledum glandulosum** Nutt., Calif., Ida., Mont., Nev., Utah, Wyo.—**L. groenlandicum** Oeder (*L. latifolium* Ait.), Conn., Mich., N.H., N.Y., Wis.; B.C., N.S., Ont., Sask.

Range: Nova Scotia to British Columbia, southward to Connecticut and central California; also in Europe, Siberia and Japan.

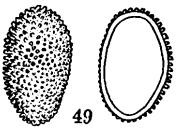
The first cultures were made by de Bary (Bot. Zeit. **37:** 802. 1879), using teliospores, and the results later confirmed by Rostrup and Klebahn. American cultures, using teliospores, were made by Fraser (Mycol. **3:** 69. 1911) in 1909 and again (same **4:** 178. 1912) in 1911, and Arthur (Mycol. **4:** 26. 1912) in 1910.

8. CHRYSOMYXA ROANENSIS. Fig. 49.

(N. A. F. 7: 690.)

Melampsoropsis roanensis Arth., Bull. Torrey Club **49:** 190. 1922.
Chrysomyxa roanensis n. comb.

Pycnia and aecia unknown. Uredia hypophyllous, in crowded groups on discolored spots, prominent, early dehiscent by a medial or lateral slit, forming a border or a cap-like covering of epidermis, pulverulent; urediospores ellipsoid, 20–26 by 32–40 μ; wall colorless, 1.5–2.5 μ thick, finely verrucose on one side, grading to coarsely verrucose on opposite side with cylindric tubercles 2 μ long. Telia hypophyllous, in groups on reddish spots, elevated, prominent, waxy, orange-red, tardily naked; teliospores cuboid, 16–20 μ broad, almost or quite as long, in a series 65–100 μ long; wall colorless, uniformly 1 μ thick, smooth.


49

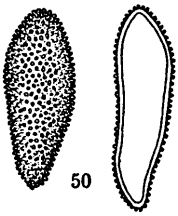
On Ericaceae: **Rhododendron catawbiense** Michx., Tenn.—**R. punctatum** Andr., Tenn. **Range:** Tennessee, on mountain summits above 1800 meters.

9. CHRYSOMYXA PIPERIANA. Fig. 50.

(N. A. F. 7: 120, 690, 820.)

Melampsoropsis piperiana Arth., N. Am. Flora **7:** 120. 1907.
Chrysomyxa piperiana (Arth.) Sacc. & Trott.; Sacc., Syll. Fung. **21:** 716. 1912.
Caeoma piperianum Sacc. & Trott.; Sacc., Syll. Fung. **21:** 787. 1912.

Pycnia and aecia unknown. Uredia hypophyllous, small, waxy, becoming somewhat pulverulent; urediospores oblong or lanceolate, 16–26 by 40–65 μ, narrowed toward each end and obtuse or pointed; wall colorless, 1.5–2 μ thick, closely and coarsely verrucose. Telia unknown.


50

On Ericaceae: **Rhododendron californicum** Hook., Ore., Wash. **Range:** Coastal region of northwestern United States.

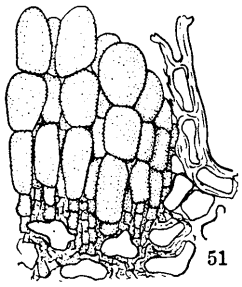
This species is assigned to the genus *Chrysomyxa*, although no telia are known, largely because of the host and the catenulate urediospores, but the long and pointed spores do not accord well with the characters found in other species of the genus.

10. CHRYSOMYXA ARCTOSTAPHYLI. Fig. 51.

(N. A. F. 7: 120, 691, 814, 820.)

Chrysomyxa arctostaphyli Diet., Bot. Gaz. **19:** 303. 1894.
Melampsoropsis arctostaphyli Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, crowded in orbicular groups on reddish-brown spots, soon naked, flat, large, waxy; teliospores oblong, 13–17 by 23–50 μ, rounded at both ends, in a series 100–170 μ long; wall colorless, uniformly 1–1.5 μ thick, smooth.



51

On Ericaceae: **Arctostaphylos uva-ursi** (L.)Spreng., Alas., Colo., Mont., Utah, Wis.; Alta., B.C., Sask., Yukon. **Range:** Southern Yukon, southeastward to northern Wisconsin and central Utah.

Although this rust is clearly a microcyclic form allied to some macrocyclic species, yet it occurs on an ericaceous host, which is not known to harbor any macrocyclic species of the genus. It is furthermore unique in being on a species of host belonging to the telial group of the macrocyclic species, and not on *Picea* which bears the aecial stages. It is one of the few exceptions to the Tranzschel law, that heteroecious species have their corresponding microcyclic form upon the aecial host.

9. COLEOSPORIUM Lév., 1847.

Heteroecious rusts, whose cycle of development includes pycnia and aecia on the leaves of the coniferous genus *Pinus,* and uredia and telia on herbaceous dicotyledonous plants in temperate regions, especially on the Carduaceae, and in the tropics also on monocotyledonous and woody dicotyledonous plants.

Pycnia subepidermal or subcortical, flattish, linear, dehiscent by a slit, with paraphyses. Aecia when present foliicolous, erumpent, with peridium prominent and often tongue-shape, the aeciospores ellipsoid or globoid, with verrucose walls. Uredia when present erumpent, pulverulent, without peridia, the globoid or oblong urediospores catenulate, with verrucose walls. Telia indehiscent, except through weathering, waxy, becoming gelatinous upon germination, the teliospores sessile or obscurely catenulate, one-celled (by early division of the contents appearing four-celled), with smooth, colorless walls that become greatly thickened and gelatinous above.

Host belonging to family Grossulariaceae.	1. *C. jonesii.*
Host belonging to family Primulaceae.	6. *C. campanulae.*
Host belonging to family Oleaceae.	2. *C. minutum.*
Host belonging to family Apocynaceae.	
Urediospore-wall thin, 1 μ.	3. *C. apocynaceum.*
Urediospore-wall thicker, 1.5–2 μ.	*. *C. domingense.*
Host belonging to family Convolvulaceae.	4. *C. ipomoeae.*
Host belonging to family Caprifoliaceae.	5. *C. viburni.*
Host belonging to family Campanulaceae.	6. *C. campanulae.*
Host belonging to family Carduaceae.	
Of the tribe Veronieae.	
Urediospore-wall thin, 1–2 μ, or thicker above.	7. *C. vernoniae.*
Urediospore-wall evenly thick, 1.5–2.5 μ.	8. *C. elephantopodis.*
Of the tribe Eupatorieae.	
Urediospores small, 20–28 μ long.	9. *C. aridum.*
Urediospores large, 24–35 μ long.	10. *C. laciniariae.*
Of the tribe Astereae.	
Urediospores ellipsoid; strongly verrucose.	11. *C. solidaginis.*
Urediospores oblong; finely verrucose.	12. *C. delicatulum.*

Of the tribe Helenieae.	11. *C. solidaginis.*
Of the tribe Inuleae.	13. *C. adenocaulonis.*
Of the tribe Heliantheae.	
Urediospores large, 18–29 μ wide.	
Urediospore-wall thicker on one side.	14. *C. madiae.*
Urediospore wall evenly thin, 1 μ.	15. *C. inconspicuum.* *C. pinicola* (m).
Urediospores small, 14–21 μ wide.	
Teliospores narrowed at ends, apical outlines distinct.	
Urediospore-wall finely verrucose.	16. *C. helianthi.*
Urediospore-wall tuberculate-verrucose.	*. *C. viguierae.*
Teliospores cylindric, apical outlines indistinct.	17. *C. terebinthinaceae.*
Of the tribe Senecioneae.	
Urediospores 25–33 μ long.	18. *C. occidentale.*
Urediospores 20–27 μ long.	19. *C. senecionis.*
Host belonging to family Cichoriaceae.	20. *C. sonchi-arvensis.*

The genus has a wide geographic distribution, in warmer as well as in temperate regions. The species show great variability, and often can not be distinguished with certainty by morphologic characters, reliance being chiefly on the hosts. In some instances it is doubtful if the species would not better be considered varieties or form species. Neither the aecia nor the telia as a rule supply as dependable diagnostic characters as the uredia. When more intensive studies are made, it will be necessary to give combined attention to cultures, morphologic characters and hosts, and to weave the results into the conception of individual species. Besides the species enumerated above there are 34 species described in Sydows' "Monographia Uredinearum."

1. COLEOSPORIUM JONESII. Fig. 52.

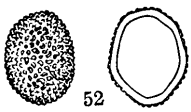
(N. A. F. 7: 86, 650, 814.)

Uredo ribicola C. & E., Grev. **6:** 86. 1878. Not *U. ribicola* Lasch, 1842.
Uredo jonesii Peck, Bull. Torrey Club **12:** 36. 1885.
Coleosporium ribicola Arth., N. Am. Flora **7:** 86. 1907.
(*Peridermium ribicola* Long, Mycol. **8:** 310. 1916.)
Coleosporium jonesii (Peck) n. comb.

Pycnia amphigenous, subcortical. Aecia amphigenous, with a convex, fragile peridium; aeciospores elliptic-oblong, oval or obovate, 20–28 by 30–43 μ; wall colorless, 2–3 μ thick, coarsely verrucose.

On Pinaceae: **Pinus edulis** Engelm.(*Caryopitys e.* Small), Ariz., Colo., N.M.

Uredia hypophyllous, on conspicuous yellow spots, orange-yellow when fresh, becoming pulverulent; urediospores broadly ellipsoid or globoid, 20–27 by 26–30 μ; wall colorless, 3–5 μ thick, closely and coarsely verrucose. Telia hypophyllous, resembling the uredia, small, orange-yellow; teliospores cylindric, 17–22 by 48–60 μ, rounded or acute at both ends; wall colorless, thin at sides, swelling 15–25 μ above, smooth.


52

On Grossulariaceae: **Grossularia cynosbati** (L.)Mill.(*Ribes c., R. gracile* Michx.), Minn., Wis.—**G. inermis** (Rydb.)Cov.&Britt.(*R. i., R. vallicola* Greene), Calif., Colo., Mont., N.M., Wyo.—**G. irrigua** (Dougl.)Cov.&Britt., Wyo.—**G. leptantha** (Gray)Cov.&Britt.(*R. l.*), Colo., N.M.—**G. pinetorum** (Greene)Cov.&Britt.(*R. p.*), N.M.—**G. reclinata** (L.)Mill.(*R. grossularia* L., *R. uva-crispa* L.), Colo., Wis.—**G. setosa** (Lindl.)Cov.&Britt.(*R. s.*), N.M., S.D., Utah, Wyo.—**Ribes americanum** Mill.(*R. floridum* L'Her.), Colo.—**R. aureum** Pursh(*Chrysobotrya a.* Rydb.), Colo., Minn., Mont., N.M., S.D., Utah, Wyo.—**R. coloradense** Cov., Utah.—**R. echinatum** Lindl.(*Lymnobotrya e.* Rydb.), Mont.—**R. inebrians** Lindl.(*R. pumilum* Nutt.), Ariz., Colo., Ida., Mont., Neb.,

N.M., S.D., Utah, Wyo.—**R. montigenum** McCl., Colo., N.M.—**R. nevadense** Kellogg, Calif.—**R. odoratum** Wendl.(*R. longiflorum* Nutt., *Chrysobotrya o.* Rydb.), Ariz., Colo., N.M.—**R. viscosissimum** Pursh, Utah.—**R. wolfii** Rothr., Colo., N.M.

Range: Northern Wisconsin to southern Montana and central California, southward to New Mexico and Arizona.

The first cultures to establish the connection on alternate hosts were made by Long (Mycol. **8:** 309. 1916), using aeciospores. The results were verified by Hedgcock and Hunt in 1916, and by Hunt in 1917 (Phytop. **8:** 323. 1918).

2. COLEOSPORIUM MINUTUM. Fig. 53.

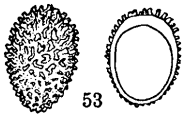
(N. A. F. 7: 651.)

(*Peridermium minutum* Hedgc. & Hunt, Mycol. **9:** 242. 1917.)
Coleosporium minutum Hedgc. & Hunt, Mycol. **12:** 187. 1920.

Pycnia epiphyllous, few or wanting. Aecia chiefly epiphyllous, low and inconspicuous, the peridium delicate, flattened laterally, recurved when mature; aeciospores ovoid, ellipsoid, or oblong, 14–18 by 26–38 μ; wall colorless, 2–4 μ thick, coarsely verrucose.

On Pinaceae: **Pinus glabra** Walt., Fla.—**P. taeda** L., Fla.

Uredia hypophyllous, small, on slightly discolored spots, orange-yellow when fresh; urediospores globoid or ellipsoid, 15–23 by 18–31 μ; wall colorless, 1–1.5 μ thick at sides, 2–8 μ above, coarsely verrucose with conic tubercles. Telia hypophyllous, small, reddish; teliospores cylindric or somewhat clavate, 18–32 by 30–70 μ, rounded or obtuse above; wall colorless, thin at sides, swelling 20–26 μ above, smooth.


53

On Oleaceae: **Forestiera ligustrina** Poir.(*Adelia l.* Michx.), Fla.

Range: Central Florida.

The alternate stage of the rust was demonstrated by Hedgcock and Hunt (Mycol. **12:** 187. 1920) in 1919, with sowings of aeciospores. All recorded collections of the rust so far have been made by Hedgcock and Hunt between 1915 and 1919.

3. COLEOSPORIUM APOCYNACEUM. Fig. 54.

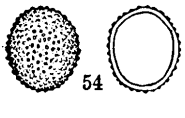
(N. A. F. 7: 87, 651, 815.)

Coleosporium apocynaceum Cooke, Hedw. **17:** 38. 1878.
Uredo amsoniae Cooke, Grev. **19:** 15. 1890.
(*Peridermium apocynaceum* Hedgc. & Hunt, Mycol. **12:** 183. 1920.)

Pycnia amphigenous, conspicuous. Aecia chiefly hypophyllous, the peridium fragile, flattened laterally, reverted when mature; aeciospores ovoid or ellipsoid, 16–23 by 22–42 μ; wall colorless, 3–6 μ thick, coarsely verrucose.

On Pinaceae: **Pinus caribaea** Morelet(*P. elliottii* Engelm., *P. heterophylla* Sudw.), Fla.—**P. palustris** Mill.(*P. australis* Michx.), Fla., Ga.—**P. taeda** L., Fla.

Uredia hypophyllous, small, orange-yellow when fresh; urediospores broadly ellipsoid or globoid, 19–23 by 22–30 μ; wall colorless, 1 μ thick, finely verrucose. Telia hypophyllous, widely scattered, orange-yellow when fresh; teliospores oblong or clavate-oblong, 13–19 by 31–51 μ, rounded at both ends; wall colorless, thin at sides, swelling 25–35 μ above, smooth.


54

On Apocynaceae: **Amsonia tabernaemontana** Walt.(*A. amsonia* Britt.), Ala., Ga., S.C.—**A. ciliata** Walt.(*A. angustifolia* Walt.), Fla., Ga., S.C.

Range: Southeastern United States.

Cultures establishing the connection of the alternate hosts were made in 1918 by Hedgcock and Hunt (Mycol. **12:** 183. 1920).

*. **Coleosporium domingense** (Berk.) Arth. (*C. plumierae* Pat.), with pycnia and aecia unknown; uredia and telia hypophyllous, the urediospores ellipsoid or obovoid, coarsely verrucose; a tropical rust occurring on Apocynaceae: various species of *Plumiera* in Central America and the West Indies, has been reported from the southern part of Florida, on **P. acutifolium** Poir. (N. A. F. **7:** 87, 652, 815.)

4. COLEOSPORIUM IPOMOEAE. Fig. 55.

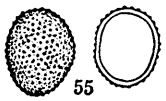
(N. A. F. 7: 87, 652, 814, 815.)

Uredo ipomoeae Schw., Schr. Nat. Ges. Leipzig **1:** 70. 1822.
Coleosporium ipomoeae (Schw.) Burr., Bull. Ill. Lab. Nat. Hist. **2:** 217. 1885.
(*Peridermium ipomoeae* Hedgc. & Hunt, Mycol. **9:** 239. 1917.)

Pycnia amphigenous, on somewhat discolored spots. Aecia hypophyllous, the peridium flattened laterally; aeciospores ovoid or ellipsoid, 17–20 by 22–27 μ; wall colorless, 2–3 μ thick, strongly verrucose.

On Pinaceae: **Pinus caribaea** Morelet(*P. elliottii* Engelm., *P. heterophylla* Sudw.), Fla.—**P. chihuahuana** Engelm., Ariz.—**P. echinata** Mill.(*P. mitis* Michx.), Ala., Ark., Ga., Mo., N.C., Pa., S.C., Tenn., Tex., Va.—**P. palustris** Mill.(*P. australis* Michx.), Fla., Ga., S.C.—**P. rigida** Mill., Ga., Md., Pa.—**P. serotina** Michx., Fla., S.C.—**P. taeda** L., Ala., Ark., D.C., Fla., Ga., N.C., S.C., Va.

Uredia hypophyllous, round, orange-yellow when fresh; urediospores ellipsoid, 13–21 by 18–27 μ; wall colorless, 1–1.5 μ thick, closely and noticeably verrucose. Telia hypophyllous, pulvinate, deep reddish-orange when fresh; teliospores oblong or slightly clavate, 19–23 by 60–80 μ, rounded or obtuse at both ends; wall colorless, thin at sides, swelling 20–40 μ above, smooth.


55

On Convolvulaceae: **Calonyction aculeatum** (L.) House(*Ipomoea bona-nox* L.), Ala., S.C., Tex.—**Convolvulus sepium** L., Ala., D.C., Ga., Va.—**Ipomoea barbigera** Sims(*Pharbitis b.* G.Don), Tenn.—**I. batatas** Lam., Miss.—**I. cathartica** Poir.(*P. c.* Choisy), Fla.—**I. digitata** L.(cult.), Miss.—**I. hederacea** (L.)Jacq.(*P. h.* Choisy, *I. nil* Pursh, not Roth), Ala., Ark., Del., D.C., Fla., Ill., Kans., Ky., La., Md., Miss., Mo., N.J., N.C., Okla., Pa., S.C., Tenn., Tex., Va.—**I. lacunosa** L., Ala., Ark., Ga., Ill., La., Miss., N.C., Tenn.—**I. pandurata** (L.)G.W.Mey., Ala., Del., Ill., Ind., Kans., Ky., Miss., Mo., N.J., N.C., Ohio, S.C., Va., W.Va.—**I. purpurea** (L.)Roth(*P. p.* Voigt), Ala., Ark., Del., Ill., La., Miss., Mo., Pa., S.C., Tex.—**I. speciosa** Walt.(*I. sagittata* Cav.), Fla., Miss.—**I. trichocarpa** Ell.(*I. carolina* Pursh, not L.), Fla., Tenn., Tex.—**I. triloba** L., N.C.—**Quamoclit coccinea** (L.) Moench, Ill., S.C., Tenn.—**Q. vulgaris** Choisy(*I. quamoclit* L., *Q. q.* Britt.), Miss.—**Thyella tamnifolia** (L.)Raf., La.

Range: New Jersey to Illinois and Kansas, southward to Florida and Texas, with one station in Arizona; also in Mexico, Central America, West Indies and South America. Most abundant in the warmer regions and lower altitudes.

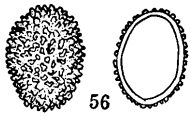
Cultures were made by Hedgcock and Hunt (Phytop. **7:** 67. 1917), in 1916, using aeciospores.

5. COLEOSPORIUM VIBURNI. Fig. 56.

(N. A. F. 7: 88, 652.)

Coleosporium viburni Arth., Bull. Iowa Agr. Coll. Dep. Bot. **1884:** 163. 1884.

Pycnia and aecia unknown. Uredia hypophyllous, round, yellow when fresh; urediospores ellipsoid, 19–25 by 24–32 μ; wall colorless, 2–2.5 μ thick, closely verrucose. Telia hypophyllous, pulvinate, orange-yellow when fresh; teliospores cylindric or clavate-oblong, 17–25 by 50–85 μ, rounded or obtuse above; wall colorless, thin at sides, swelling 25–35 μ above, smooth.


56

On Caprifoliaceae: **Viburnum acerifolium** L., Ill.—**V. cassinoides** L., Ont.—**V. lentago** L., Iowa, Mich., Wis.; Man.—**V. pubescens** (Ait.)Pursh, Wis. **Range:** Northeastern Ontario to Manitoba and northern Iowa; also in Mexico, Central America, South America and Japan. Locally distributed in widely separated localities.

6. COLEOSPORIUM CAMPANULAE. Fig. 57.

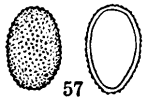
(N. A. F. 7: 88, 653, 814, 815.)

Uredo campanulae Pers., Syn. Fung. 217. 1801.
Coleosporium campanulae (Pers.) Lév., Ann. Sci. Nat. III. **8:** 373. 1847.
(*Peridermium rostrupi* Fisch., Bull. Soc. Bot. Fr. **41:** clxxi. 1894.)

Pycnia amphigenous, subcortical, noticeable. Aecia amphigenous, large, flattened at sides, 0.7–1.5 mm. high, with a fragile peridium; aeciospores broadly ellipsoid or globoid, 17–22 by 22–31 μ; wall colorless, 2–3.5 μ thick, densely verrucose.

On Pinaceae: **Pinus resinosa** Ait., Mich., N.H., N.Y.—**P. rigida** Mill., Md., N.H., N.J., N.C., Ohio.

Uredia hypophyllous, round, orange-red when fresh; urediospores ellipsoid, 18–23 by 20–30 μ; wall colorless, 1–1.5 μ thick, densely verrucose. Telia hypophyllous, round, small, blood-red when fresh; teliospores cylindric or clavate-oblong, 17–24 by 55–85 μ, rounded or obtuse at each end; wall colorless, thin at sides, swelling 15–25 μ above, smooth.


57

On Campanulaceae: **Campanula aparinoides** Pursh, Wis.—**C. divaricata** Michx., Ky.—**C. persicifolia** L., Calif.—**C. rapunculoides** L., Conn., Md., N.J., N.Y., Pa., Vt.—**Campanulastrum americanum** (L.)Small (*Campanula a.*), Ill., Ind., Ky., Mich., Miss., Mo., Ohio, Pa., Tenn., W.Va.—**Specularia perfoliata** (L.)A.DC.(*Campanula p., C. amplexicaulis* Michx.), N.C., Pa.; on Primulaceae: **Lysimachia quadrifolia** L., Tenn.

Range: New Hampshire to northern Wisconsin, southward to the Gulf of Mexico, and in central California; also in Europe and Japan.

Numerous cultures made in Europe have shown considerable specialization (Klebahn, Wirtw. Rostp. 365–369. 1904). The only culture with American material was made in 1904 by Kellerman (Jour. Myc. **11:** 32. 1905), using aeciospores on *Campanula americana.* The assignment of uredia on *Lysimachia* to this species is based on similarity of spores and of leaf structure.

7. COLEOSPORIUM VERNONIAE. Fig. 58.

(N. A. F. 7: 89, 653, 814, 815.)

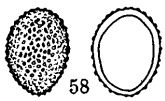
(*Tuberculariа carnea* Bosc, Ges. Nat. Freunde Berlin Mag. **5:** 88. 1811.)
Coleosporium vernoniae B. & C., Grev. **3:** 57. 1874.

(*Peridermium ravenelii* Kleb., Ber. Deuts. Bot. Ges. **8²:** 69. 1890.)
(*Peridermium carneum* Seym. & Earle, Econ. Fungi *550.* 1899.)
Stichopsora vernoniae Diet., Hedw. Beibl. **42:** 179. 1903.
(*Peridermium intermedium* A. & K., Bull. Torrey Club **33:** 416, p.p. 1906.)
Coleosporium carneum Jacks., Proc. Ind. Acad. **1917:** 312. 1918.

Pycnia chiefly epiphyllous. Aecia amphigenous, large, 1.8–4 mm. high, flattened on the sides, truncate above, the peridium sometimes vertically striate; aeciospores obovoid or ellipsoid, 16–25 by 25–38 μ; wall colorless, 3–9 μ thick, often thicker above, coarsely verrucose.

On Pinaceae: **Pinus caribaea** Morelet(*P. elliottii* Engelm., *P. heterophylla* Sudw.), Fla., Ga., Ky., La., Miss.—**P. contorta** Dougl.(*P. murrayana* Balf.), N.C.—**P. echinata** Mill.(*P. mitis* Michx.), Ala., Ark., D.C., Fla., Ga., Ind., Kans., Mo., N.C., S.C., Tenn., Tex., Va.—**P. glabra** Walt., Fla.—**P. nigra** Arnold(*P. austriaca* Höss.), Ind., Ohio.—**P. palustris** Mill.(*P. australis* Michx.), Ala., Ark., Fla., Ga., La., Miss., N.C., S.C.—**P. ponderosa** Dougl., D.C., Ohio.—**P. rigida** Mill., Conn., D.C., Ky., Md., N.C., Ohio, Pa., S.C., Va., W.Va.—**P. scopulorum** (Engelm.)Lemm.(*P. ponderosa scopulorum* Engelm.), Ohio.—**P. serotina** Michx., Fla., Ga., S.C.—**P. sylvestris** L., Ohio.—**P. taeda** L., Ala., Ark., Fla., Ga., Ky., La., Md., Miss., Mo., N.C., S.C., Tex., Va.

Uredia hypophyllous, round, yellow when fresh; urediospores ellipsoid, globoid or obovate, 15–20 by 22–27 μ; wall colorless, 1–2 μ thick, sometimes twice as thick above, strongly verrucose. Telia hypophyllous, round, orange-yellow when fresh; teliospores oblong-clavate or cylindric, 19–24 by 50–67 μ, rounded or obtuse above; wall colorless, thin at sides, swelling 30–40 μ above, smooth.


58

On Carduaceae (tribe *Vernonieae*): **Vernonia altissima** Nutt.(*V. maxima* Small), Ala., Ark., Ga., Ind., Ky., La., Miss., Mo., Ohio, Pa., S.C., Tenn.—**V. angustifolia** Michx., Ala., Fla.—**V. baldwinii** Torr., Ark., Ill., Iowa, Kans., Miss., Mo., Okla., Tex.—**V. blodgettii** Small, Fla., N.C., S.C.—**V. crinita** Raf., Ark., Mo.—**V. fasciculata** Michx., Ala., Ark., D.C., Ga., Ill., Ind., Iowa, Miss., Neb., N.C., Ohio, Okla., Tenn., Tex.—**V. flaccidifolia** Small, Ala., Fla., Tenn.—**V. gigantea** (Nutt.)Britt., Ark., Del., Fla., Ga., Ill., Ky., Miss., Ohio, Tenn.—**V. glauca** (L.)Britt., Ark., La., Ky., N.C., Ohio, W.Va.—**V. guadalupensis** Heller, Tex.—**V. illinoensis** Gleason, Ind.—**V. interior** Small, Ark., Iowa, Kans., Mo., Neb., Tex.—**V. missurica** Raf.(*V. drummondii* Shuttl.), Ark., Ill., Mo., Neb., Tenn., Tex.—**V. noveboracensis** (L.) Willd., Ala., Conn., Del., D.C., Ga., Ill., Ind., Md., Mass., N.J., N.C., Ohio, Pa., S.C., Tenn., Va., W.Va.—**V. oligantha** Greene, Fla., La.—**V. ovalifolia** T.&G., Ala., La.—**V. pulchella** Small, Ga.—**V. texana** (Gray)Small, La., Tex.—**V. tomentosa** (Walt.)Ell., D.C., Ga., Md.

Range: Massachusetts to Indiana and Nebraska, southward to Florida and Texas; also in the West Indies and South America.

Cultures of this rust using aeciospores were made by Arthur in 1910, 1911, 1913 and 1914 (Mycol. **4:** 29; same **5:** 57; same **7:** 80, 84). Subsequent cultures have been made by Hedgcock and Hunt in 1917, 1918 and 1920 (Phytop. **7:** 67. 1917; same **8:** 326. 1918; Mycol. **12:** 188. 1922; same **25:** 392. 1933).

8. COLEOSPORIUM ELEPHANTOPODIS. Fig. 59.

(N. A. F. 7: 89, 654, 816.)

Uredo elephantopodis Schw., Schr. Nat. Ges. Leipzig **1:** 70. 1822.
Coleosporium elephantopodis (Schw.) Thüm., Myc. Univ. *953.* 1878.

Stichopsora elephantopodis Diet., Hedw. Beibl. **42:** 181. 1903.
(*Peridermium intermedium* A. & K., Bull. Torrey Club **33:** 416, p.p. 1906.)
(*Peridermium elephantopodis* Hedgc. & Hahn, Mycol. **12:** 190. 1920.)

Pycnia as in *C. vernoniae,* but fewer, smaller and lighter colored. Aecia as in *C. vernoniae,* but slightly smaller, with aeciospores somewhat smaller, more globoid, and with no apical thickening of the cell wall.

On Pinaceae: **Pinus caribaea** Morelet(*P. elliottii* Engelm., *P. heterophylla* Sudw.), Ala., Fla., Ga.—**P. echinata** Mill.(*P. mitis* Michx.), Ark., Ga., Ky., Md., Mo., N.C., S.C., Va.—**P. palustris** Mill.(*P. australis* Michx.), Ala., Fla., Ga., La., Miss., N.C., S.C., Tex.—**P. rigida** Mill., N.C.—**P. serotina** Michx., Fla., S.C.—**P. taeda** L., Ala., Fla., Ga., Miss., N.C., S.C., Tenn., Tex.

Uredia chiefly hypophyllous, round, yellow when fresh; urediospores more globoid and slightly smaller than in *C. vernoniae;* wall colorless, uniformly 1–1.5 μ thick, strongly verrucose. Telia and teliospores as in *C. vernoniae.*


59

On Carduaceae (tribe *Vernonieae*): **Elephantopus carolinianus** Willd., Ala., Ark., Del., D.C., Fla., Ga., Ill., Ind., Ky., La., Md., Miss., Mo., N.J., N.C., Ohio, Okla., Pa., S.C., Tenn., Tex., Va., W.Va.—**E. elatus** Bertol., Fla., Ga., Miss.—**E. nudatus** Gray, Ala., Fla., Ga., Miss., S.C., Va.—**E. tomentosus** L., Ala., Ark., Fla., Ga., La., Miss., N.C., S.C., Tenn., Tex., Va.

Range: New Jersey to Missouri, southward to Florida and Texas; also in Central America, West Indies and South America.

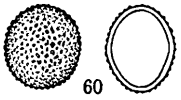
This species and *C. vernoniae* are scarcely distinguishable by morphologic characters, and might fairly be considered as the diverse expression of one species. In both physiology and morphology as shown by many cultures and much microscopic study (Hedgcock, Hunt & Hann, Mycol. **12:** 188–193. 1920) "the two are distinct in their host adaptation, in addition to slight differences in morphology." Cultures of *C. elephantopodis* were made in 1915 by Hedgcock and Long (Phytop. **7:** 66) using teliospores on *Pinus heterophylla,* and the resulting aeciospores used the following year on *Elephantopus tomentosus.* Other cultures have been made by the same experimenters with similar results (see Mycol. **25:** 393. 1933).

9. COLEOSPORIUM ARIDUM. Fig. 60.

(N. A. F. 7: 654, 814.)

Coleosporium aridum Jacks.; Arth., Bull. Torrey Club **51:** 52. 1924.

Pycnia and aecia unknown. Uredia hypophyllous, small, round, orange-yellow when fresh; urediospores globoid or ellipsoid, 16–20 by 20–28 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Telia unknown.


60

On Carduaceae (tribe *Eupatorieae*): **Brickellia californica** T.&G.(*Coleosanthus c.* Ktze.), Calif. **Range:** Known only from Andreas Cañon in the Mojave desert, Riverside County, California.

10. COLEOSPORIUM LACINIARIAE. Fig. 61.

(N. A. F. 7: 90, 655, 814, 816.)

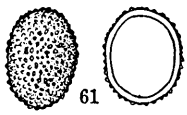
Coleosporium laciniariae Arth., N. Am. Flora **7:** 90. 1907.
(*Peridermium fragile* Hedgc. & Hunt, Mycol. **9:** 241. 1917.)

Pycnia amphigenous, few, on somewhat paler spots. Aecia hypophyllous, small, inconspicuous, with delicate peridium, flattened laterally; aeciospores

ovoid or ellipsoid, 18–22 by 25–34 μ; wall colorless, 2–3 μ thick, coarsely verrucose.

On Pinaceae: **Pinus palustris** Mill.(*P. australis* Michx.), Fla., Ga.—**P. rigida** Mill., D.C., N.J.—**P. taeda** L., N.J.

Uredia amphigenous, round, large, yellow when fresh; urediospores ellipsoid or globoid, 18–23 by 24–35 μ; wall colorless, 1–1.5 μ thick, strongly verrucose. Telia amphigenous and sometimes caulicolous, reddish-orange when fresh; teliospores clavate or oblanceolate, 16–21 by 58–77 μ, obtuse or rounded above, much narrowed below, smooth.


61

On Carduaceae (tribe *Eupatorieae*): **Liatris aspera** (Michx.) Greene(*L. scariosa* Auth., not Willd.), Ark., Ga., Tenn.—**L. chapmanii** T.&G.(*Laciniaria c.* Ktze.), Fla.—**L. elegans** (Walt.)Willd.(*L. e.* Ktze.), Fla.—**L. elegantula** (Greene)Schum.(*L. e.*), Ala.—**L. garberi** Gray(*L. nashii* Small), Fla.—**L. gracilis** Pursh(*L. g.* Ktze.), Fla.—**L. graminifolia** (Walt.)Pursh, not Willd.(*L. g.* Ktze.), Ala., Ga., N.J.—**L. laxa** (Small)Schum.(*L. l.*), Fla.—**L. pilosa** (Ait.)Heller, Ga.—**L. tenuifolia** Nutt.(*L. t.* Ktze.), Fla.

Range: New Jersey to Arkansas, southward to Florida and Alabama.

Successful cultures showing the connection of the alternate stages were made by Hunt in 1918 and Hedgcock in 1919, both using aeciospores (Mycol. **12:** 185. 1920; same **25:** 394. 1933).

11. COLEOSPORIUM SOLIDAGINIS. Fig. 62.

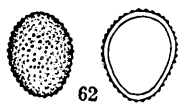
(N. A. F. **7:** 90, 655, 814, 816.)

Uredo solidaginis Schw., Schr. Nat. Ges. Leipzig **1:** 70. 1822.
Coleosporium solidaginis (Schw.) Thüm., Bull. Torrey Club **6:** 216. 1878.
(*Peridermium acicolum* Underw. & Earle, Bull. Torrey Club **23:** 400. 1896.)
Stichopsora asterum Diet., Bot. Jahrb. **28:** 565. 1899.
(*Peridermium montanum* A. & K., Bull. Torrey Club **33:** 413. 1906.)
Coleosporium pini-asteris Orish., Bot. Mag. Tokyo **24:** 4. 1910.
Coleosporium asterum Syd., Ann. Myc. **12:** 109. 1914.
Coleosporium heterothecae Hedgc. & Hunt, Mycol. **25:** 396. 1933.

Pycnia amphigenous, numerous, subcortical. Aecia amphigenous, on discolored spots, flattened at sides, with moderately firm peridium; aeciospores ellipsoid, 20–25 by 28–40 μ; wall colorless, coarsely verrucose with tubercles directed away from a smooth spot extending up one side, 2–3 μ thick on the smooth side, twice as thick on the opposite side.

On Pinaceae: **Pinus banksiana** Lamb.(*P. sylvestris divaricata* Ait., *P. divaricata* Sudw.), Nebr., Wis.; Man., Sask.—**P. contorta** Dougl.(*P. murrayana* Balf.), Colo., Ida., Mont., N.C., Ore., Wash.; Alta.—**P. echinata** Mill.(*P. mitis* Michx.), Ala., Ark., Del., D.C., Ga., Md., Miss., N.C., Pa., S.C., Tenn., Va.—**P. pungens** Lamb., Md., Pa.—**P. resinosa** Ait., Me., Mass., Mich., Minn., N.H., N.Y., Pa., S.C., Vt., Wis.—**P. rigida** Mill., Conn., Del., D.C., Me., Md., Mass., N.J., N.Y., N.C., Pa., R.I., S.C., Tenn., Va., W.Va.—**P. scopulorum** (Engelm.) Lemm.(*P. ponderosa scopulorum* Engelm.), Mont.—**P. taeda** L., Ala., Ga., Md., N.C., S.C., Va.—**P thunbergii** Parl., Md.—**P. virginiana** Mill.(*P. inops* Ait.), Pa., Tenn., Va.

Uredia hypophyllous, round, orange-yellow when fresh; urediospores ellipsoid or globoid, 17–22 by 20–30 μ; wall colorless, 1–2 μ thick, strongly verrucose.



62

Telia hypophyllous, scattered, reddish-orange when fresh; teliospores cylindric, rounded or obtuse at both ends, 15–23 by 55–80 μ; wall colorless, thin at sides, swelling 30–40 μ above, smooth.

On Carduaceae (tribe *Astereae*): **Aster,** 50 species reported from various parts of the United States and southern Canada (see N. Am. Flora 7: 91, 655, 816).—**Brachyactis frondosa** (Nutt.)Gray(*Aster f.* T.&G.), Colo.—**Callistephus hortensis** Cass., Conn., Ind., Iowa, Md., Mass., N.J., N.Y., Pa., S.C., Vt., W.Va.; Ont.—**Chrysoma pauciflosculosa** (Michx.) Greene(*Solidago p.*), Miss.—**Chrysopsis caudata** Rydb., Colo.—**C. hirsutissima** Greene, Colo.—**C. horrida** Rydb., Colo.—**C. scabrella** T.&G., Fla.—**C. villosa** (Pursh)Nutt., Colo., Neb.—**Doellingeria sericocarpoides** Small, Tex.—**D. umbellata** (Mill.)Nees(*Aster u.*), Me., Minn., N.H., N.D.—**Erigeron inornatus** Gray, Calif.—**E. peregrinus** (Pursh)Greene, Alas.—**Grindelia cuneifolia** Nutt., Calif.—**G. oregana** Gray, Wash.—**G. squarrosa** (Pursh)Dunal, Colo., Wis.—**Gutierrezia texana** (DC.)T.&G., Tex.—**Heterotheca subaxillaris** (Lam.) Britt.&Rusby, Fla.—**Machaeranthera viscosula** Rydb., Colo.—**Oligoneuron canescens** Rydb.(*Solidago rigida humilis* Porter), Neb.—**Psilactis asteroides** Gray, N.M.—**Pyrrocoma lanceolata** (Hook.)Greene(*Aplopappus l.* T.&G.)., Mont.—**Solidago,** 54 species reported from various parts of the United States, Alaska and southern Canada (see N. Am. Flora 7: 91, 656, 816); (tribe *Helenieae*): **Gaillardia aristata** Pursh, Calif.

Range: Southern Alaska and Canada to the southern boundary of the United States; also in Mexico, China and Japan.

Cultures establishing the connection of alternate hosts were made by Clinton in 1906 (Science II. **25:** 289. 1907). The western form (*Peridermium montanum*) with somewhat larger spores was connected by Hedgcock (Phytop. **6:** 65. 1916), using aeciospores from *Pinus murrayana* on *Aster conspicuus,* and confirmed by Weir and Hubert (same, p. 66) on other telial hosts. The form on *Heterotheca subaxillaris* is only known in the uredial stage. It is considered a distinct species by Hedgcock & Hunt (*l. c.*).

This is one of the most common of rusts. The uredia may be found in early spring coming from overwintered mycelium.

12. COLEOSPORIUM DELICATULUM. Fig. 63.

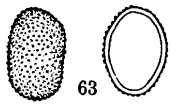
(N. A. F. 7: 657.)

(*Peridermium delicatulum* A. & K., Bull. Torrey Club **33:** 412. 1906.)
Coleosporium delicatulum [A. & K.] Hedgc. & Long. Phytop. **3:** 250. 1913.

Pycnia amphigenous, few, conspicuous. Aecia amphigenous, with delicate and inconspicuous peridium; aeciospores ovoid, 19–21 by 21–28 μ; wall colorless, 2.5–3 μ thick, finely verrucose.

On Pinaceae: **Pinus caribaea** Morelet (*P. elliottii* Engelm., *P. heterophylla* Sudw.), Fla.—**P. echinata** Mill.(*P. mitis* Michx.), Ga., Md., Pa., S.C.—**P. palustris** Mill.(*P. australis* Michx.), Fla., Ga., Miss.—**P. resinosa** Ait., Vt.—**P. rigida** Mill., Conn., D.C., Md., Mass., N.H., N.J., N.Y., N.C., Pa.—**P. serotina** Michx., S.C.—**P. taeda** L., Fla., Md., N.C., S.C., Tex., Va.

Uredia amphigenous, round, yellow or orange-yellow when fresh; urediospores oblong or ovoid, 13–19 by 20–30 μ; wall colorless, about 1 μ thick, finely


63

verrucose. Telia amphigenous, waxy, reddish-orange when fresh, teliospores cylindric, rounded or truncate at both ends, 16–26 by 60–90 μ; wall thin at sides, swelling 25–30 μ above, smooth.

On Carduaceae: (tribe *Astereae*): **Euthamia caroliniana** (L.)Greene(*Solidago tenuifolia* Pursh), Fla., N.H., N.Y., Pa.—**E. graminifolia** (L.)Nutt.(*S. lanceolata* L.), Conn., Del., D.C., Ind., Kans., Me., Md., Mass., Mo., N.H., N.J., N.Y., Pa., R.I., Vt., Va., W.Va.—**E. gymnospermoides** (Fern.)Greene(*S. g.*), Tex.—**E. leptocephala** (T.&G.)Greene(*S. l.*), Fla., La., Tex.—**E. minor** (Michx.)Greene(*S. m.* Fern.), Fla.

Range: Maine to eastern Kansas, southward to Florida and eastern Texas.

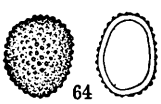
Successful cultures were made by Hedgcock and Long (Phytop. **3:** 250. 1913), using aeciospores from *Pinus rigida,* sown on *Euthamia graminifolia,* and were subsequently confirmed by Hedgcock and Hunt.

13. COLEOSPORIUM ADENOCAULONIS. Fig. 64.

(N. A. F. 7: 657.)

Coleosporium adenocaulonis Jacks., Brooklyn Bot. Gard. Mem. **1:** 202. 1918.

Pycnia and aecia unknown. Uredia hypophyllous, on conspicuous discolored spots, small, round, orange-yellow when fresh, pulverulent; urediospores globoid or ellipsoid, 18–24 by 23–26 μ; wall nearly or quite colorless, 2–3 μ thick, prominently verrucose. Telia unknown.


64

On Carduaceae (tribe *Inuleae*): **Adenocaulon bicolor** Hook., Ore. **Range:** Only known from the vicinity of Corvallis, Oregon.

14. COLEOSPORIUM MADIAE. Fig. 65.

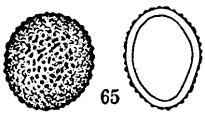
(N. A. F. 7: 92, 94, 658, 817.)

Coleosporium madiae Cooke, Grev. **7:** 102. 1879.
Stichopsora madiae Syd., Ann. Myc. **2:** 30. 1904.
Coleosporium arnicale Arth., N. Am. Flora **7:** 94. 1907.
(*Peridermium californicum* A. & K., Mycol. **6:** 118. 1914.)

Pycnia amphigenous, large, conspicuous. Aecia amphigenous, large, tongue-shaped, flattened on the sides; aeciospores broadly ellipsoid, 25–29 by 40–45 μ; wall colorless, 3–4.5 μ thick, coarsely verrucose.

On Pinaceae: **Pinus radiata** D.Don(*P. insignis* Dougl.), Calif.

Uredia hypophyllous, round, bright orange-yellow when fresh; urediospores ellipsoid or globoid, 18–29 by 26–38 μ; wall colorless, 2–4 μ thick, coarsely verrucose. Telia hypophyllous, orange-yellow when fresh; teliospores cylindric or oblong-lanceolate, 16–20 by 48–65 μ, obtuse or acute at both ends; wall thin at sides, swelling 20–30 μ above, smooth.


65

On Carduaceae (tribe *Heliantheae*): **Anisocarpus madioides** Nutt.(*Madia nuttalii* Gray), Calif.—**Centromadia pungens** (H.&A.)

Greene(*Hemizonia p.* T.&G.), Calif.—**Harpaecarpus exiguus** (Smith)Gray (*Madia e.* Greene), Ore.—**? Hemizonella durandi** Gray(*Hemizonia d.*), Wash. —**Hemizonia citriodora** (Greene)Gray(*Madia c.*), Ore.—**H. congesta** DC., Calif.—**Madaria corymbosa** DC., Calif.—**M. elegans** (D.Don)DC.(*Madia e.*), Calif.—**Madia anomala** Greene, Calif.—**M. capitata** Nutt., Calif.—**M. dissitiflora** (Nutt.)T.&G., Calif.—**M. glomerata** Hook., Ore.—**M. racemosa** (Nutt.)T.&G., Ore., Wash.—**M. ramosa** Piper, Ore.—**M. sativa** Molina, Calif., Ore.; B.C.—**Zonanthemis corymbosa** (DC.)Greene, Calif.

Range: Pacific Coast region, from British Columbia to central California.

The connection of the alternate stages was demonstrated by E. P. Meinecke in 1917, by using aeciospores from *Pinus radiata* sown on *Madia dissitiflora*, but the data were not published (Phytop. **8:** 323. 1918).

15. COLEOSPORIUM INCONSPICUUM. Fig. 66.

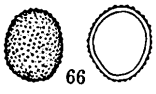
(N. A. F. 7: 659.)

(*Peridermium inconspicuum* Long, Mycol. **4:** 283. 1912.)
Coleosporium inconspicuum [Long] Hedgc. & Long, Phytop. **3:** 250. 1913.

Pycnia chiefly hypophyllous. Aecia amphigenous, with fragile and evanescent peridium, flattened on the sides; aeciospores ellipsoid or obovoid, 15–18 by 21–30 μ; wall colorless, 2–3 μ thick, minutely verrucose.

On Pinaceae: **Pinus echinata** Mill.(*P. mitis* Michx.), Ga., Md., N.C.—**P. palustris** Mill.(*P. australis* Michx.), S.C.—**P. virginiana** Mill.(*P. inops* Ait.), D.C., Ky., Md., N.C., Tenn., Va.

Uredia hypophyllous, round, golden-yellow when fresh, pulverulent; urediospores broadly ellipsoid or globoid, 19–23 by 23–26 μ; wall colorless, 1 μ thick, finely verrucose. Telia hypophyllous, pulvinate, waxy, orange-yellow when fresh; teliospores oblong or somewhat clavate, 16–24 by 65–75 μ, usually acuminate below; wall colorless, thin at sides, swelling 20–29 μ above, smooth.


66

On Carduaceae (tribe *Heliantheae*): **Coreopsis delphinifolia** Lam., S.C., Tenn.—**C. lanceolata** L., N.C., Tenn.—**C. major** Walt., Ga., N.C., Ohio, S.C., Tenn., Va.—**C. palmata** Nutt., Tenn.—**C. verticellata** L., D.C., Md., Va.

Range: The Alleghany Mountains and eastward from Maryland to Georgia, and in Ohio.

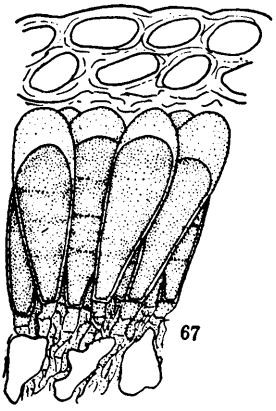
Successful cultures were made by Hedgcock and Long (Phytop. **3:** 250) in 1913, by sowing aeciospores from *Pinus virginiana* on *Coreopsis verticillata*.

Coleosporium pinicola. Fig. 67.

(N. A. F. 7: 95, 661, 817.)

Coleosporium pini Gall., Jour. Myc. **7:** 44. 1891. Not *C. pini* Lagerh., 1889.
Gallowaya pini Arth., Rés. Sci. Congr. Bot. Vienne 336. 1906.
Gallowaya pinicola Arth., Bull. Torrey Club **48:** 36. 1921.
Coleosporium pinicola n. comb.

Pycnia rudimentary, not externally visible. Aecia and uredia wanting. Telia amphigenous, long covered by the epidermis, 1–5 mm. long, or longer



67

if confluent, reddish-orange when fresh; teliospores clavate, 13–20 by 60–100 μ, acute or rounded above, narrowed below; wall colorless, thin at sides, swelling 30–50 μ above, smooth.

On Pinaceae: **Pinus virginiana** Mill.(*P. inops* Ait.), Del., D.C., Md., N.C., Tenn., Va. **Range:** Delaware to eastern Tennessee, nearly throughout the range of the host; also reported from western Siberia on *Pinus cembra.*

Extensive studies of this rust have been made by Galloway (Bot. Gaz. **22:** 433. 1896) and Dodge (Jour. Agric. Res. **31:** 641. 1925). The correlation of this microcyclic species with a particular macrocyclic form is somewhat uncertain, but it seems to accord well with *Coleosporium inconspicuum,* less so with *C. helianthi.*

16. COLEOSPORIUM HELIANTHI. Fig. 68.

(N. A. F. 7: 93, 658, 814, 817.)

Caeoma (*Uredo*) *helianthi* Schw., Trans. Am. Phil. Soc. II. **4:** 291. 1832.
Coleosporium helianthi (Schw.) Arth., N. Am. Flora **7:** 93. 1907.
(*Peridermium helianthi* Hedgc. & Hunt, Mycol. **9:** 240. 1917.)

Pycnia amphigenous, large. Aecia amphigenous, large, the peridium flattened laterally; aeciospores globoid or broadly ellipsoid, 15–20 by 20–28 μ; wall colorless, 2.5–3.5 μ thick, coarsely verrucose.

On Pinaceae: **Pinus echinata** Mill.(*P. mitis* Michx.), N.C.—**P. virginiana** Mill.(*P. inops* Ait.), Ga., Md., N.C., Ohio, Pa., S.C., Tenn., Va., W.Va.

Uredia hypophyllous, round, golden-yellow when fresh; urediospores ellipsoid, 14–20 by 19–27 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Telia hypophyllous, pulvinate, orange-yellow when fresh; teliospores oblong or somewhat clavate, 16–22 by 55–70 μ; wall colorless, thin at sides, swelling 30–40 μ above, smooth.



68

On Carduaceae (tribe *Heliantheae*): **Helianthus australis** Small, Ga., S.C.—**H. decapetalus** L., D.C., Ind., Md., N.Y., N.C., Pa., Tenn., Va., W.Va.—**H. divaricatus** L., D.C., N.Y., N.C., Pa., Tenn., Va.—**H. doronicoides** Lam., Ohio.—**H. eggertii** Small, Tenn.—**H. giganteus** L., Ala., Miss., Pa., Va.—**H. glaucus** Small, D.C., Ga., Tenn.—**H. grosse-serratus** Martens, N.C., Tenn.—**H. hirsutus** Raf., Ark., D.C., Ga., La., W.Va.—**H. microcephalus** T.&G., Ala., Ga., Md., N.C., Ohio, S.C., Tenn., Va., W.Va.—**H. occidentalis** Ridd., La.—**H. rigidus** (Cass.)Desf.(*H. scaberrimus* Ell.), Okla.—**H. saxicola** Small, Ga.—**H. strumosus** L., Mo., Pa., Wis.—**H. tomentosus** Michx., Va.—**H. tuberosus** L., Ala., Ill., Pa., Tenn., Va.

Range: Southern New York to southern Wisconsin and southward to Georgia and Arkansas.

Cultures, using aeciospores on 4 species of *Helianthus,* were made by Hedgcock and Hunt in 1916 (Phytop. **7:** 67. 1917). Probably all species of *Helianthus* are susceptible to the rust.

*. **Coleosporium viguierae** D. & H. (*C. verbesinae* D. & H.), a rust of the warmer regions of North America; occurs on Carduaceae (tribe *Heliantheae*): **Phaethusa laciniata** (Poir.)Small(*Verbesina l.*), in southern Florida, **Verbesina texana** Buckl., in southern Texas and **Ximenesia exauriculata** (Rob.&Greenm.)Rydb., in central Arizona; also in Mexico, Central America and Jamaica. The species was

for a time thought to be a form of *C. helianthi*, but both from morphology and host reaction it is now considered distinct. In 1916 the aeciospores of *C. helianthi* were sown upon *Coreopsis* and *Verbesina* by Hedgcock and Long (Phytop. **7**: 68. 1917), without effect. (N. A. F. **7**: 93, 658, 659.)

17. COLEOSPORIUM TEREBINTHINACEAE. Fig. 69.

(N. A. F. 7: 93, 660, 817.)

Uredo terebinthinaceae Schw., Schr. Nat. Ges. Leipzig **1**: 70. 1822.
Coleosporium terebinthinaceae (Schw.) Arth., N. Am. Flora **7**: 93. 1907.
(*Peridermium terebinthinaceae* Hedgc. & Hunt, Mycol. **9**: 240. 1917.)

Pycnia amphigenous, small. Aecia hypophyllous, large, flattened laterally; aeciospores ellipsoid or ovoid, 18–22 by 29–36 μ; wall colorless, 2–3.5 μ thick, strongly verrucose.

On Pinaceae: **Pinus echinata** Mill.(*P. mitis* Michx.), Ala., Ga., N.C., S.C. —**P. serotina** Michx., S.C.—**P. taeda** L., Ala., S.C.—**P. virginiana** Mill.(*P. inops* Ait.), S.C.

Uredia hypophyllous, round, orange-yellow when fresh; urediospores globoid, 16–21 by 16–27 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Telia hypophyllous, orange-yellow when fresh; teliospores oblong or cylindric, 17–22 by 48–64 μ, truncate or rounded at both ends; wall colorless, thin at sides, swelling 20–30 μ above, smooth.


69

On Carduaceae (tribe *Heliantheae*): **Parthenium integrifolium** L., Ga., Tenn., Va.—**Silphium angustum** (Gray)Small, Ga., S.C.—**S. asperrimum** Hook., Miss., Tex.—**S. asteriscus** L., Ga., La.—**S. compositum** Michx., Tenn.—**S. dentatum** Ell., Ga., N.C.—**S. glabrum** Eggert, Ga., N.C., Tenn.—**S. integrifolium** Michx., Ark., Ill., Ind., La., Miss., Mo., Va.—**S. laciniatum** L., Iowa, Kans.—**S. perfoliatum** L., Ind., Mo.—**S. pinnatifidum** Ell., Ga., N.C.—**S. scaberrimum** Ell., N.C., Tex.—**S. terebinthinaceum** Jacq., Ill., Ind., N.C.—**S. trifoliatum** L., Ala., Ga., N.C., Pa., Va.

Range: Central Pennsylvania to Iowa and Kansas, southward to Georgia and Texas.

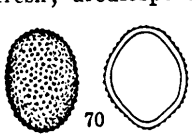
Successful cultures were made in 1916 with aeciospores sown on *Silphium asteriscus*, *S. integrifolium*, *S. trifoliatum* and *Parthenium integrifolium*, by Hedgcock and Hunt (Phytop. **7**: 67. 1917). Probably all species of *Silphium* are susceptible to the rust.

18. COLEOSPORIUM OCCIDENTALE. Fig. 70.

(N. A. F. 7: 94, 660.)

Coleosporium occidentale Arth., N. Am. Flora **7**: 94. 1907.

Pycnia and aecia unknown. Uredia hypophyllous, round, yellow when fresh; urediospores broadly ellipsoid, 16–22 by 25–33 μ; wall colorless, 1.5–2 μ thick, finely verrucose. Telia hypophyllous, orange-yellow when fresh; teliospores oblong or clavate-oblong, 17–20 by 50–72 μ; wall colorless, thin at sides, swelling 15–20 μ above, smooth.


70

On Carduaceae (tribe *Senecioneae*): **Senecio aronicoides** DC., Calif.—**S. canus** Hook., Wyo.—**S. fendleri** Gray(*S. nelsoni* Rydb.), Colo., Wyo.—**S. hydrophiloides** Rydb., Wash.—**S. serra** Hook., Wyo.—**S. triangularis** Hook., Mont., Ore.—**S. uintahensis** (Nels.)Greene, Utah. **Range**:

Washington to northern California, eastward to Wyoming and northern Utah.

19. COLEOSPORIUM SENECIONIS. Fig. 71.

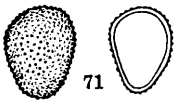
(N. A. F. 7: 94, 817.)

Uredo farinosa β senecionis Pers., Syn. Fung. 218. 1801.
Uredo senecionis Schum., Enum. Pl. Saell. **2:** 229. 1803.
Coleosporium senecionis (Pers.) Fries, Summa Veg. Scand. 512. 1849.
(*Peridermium oblongisporium* Fckl., Jahr. Nass. Ver. Nat. **23–24:** 42. 1870.)

Pycnia amphigenous, subcortical, noticeable. Aecia amphigenous, tongue-shaped, large, fragile; aeciospores broadly ellipsoid, 17–24 by 28–36 μ; wall colorless, 3–4 μ thick, conspicuously verrucose.

On Pinaceae: **Pinus sylvestris** L., in Europe; not yet found in America.

Uredia hypophyllous, round, bright orange-yellow when fresh; urediospores ellipsoid or obovate-globoid, 17–21 by 20–27 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Telia hypophyllous, small, bright orange-yellow when fresh; teliospores clavate or clavate-oblong, 16–20 by 60–83 μ; wall colorless, thin at sides, swelling 15–25 μ above, smooth.


71

On Carduaceae (tribe *Senecioneae*): **Senecio vulgaris** L., Colo., R.I.

Range: At the foot of Pikes Peak in Colorado (1926); found in Rhode Island in 1883, but has not been seen since; also in South America, Europe, Siberia and Japan.

The telial host is a cosmopolitan weed, on which the urediospores may overwinter and reproduce the rust without the intervention of the aecial stage. It occurs on other species of *Pinus* and *Senecio* than those mentioned. Successful cultures were carried out by Wolf (Bot. Zeit. **32:** 184. 1874) in 1872, and by many other European investigators since.

20. COLEOSPORIUM SONCHI-ARVENSIS. Fig. 72.

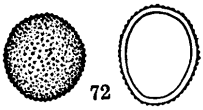
(N. A. F. 7: 660.)

Uredo sonchi-arvensis Pers., Syn. Fung. 217. 1801.
Uredo sonchi Schum., Enum. Pl. Saell. **2:** 229. 1803.
Coleosporium sonchi-arvensis (Pers.) Lév.; Berk., Outl. Brit. Fungol. 333. 1860.
Coleosporium sonchi Schroet., Beitr. Biol. Pfl. **3:** 57. 1879.
(*Peridermium fischeri* Kleb., Zeits. Pflanzenkr. **5:** 71. 1895.)

Pycnia chiefly epiphyllous, 0.5–1 mm. long. Aecia amphigenous, prominent, flattened laterally; aeciospores broadly ellipsoid, 18–25 by 25–35 μ; wall colorless, about 2 μ thick, noticeably verrucose.

On Pinaceae: **Pinus sylvestris** L., Wis.

Uredia hypophyllous, round or oblong, pulverulent; urediospores globoid or broadly ellipsoid, 14–21 by 18–30 μ; wall colorless, about 1.5 μ thick, finely verrucose. Telia hypophyllous, roundish, waxy; teliospores cylindric-clavate, 15–18 by 60–100 μ; wall colorless, thin at sides, swelling to 18 μ above.


72

On Cichoriaceae: **Sonchus asper** (L.)Hill, Wis.

Range: Vicinity of Sturgeon Bay, eastern Wisconsin; also in West Indies and Europe.

The circumstances under which the first American locality was discovered have been recorded by Davis (Phytop. **3**: 306. 1913). Cultures, using teliospores, have been made in 1893 by Ed. Fischer (Mitt. Nat. Ges. Bern 1894), Klebahn (Zeits. Pflanzenkr. **5**: 71. 1895) and later by Wagner (Zeits. Pflanzenkr. **8**: 345. 1898.), using teliospores. Fischer and Klebahn also successfully used aeciospores (*l. c.*).

10. MELAMPSORA Cast., 1843.

A genus with heteroecious species when the telia are on woody plants (except one instance), and autoecious when on herbaceous plants. The aecia of heteroecious species do not occur on *Pinus,* but do occur on *Abies, Larix, Tsuga, Pseudotsuga,* and on *Ribes-Grossularia* and *Saxifraga.* The autoecious species are on many diverse families of plants, but in America, with one exception, are only on Euphorbiaceae.

Pycnia subepidermal or subcuticular, without paraphyses. Aecia when present foliicolous, with rudimentary peridium or none, orange-yellow when fresh, the aeciospores globoid or ellipsoid, with verrucose walls. Uredia when present erumpent, pulverulent, with a delicate, evanescent peridium, the urediospores borne singly on pedicels, globoid or ellipsoid, interspersed with capitate paraphyses, which are more slender at the periphery of the sorus. Telia subcuticular or subepidermal, forming crusts of a single layer of spores, the teliospores 1-celled, adhering laterally and with colored walls.

Host belonging to family Salicaceae.	
Of the genus *Populus.*	
Urediospores ellipsoid.	
Urediospores large, 26–35 μ long.	1. *M. medusae.*
Urediospores medium size, 23–32 μ long.	2. *M. albertensis.*
Urediospores very large, 32–48 μ long.	3. *M. occidentalis.*
Urediospores globoid, small, 18–24 μ long.	
Uredispore-wall thin, 1–2 μ.	4. *M. abietis-canadensis.* *M. farlowii*(m).
Uredispore-wall thick, 2–3 μ.	5. *M. aecidioides.*
Of the genus *Salix.*	
Urediospores large, 17–24 μ long.	6. *M. bigelowii.*
Urediospores small, 12–20 μ long.	
Uredispore-wall thin, 1–1.5 μ.	7. *M. abieti-capraearum.*
Urediospore-wall thick, 2–3.5 μ.	
Urediospores globoid.	8. *M. ribesii-purpureae.*
Urediospores ellipsoid.	9. *M. arctica.*
Host belonging to family Linaceae.	10. *M. lini.*
Host belonging to family Euphorbiaceae.	
Uredia large, 0.5–1 mm. long; paraphyses few.	11. *M. monticola.*
Uredia small, less than 0.5 mm. long; paraphyses numerous.	
Urediospore-wall thick, 2–3 μ.	
Teliospore-wall not or slightly thickened above.	12. *M. euphorbiae.*
Teliospore-wall decidedly thickened above.	13. *M. euphorbiae-gerardianae.*
Urediospore-wall thinner, 1.5–2 μ.	14. *M. piscariae.*

The genus in a number of respects is intermediate in character between the Melampsoraceae and Pucciniaceae. While the telia have 1-celled spores adhering laterally, yet the walls are colored, as is usual in the Pucciniaceae, but not so common in other genera of the Melampsoraceae. The aecia of the heteroecious species of the genus are mostly on coniferous hosts, like other melampsoraceous species, while those of the autoecious species are more like the aecia of the Pucciniaceae. The uredia with their pedicellate spores are distinctly like those of the Pucciniaceae, although possessing the unusual character of intermixed and conspicuous paraphyses. The urediospores are verrucose in the heteroecious species, but mostly echinulate in the autoecious species. In

short, the characters of the genus, in so far as they are not unique, are about equally divided in simulating the Melampsoraceae on the one hand and the Pucciniaceae on the other.

In addition to the above there are 28 species described in the fourth volume of Sydows' "Monographia Uredinearum," many of them in regions east of Europe.

1. MELAMPSORA MEDUSAE. Fig. 73.

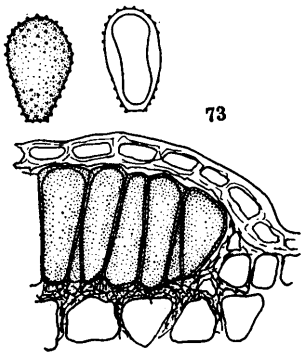
(N. A. F. 7: 98, 664, 817.)

Melampsora medusae Thüm., Bull. Torrey Club **6:** 216. 1878.
Uredo medusae Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.

Pycnia chiefly epiphyllous, subcuticular, minute, inconspicuous. Aecia chiefly hypophyllous, round or oblong, small, yellow when fresh, pulverulent; aeciospores globoid, 17–22 by 17–24 μ; wall colorless, 2.5–3 μ thick, minutely verrucose.

On Pinaceae: **Larix laricina** (DuRoi)Koch(*L. americana* Michx.), Conn., Mich., N.H., N.Y.; N.S.

Uredia chiefly hypophyllous, roundish, small, orange-yellow when fresh, pulverulent; urediospores ellipsoid or obovate-ellipsoid, usually flattened laterally, 16–23 by 26–35 μ, with intermixed paraphyses; wall colorless, smooth, 5–6.5 μ thick on the flattened sides, 2.5–3 μ thick and sparsely verrucose on other sides. Telia chiefly hypophyllous, roundish, small, light reddish-brown when fresh, subepidermal; teliospores prismatic, 12–15 by 30–45 μ; wall cinnamon-brown, uniformly 1 μ thick, smooth.



73

On Salicaceae: **Populus balsamifera** L., Conn., N.H.; Sask.; Newf.—**P. candicans** Michx., Iowa, Mass., Pa., W.Va., Wis.—**P. deltoides** Marsh.(*P. canadensis* Moench, *P. medusa* Benth., *P. monilifera* Ait.), Ala., Ark., Conn., Ill., Ind., Iowa, La., Me., Mass., Mich., Minn., Miss., Mo., N. Y., N.D., Ohio, Okla., S.C., S.D., Tex., W.Va., Wis.; Sask.—**P. dilatata** Ait.(*P. pyramidalis* Salisb.), Pa.—**P. occidentalis** (Rydb.)Britt.(*P. sargentii* Dode), Iowa, Kans., Neb., S.D.—**P. tremuloides** Michx., Ariz., Conn., Ind., Mass., Mich., N.H., N.Y., Ohio, Pa., Tex., Vt., Wis.—**P. wislizeni** (Wats.)Sarg., N.M.

Range: Nova Scotia to North Dakota and southward to South Carolina and New Mexico; doubtfully in South America.

Successful cultures were made by Arthur in 1903 and later (Jour. Myc. **10:** 13. 1904; same **11:** 52. 1905; same **12:** 13. 1906; Mycol. **1:** 242. 1909), by sowing teliospores on *Larix*, and with confirmatory cultures made in 1917 by Weir and Hubert (Phytop. **7:** 108. 1917).

2. MELAMPSORA ALBERTENSIS. Fig. 74.

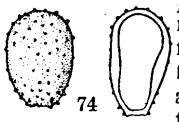
(N. A. F. 7: 101, 665.)

Melampsora albertensis Arth., Bull. Torrey Club **33:** 517. 1906.
(*Caeoma occidentale* Arth., Bull. Torrey Club **34:** 591. 1907.)
(*Caeoma pseudotsugae-douglasii* Tubeuf, Nat. Zeits. Forst. Landw. **12:** 91. 1914.)
Melampsora pseudotsugae Tubeuf, Nat. Zeits. Forst. Landw. **12:** 91. 1914.

Pycnia amphigenous, subcuticular, minute, inconspicuous. Aecia hypophyllous, roundish or oblong, 0.3–1 mm. or more long, orange-yellow when fresh; aeciospores broadly ellipsoid, 20–24 by 27–32 μ; wall colorless, 1.5–2.5 μ thick, finely verrucose.

On Pinaceae: **Pseudotsuga mucronata** (Raf.)Sudw.(*P. taxifolia* Britt., *Abies douglasii* Lindl.), Colo., Ida., Mont., Ore., Utah, Wash., Wyo.; B.C.

Uredia hypophyllous, round, pulverulent, yellow when fresh; urediospores broadly ellipsoid, usually flattened laterally, 15–22 by 23–32 μ, with intermixed paraphyses; wall colorless, 1.5–2 μ thick and more or less verrucose, nearly twice as thick and nearly or quite smooth on the flattened sides. Telia chiefly hypophyllous, small, often confluent, usually crowded in more or less extensive, fused, cereous areas about the uredia, subepidermal, orange-brown when fresh; teliospores prismatic, 10–13 by 29–39 μ; wall golden-brown, about 1 μ thick at sides, 2–3 μ above, smooth.


74

On Salicaceae: **Populus acuminata** Rydb., Colo.—**P. angustifolia** James, Colo.—**P. balsamifera** L., Colo., Mont., Wash.—**P. occidentalis** (Rydb.)Britt. (*P. sargentii* Dode), Colo., Mont.—**P. tremuloides** Michx., Colo., Ida., Mont., N.M., Ore., Utah, Wash., Wyo.; Alta., B.C.

Range: Colorado and Wyoming westward to Oregon and British Columbia; also in northern Lower California.

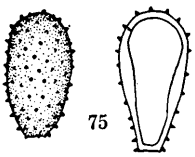
Successful cultures were made in 1910 by Arthur (Mycol. **4:** 29. 1912) upon three different dates, and again in 1911 (same **4:** 58. 1912), each time using teliospores and sowing upon *Larix* and *Pseudotsuga*. The results were uniform in infecting *Pseudotsuga* but not *Larix*. Cultures undertaken in 1917 by Weir and Hubert (Phytop. **8:** 327. 1918) proved inconclusive.

3. MELAMPSORA OCCIDENTALIS. Fig. 75.

(N. A. F. 7: 666.)

Melampsora occidentalis Jacks., Phytop. **7:** 354. 1917.

Pycnia and aecia unknown. Uredia chiefly hypophyllous, roundish, pulverulent, orange-yellow when fresh; urediospores ellipsoid, oblong or pyriform, slightly flattened laterally, 16–29 by 32–48 μ, with intermixed paraphyses; wall colorless, 2–3 μ thick, twice as thick on the flattened sides, prominently echinulate, without smooth spots. Telia chiefly hypophyllous, scattered, or often confluent about the uredia, roundish, small, waxy, light cinnamon-brown when fresh, subepidermal; teliospores prismatic, 10–20 by 40–64 μ; wall cinnamon-brown, 1–2 μ thick at sides, 3–5 μ and darker above, smooth.


75

On Salicaceae: **Populus acuminata** Rydb., Mont., Wyo.; B.C.—**P. angustifolia** James, Calif., Mont., Wash., Wyo.—**P. balsamifera** L., Ida., Mont., Wash., Wis.; B.C.—**P. candicans** Michx., Mont.—**P. dilatata** Ait.(*P. pyramidalis* Salisb.), Calif.—**P. fremontii** Wats., Calif.—**P. hastata** Dode, Mont.—**P. trichocarpa** T.&G., Calif., Ida., Mont., Ore., Wash.; B.C. **Range:** British Columbia and southern California eastward to Wyoming.

It has been suggested by Jackson (Phytop. **7:** 355. 1917) that the alternate host is probably *Larix*, but no cultures have been undertaken.

4. MELAMPSORA ABIETIS-CANADENSIS. Fig. 76.

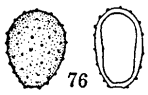
(N. A. F. 7: 664, 814.)

(*Caeoma abietis-canadensis* Farl., Proc. Am. Acad. **20:** 323. 1885.)
(*Peridermium fructigenum* Arth., Bull. Torrey Club **37:** 578. 1910.)
Melampsora abietis-canadensis [Farl.] C. A. Ludwig, Phytop. **5:** 279. 1915.
Melampsora populi-tsugae J. J. Davis, Trans. Wis. Acad. **19:** 676. 1919.

Pycnia amphigenous, punctiform, noticeable, subcuticular. Aecia amphigenous and also on young stems and cones, oblong, often crowded, subepidermal, somewhat pulverulent; aeciospores broadly ellipsoid or obovate, 13–18 by 17–26 μ; wall colorless, 1–2 μ thick, finely verrucose.

On Pinaceae: **Tsuga canadensis** (L.)Carr.(*Abies c.* Michx.), Conn., Mass., N.Y., Pa., Wis.; N.S., Queb.

Uredia chiefly amphigenous, round, orange-yellow when fresh, pulverulent; urediospores broadly ellipsoid or globoid, occasionally flattened laterally, 13–18 by 16–24 μ, with paraphyses intermixed; wall colorless, 1–2 μ thick, or twice as thick on the flattened sides, sparsely and evenly verrucose, sometimes with a smooth spot on the flattened sides. Telia chiefly amphigenous, roundish, small, sometimes confluent, subepidermal, reddish-brown when fresh; teliospores prismatic, 9–12 by 30–40 μ; wall cinnamon-brown, 1 μ thick, or slightly thicker above, smooth.


76

On Salicaceae: **Populus candicans** Michx., Conn., Mass., Mich.—**P. grandidentata** Michx., Conn., Ind., Mich., N.Y., Ohio, Pa., W.Va.; N.S., Ont., Queb.—**P. heterophylla** L., Ind.—**P. occidentalis** (Rydb.)Britt.(*P. sargentii* Dode), Colo., Iowa.—**P. tremuloides** Michx., Conn., Ind., Me., N.H., Ohio, Pa., Vt.; Ont., Queb.

Range: Nova Scotia to Wisconsin, southward to Pennsylvania and Iowa.

Successful cultures were made in 1911 by Fraser (Mycol. **4:** 188. 1912), and again in 1912 (same **5:** 238. 1913) and 1913 (same **6:** 26. 1914), using teliospores from *Populus grandidentata* on *Tsuga canadensis.* In the first trial a few pycnia were produced on *Larix,* which led to the suggestion that the rust might be considered a form of *M. medusae,* to which it is undoubtedly closely related. In 1922 Clinton (Ann. Rep. Conn. Agric. Exper. Sta. **47:** 493. 1924) used aeciospores from *Tsuga canadensis* on *P. grandidentata* with ample results, and with slight infection on *P. tremuloides.*

Melampsora farlowii.

(N. A. F. 7: 114, 682, 819.)

Necium farlowii Arth., N. Am. Flora **7:** 114. 1907.
Chrysomyxa farlowii Sacc. & Trav.; Sacc., Syll. Fung. **19:** 284. 1910.
Melampsora farlowii (Arth.) J. J. Davis, Trans. Wis. Acad. **18:** 107. 1915.

Pycnia obsolete. Aecia and uredia wanting. Telia hypophyllous and on cones, linear, confluent, waxy, reddish, subepidermal; teliospores oblong or cylindric, 7–10 by 35–58 μ; wall pale-brown, uniformly 0.5–1 μ thick or slightly thicker above, smooth.

On Pinaceae: **Tsuga canadensis** (L.)Carr.(*Abies c.* Michx.), Conn., Mass., N.H., W.Va., Wis.; N.S. **Range:** Northeastern United States and Canada.

Cultures were made by Fraser (Mycol. **4:** 182. 1912) in 1911, using teliospores on *Tsuga canadensis,* confirming the microcyclic character of the rust. The correlation of this species with *Melampsora abietis-canadensis* is one of the few cases among the Melampsoraceae, which can be confidently accepted. The agreement in characters of the teliospores, hosts and distribution between the macrocyclic and microcyclic forms is

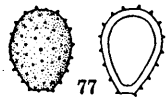
particularly striking. The correlation has been noted by Jackson (Mem. Torrey Club **18:** 29. 1931).

5. MELAMPSORA AECIDIOIDES. Fig. 77.

(N. A. F. 7: 665.)

Uredo aecidioides DC., Fl. Fr. **2:** 236. 1805.
Melampsora aecidioides (DC.) Schroet., Krypt.-Fl. Schl. **3**[1]**:** 326. 1887.

Pycnia and aecia unknown. Uredia from over-wintered bud-protected urediospores large and caeomoid, early general infection epiphyllous, small, uniformly round and aecidioid, later infection hypophyllous, less regular in form, very pulverulent, yellow, all forms with peripheral incurved paraphyses, most abundant and prominent in aecidioid forms; urediospores obovate or broadly ellipsoid, 15–22 by 20–30 μ; wall yellowish or colorless, 2–3 μ thick, prominently echinulate-verrucose, without smooth spot. Telia not positively known.


77

On Salicaceae: **Populus alba** L., Calif., Colo., Ore., R.I., Wash. **Range:** Local on Atlantic border, common on Pacific border from Washington to central California; also in Europe and India.

A culture, which is now believed to have been an error, was reported by Plowright in 1887 (Brit. Ured. 242. 1889). The name has been used in various connections by different writers. The species was assigned to *M. abietis-canadensis* in the N. Am. Flora. The collections from Ontario (Barth., N. Am. Ured. *2417, 2418*), erroneously said to be on *P. alba,* and showing telia, do not belong here, although so listed in the N. Am. Flora. Telia are said by Schroeter (*l. c.*) to occur in "small brown crusts."

6. MELAMPSORA BIGELOWII. Fig. 78.

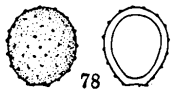
(N. A. F. 7: 100, 666, 814.)

Melampsora bigelowii Thüm., Mitth. Forstl. Vers. Oest. **2:** 37. 1879.
Lecythea macrosora Peck, Bot. Gaz. **5:** 35. 1880.
Melampsora paradoxa D. & H., Hedw. Beibl. **40:** 32. 1901.
Uredo bigelowii Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.

Pycnia amphigenous, minute, inconspicuous, subcuticular. Aecia chiefly hypophyllous, oblong, small, pale-yellow when fresh, pulverulent; aeciospores globoid, 15–22 by 18–27 μ; wall colorless, 2–3 μ thick, finely verrucose.

On Pinaceae: **Larix decidua** Mill.(*L. europaea* DC.), N.Y.—**L. laricina** (DuRoi)Koch(*L. americana* Michx.), Me., Mich., N.Y., Vt., Wis.; Alta.—**L. lyallii** Parl., Alta.—**L. occidentalis** Nutt., Mont., Ore.

Uredia chiefly hypophyllous, round, orange-yellow when fresh, somewhat pulverulent; urediospores globoid, 15–19 by 17–24 μ, with intermixed paraphyses; wall colorless, 2.5–3.5 μ thick, sparsely verrucose. Telia usually amphigenous, often confluent, orange-yellow when fresh, subepidermal; teliospores prismatic or oblong, 11–14 by 29–43 μ; wall cinnamon-brown, uniformly 1 μ thick, smooth.


78

On Salicaceae: **Salix amygdaloides** Anders., and 28 other species reported from Maine to Alaska and southward to Pennsylvania, Iowa and New Mexico (see N. Am. Flora 7: 666. 1924).

Range: Especially abundant in north-temperate regions; not known south of the United States.

Cultures were made in 1904 by Arthur (Jour. Myc. **11:** 60. 1905), and again in 1906 (same **13:** 194. 1907), using telial material, and were confirmed in 1916 by

Weir and Hubert (Phytop. **6:** 372. 1916; same **7:** 109. 1917), also using telial material.

7. MELAMPSORA ABIETI-CAPRAEARUM. Fig. 79.

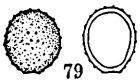
(N. A. F. **7:** 668, 814.)

(*Caeoma abietis-pectinatae* Reess, Abh. Nat. Ges. Halle **11:** 115. 1869.)
Melampsora abieti-capraearum Tubeuf, Centr. Bak. II. **9:** 241. 1902.
Melampsora humboldtiana Speg., An. Mus. Nac. Buenos Aires **23:** 28. 1912.
Melampsora americana Arth., Bull. Torrey Club **47:** 465. 1920.

Pycnia hypophyllous, inconspicuous, subcuticular. Aecia hypophyllous, oval or oblong, pulverulent, orange-yellow when fresh; aeciospores globoid or ellipsoid, 12–18 by 16–23 μ; wall colorless, 1.5–2.5 μ thick, finely verrucose.

On Pinaceae: **Abies balsamea** (L.)Mill., Mich., Pa., Wis., Vt.; N.S., Sask.—**A. concolor** Lindl.&Gord., Colo., Utah.—**A. grandis** Lindl., Ida., Mont., Ore., Wash.—**A. lasiocarpa** (Hook.)Nutt.(*A. subalpina* Engelm.), Wash.

Uredia hypophyllous, round, either very small (primary) or else large (secondary), pulverulent, orange-colored when fresh; urediospores mostly globoid, small, 13–16 by 15–20 μ, with paraphyses intermixed; wall colorless, 1.5–2 μ thick, finely verrucose. Telia hypophyllous, roundish, reddish-brown when fresh, subepidermal; teliospores oblong or prismatic, 7–12 by 30–32 μ; wall light-brown, 1 μ thick or less, slightly or not thickened above, smooth.


79

On Salicaceae: **Salix cordata** Muhl., **S. interior** Rowlee(*S. longifolia* Muhl.), **S. nigra** Marsh., and 30 other species reported from Nova Scotia to British Columbia and southward to West Virginia, Iowa and New Mexico (see N. Am. Flora 7: 669. 1925).

Range: Throughout southern Canada and all of the United States; also in Mexico, Central America, South America, and western Europe.

This rust is not common in Europe and consequently is rare in foreign collections, while in America it is the most common and wide-spread rust occurring on *Salix*. Until recently the American form has been confused with *M. arctica*, a more northern species, and has been treated under that name. In part 9 of the N. Am. Flora (**7:** 668. 1924) the name *M. humboldtiana* was adopted, but is now supplanted by the earlier name used above.

Cultures were made by Tubeuf in 1902 (Centr. Bak. II. **9:** 241) using aeciospores, and in 1917, 1918 and 1919, by Mayor (Bull. Soc. Neuch. Sc. Nat. **42:** 110. 1918; Bull. Soc. Myc. **36:** 191. 1920) using both teliospores and aeciospores. In America cultures were made in 1911 by Fraser (Mycol. **4:** 187. 1912), and again the following year (Mycol. **5:** 238. 1913), using teliospores. Cultures also were made in the open, using both aeciospores and teliospores by Bethel (Phytop. **8:** 117, 328. 1918; Bull. Torrey Club **47:** 467. 1920). Weir and Hubert (Phytop. **8:** 118. 1918) confirmed these results in 1917, using aeciospores from *Abies grandis* sown on *Salix scouleriana*.

8. MELAMPSORA RIBESII-PURPUREAE. Fig. 80.

(N. A. F. **7:** 99, 667, 814.)

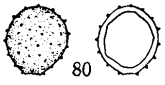
(*Uredo confluens* Pers., Obs. Myc. **1:** 98. 1796.)
(*Caeoma ribesii* Link, in Willd., Sp. Pl. 6^2: 28. 1825.)
(*Uredo ribicola* Lasch, in Klotzsch, Herb. Myc. *490*. 1842; Rab., Krypt. Fl. **1:** 579. 1844.)
Melampsora ribesii-purpureae Kleb., Jahrb. Wiss. Bot. **35:** 667. 1901.
Melampsora ribesii-auritae Kleb., Jahrb. Wiss. Bot. **35:** 668. 1901.
Melampsora ribesii-salicum Bubák, Arch. Nat. Land. Böhmen 13^5: 200. 1908.
Melampsora confluens Jacks., Brooklyn Bot. Gard. Mem. **1:** 210. 1918.

Pycnia chiefly epiphyllous, crowded in small groups, punctiform, subepidermal. Aecia hypophyllous, in small groups on discolored spots, round,

bright-yellow when fresh; aeciospores globoid or broadly ellipsoid, 15–20 by 18–26 μ; wall colorless, irregularly 1.5–3 μ thick, finely verrucose.

On Grossulariaceae: **Grossularia divaricata** (Dougl.)Cov.&Britt.(*Ribes d.*), B.C.—**G. inermis** (Rydb.)Cov.&Britt.(*R. i., R. vallicola* Greene), Utah.—**G. leptantha** (Gray)Cov.&Britt.(*R. l.*), Utah.—**Ribes aureum** Pursh(*Chrysobotrya a.* Rydb.), Utah.—**R. echinatum** Lindl.(*Lymnobotrya e.* Rydb.), Ore., Wash.; B.C.—**R. nevadense** Kellogg, Calif.—**R. petiolare** Dougl., Utah, Wyo.—**R. triste** Pall.(*R. rubrum* Gray, not L.), Yukon.

Uredia chiefly hypophyllous, round, pulvinate, pale orange-yellow when fresh; urediospores globoid or broadly ovoid, small, 14–18 by 12–20 μ, with intermixed paraphyses; wall colorless, irregularly 2–3.5 μ thick, sparsely echinulate-verrucose. Telia chiefly hypophyllous, round, often covering the entire surface, brownish; teliospores oblong, rounded at both ends, 7–11 by 20–35 μ; wall light-brown, uniformly 1 μ thick or less, smooth.


80

On Salicaceae: **Salix**, 14 species reported from central Yukon to New Mexico and central California (see N. Am. Flora **7**: 99, 667).

Range: Mountainous regions of western Canada and the United States; also in Europe.

A summary of culture work done in Europe is given in Klebahn, Wirtswechselnde Rostpilze 424, where the results seem to justify the separation of the species into two forms under the names *M. ribesii-purpureae* Kleb. and *M. ribesii-auritae* Kleb. No cultures have been undertaken in America.

The descriptions of Persoon's *Uredo confluens* and Link's *Caeoma ribesii* apply only to aecia, and the names are therefore not tenable. A portion of Lasch's *Uredo ribicola* has been examined both by Sydow (Monog. Ured. **4**: 590) and by the writer. It proves to be a form of *Caeoma* and not true *Uredo* as heretofore assumed (see Sydow, Monog. Ured. **3**: 568. 1915; Arthur, Phytop. **23**: 560. 1933).

9. MELAMPSORA ARCTICA. Fig. 81.

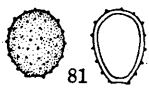
(N. A. F. 7: 99, 100, 669.)

Melampsora arctica Rostr., Medd. Grønland **3**: 535. 1888.
Melampsora alpina Juel, Oefv. Sv. Vet. Akad. Forh. **1894**: 417. 1894.
Uredo alpina Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.
Uredo rostrupiana Arth., N. Am. Flora **7**: 100. 1907.

Pycnia amphigenous, subepidermal. Aecia chiefly hypophyllous, orange-red when fresh, pulverulent; aeciospores globoid or broadly ellipsoid, 18–21 by 21–26 μ; wall colorless, 2.5–3.5 μ thick, finely verrucose.

On Saxifragaceae: **Antiphylla oppositifolia** (L.)Fourr.(*Saxifraga o.*), Greenl.—**Leptasea flagellaris** (Willd.)Small(*Saxifraga f.*), Colo.—**Saxifraga bracteata** D.Don, Alas.

Uredia chiefly hypophyllous, round, orange-yellow when fresh, pulverulent; urediospores globoid or broadly ellipsoid, 13–18 by 17–21 μ, with paraphyses intermixed; wall colorless, 1.5–2 μ thick, sparsely verrucose. Telia amphigenous, round, sometimes confluent, chestnut-brown, subepidermal; teliospores oblong or prismatic, 9–13 by 25–40 μ; wall golden-brown, uniformly 1 μ thick, smooth.


81

On Salicaceae: **Salix anglorum** Cham., Alta., B.C.—**S. arbusculoides** Anders., Alta.—**S. balsamifera** (Hook.)Barratt, Alta.—**S. chamissonis** Anders., Alas.—**S. fuscescens** Anders., Alas.—**S. glauca** L., Greenl.—**S. glaucops**

Anders., Alta.—**S. groenlandica** (Anders.)Lundst., Greenl.—**S. herbacea** L., N.H.; Greenl.—**S. myrtillifolia** Anders., Alta.—**S. ovalifolia** Trautv., Alas.—**S. petrophila** Rydb., Alta., B.C.—**S. polaris** Wahl., Alas.—**S. sitchensis** Bong., Alas.—**S. stolonifera** Cov., Alas.

Range: Summits of Mt. Washington and Pikes Peak, and boreal regions northward from Greenland to Alberta and Alaska; also in Europe.

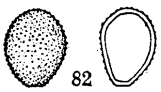
The only cultures reported were made by Jacky (Ber. Schweiz. Bot. Ges. **9:** 49. 1899).

10. MELAMPSORA LINI. Fig. 82.

(N. A. F. 7: 101, 670, 817.)

Uredo miniata β lini Pers., Syn. Fung. 216. 1801.
Xyloma lini Ehrenb., Sylvae Myc. Berol. 27. 1818.
Melampsora lini (Pers.) Lév., Ann. Sci. Nat. III. **8:** 376. 1847.
Melampsora liniperda Palm, Sv. Bot. Tidskr. **4:** (4). 1910.

Pycnia amphigenous, inconspicuous, subepidermal. Aecia chiefly hypophyllous, conspicuous, orange-yellow when fresh, subepidermal; aeciospores globoid, 19–27 by 21–28 μ; wall colorless, about 1 μ thick, finely verrucose. Uredia amphigenous and caulicolous, reddish-yellow when fresh, pulverulent; urediospores broadly ellipsoid or obovate, 13–20 by 15–25 μ, with paraphyses intermixed; wall colorless, 2 μ thick, finely verrucose. Telia amphigenous and caulicolous, often confluent, reddish-brown when fresh, subepidermal; teliospores prismatic, 10–20 by 42–50 μ; wall brown, about 1 μ thick, smooth.


82

On Linaceae: **Linum australe** Heller, N.M.—**L. berlandieri** Hook.(*L. arkansanum* Osterh.), Wyo.—**L. breweri** Gray, Calif.—**L. congestum** Gray, Calif.—**L. drymarioides** Gray, Calif.—**L. lewisii** Pursh(*L. perenne* Nutt.), Ariz., Calif., Colo., Ida., Mont., Neb., Nev., N.M., N.D., Ore., S.D., Utah, Wyo.; Alta., Man.—**L. medium** (Planch)Britt., N.Y.—**L. micranthum** Gray, Calif.—**L. puberulum** (Engelm.)Small, Wyo.—**L. rigidum** Pursh, Kans., Mont., Neb., N.D.; Sask.—**L. sulcatum** Ridd., Iowa, N.D., S.D., Wis., Wyo.—**L. usitatissimum** L., Conn., Iowa, N.D.; Ont., Sask.—**L. virginianum** L., N.Y. **Range:** Manitoba to Alberta, southward to New Mexico and Nevada, and on *L. usitatissimum* and *L. virginianum* eastward to Connecticut and Ontario; also in Europe, Japan and New Zealand.

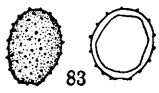
Cultures establishing the full life cycle were made by Arthur (Jour. Myc. **13:** 207. 1907), using teliospores. The size of the teliospores and cultures with urediospores indicate that two or more biologic forms exist, one of which occurring on *L. usitatissimum* has been named *M. lini liniperda* Körn. (1865).

11. MELAMPSORA MONTICOLA. Fig. 83.

(N. A. F. 7: 670, 814.)

Melampsora monticola Mains, Phytop. **7:** 103. 1917.

Pycnia and aecia unknown. Uredia amphigenous and caulicolous, long covered by the epidermis, orange-yellow when fresh, pulverulent; urediospores globoid, ellipsoid or obovoid, 13–20 by 16–29 μ, with paraphyses intermixed; wall colorless, 1.5–3 μ thick, finely and closely echinulate. Telia amphigenous and caulicolous, circinating about the uredia, blackish-brown, subepidermal; teliospores prismatic, 9–16 by 27–56 μ, rounded at both ends; wall light chestnut-brown, darker above, 1–2 μ thick at sides, 2–4 μ above, smooth.


83

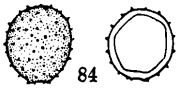
On Euphorbiaceae: **Tithymalus leptocerus** (Engelm.)Arth.(*Euphorbia l.*), Ariz., Calif., Ore.—**T. palmeri** (Engelm.)Abrams(*E. p.*),Calif.—**T. robustus** (Engelm.)Small(*E. r.*), Colo., Neb., S.D., Utah, Wyo. **Range:** Wyoming and western Nebraska to central and southern California.

12. MELAMPSORA EUPHORBIAE. Fig. 84.

(N. A. F. 7: 670.)

Uredo euphorbiae-helioscopiae β euphorbiae-exiguae Pers., Syn. Fung. 215. 1801.
Xyloma (Placuntium) euphorbiae Schub., in Ficinus, Fl. Dresd. Ed. 2. 310. 1823.
Melampsora euphorbiae (Schub.) Cast., Obs. Myc. **2:** 18. 1843.
Melampsora euphorbiae-exiguae W. Müll., Centr. Bak. II. **19:** 449, 561. 1907.
Melampsora euphorbiae-pepli W. Müll., Centr. Bak. II. **19:** 450, 553. 1907.
Melampsora euphorbiae-cyparissiae W. Müll., Centr. Bak. II. **19:** 453, 561. 1907.
Melampsora cyparissiae W. Müll., Centr. Bak. II. **19:** 561. 1907.

Pycnia hemispheric. Aecia foliicolous and caulicolous, orange-yellow when fresh; aeciospores globoid or ellipsoid, 19–24 by 21–28 μ; wall colorless, closely verrucose. Uredia amphigenous or caulicolous, pulvinate from the mass of paraphyses, golden-yellow when fresh, pulverulent; urediospores globoid or ellipsoid, 13–19 by 17–23 μ, with paraphyses intermixed; wall colorless, 2–3 μ thick, finely echinulate. Telia amphigenous and occasionally caulicolous, small, dark chocolate-brown; teliospores prismatic, 7–13 by 32–45 μ; wall light chestnut-brown below, darker above, uniformly 1–1.5 μ thick, smooth.


84

On Euphorbiaceae: **Tithymalus cyparissias** (L.)Hill(*Euphorbia c.*), Ind., Me., Mass., Mich., N.H., Pa. **Range:** Locally from Maine and Massachusetts to Indiana; also in southern Mexico, Europe and Africa.

Extensive cultural and morphologic studies were made by W. Müller (Centr. Bak. II. **19:** 441–460, 544–563. 1907), delimiting the species and showing it to be separable into three biologic forms, to which he gave names as indicated above in the synonymy.

13. MELAMPSORA EUPHORBIAE-GERARDIANAE. Fig. 85.

(N. A. F. 7: 671.)

Melampsora euphorbiae-gerardianae W. Müll., Centr. Bak. II. **19:** 452, 548. 1907.

Pycnia and aecia unknown. Uredia amphigenous and caulicolous, pulvinate due to the crowded paraphyses, pale-yellow, pulverulent; urediospores globoid or ellipsoid, 13–16 by 16–20 μ, with paraphyses intermixed; wall colorless, 2–3 μ thick, finely echinulate. Telia caulicolous, probably also amphigenous, circinating about the uredia, blackish-brown, subepidermal; teliospores prismatic, 9–15 by 31–60 μ, rounded at both ends; wall light chestnut-brown below, darker above, 1.5 μ thick at sides, 3–6 μ above, smooth.


85

On Euphorbiaceae: **Tithymalus commutatus** (Engelm.)K.&G.(*Euphorbia c.*), Ind., W.Va. **Range:** Local in northern Indiana and eastern West Virginia; also in Europe and Asia.

Uredial cultures and morphologic studies were made by W. Müller (Centr. Bak. II. **19:** 452, 548. 1907), delimiting the species.

14. MELAMPSORA PISCARIAE. Fig. 86.

(N. A. F. 7: 671.)

Melampsora piscariae Jacks., Brooklyn Bot. Gard. Mem. **1:** 212. 1918.

Pycnia and aecia unknown. Uredia hypophyllous, round, orange-yellow when fresh, somewhat pulverulent; urediospores globoid or ellipsoid, 14–16 by 16–19 μ, with paraphyses intermixed; wall colorless, 1.5–2 μ thick, finely verrucose-echinulate. Telia unknown.


86

On Euphorbiaceae: **Piscaria setigera** (Hook.)Piper (*Eremocarpus s.* Benth.), Ore. **Range:** Known only in the vicinity of Corvallis, Oregon.

11. APLOPSORA Mains, 1921.

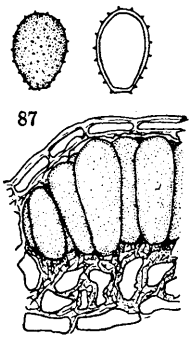
A monotypic genus, for which uredia and telia only are known, both subepidermal.

Uredia cinnamon-brown, with a short membranous peridium surmounted by a single row of paraphyses, pulverulent; urediospores borne singly on pedicels, the walls echinulate. Telia small, with a single layer of 1-celled teliospores with smooth, colorless walls.

1. APLOPSORA NYSSAE. Fig. 87.

(N. A. F. 7: 672.)

Uredo nyssae Ellis & Tr., Jour. Myc. **6:** 77. 1890.
Aplopsora nyssae (Ellis & Tr.) Mains, Am. Jour. Bot. **8:** 442. 1921.


87

Uredia hypophyllous, scattered, round, minute, early naked, cinnamon-brown, pulverulent, with peripheral paraphyses surmounting a very short peridium; urediospores obovoid or oblong, 13–17 by 16–26 μ; wall very pale cinnamon-brown, 1 μ thick, finely echinulate. Telia hypophyllous, gregarious in small groups, round, small, soon becoming naked, pale translucent-yellow, becoming cinereous by germination; teliospores in a single layer, cylindric, rounded above and below, 7–15 by 29–40 μ; wall colorless, 0.5 μ thick or less, smooth.

On Nyssaceae: **Nyssa aquatica** L., Ky., Miss. **Range:** Swamps from western Kentucky, southward through Mississippi to the Gulf of Mexico.

12. BUBAKIA Arth., 1906.

An autoecious genus of ten or more species, but the full life cycle not yet definitely known for any one species. Pycnia appear to be subcuticular, and other sori subepidermal.

Aecia uredinoid, closely resembling the uredia. Uredia erumpent, pulverulent, without peridium or paraphyses, the urediospores borne singly on pedicels, obovate or ellipsoid, with pale-yellow, echinulate walls. Telia indehiscent, compacted into dense masses, the teliospores 1-celled, catenulate, with colored walls.

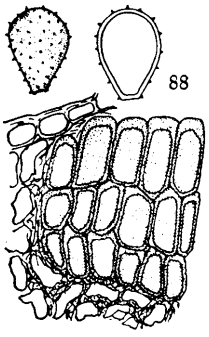
The genus is chiefly represented in Mexico and Central and South America, only one species extending into the United States. Species also occur in eastern Europe, southern Africa, Asia and Formosa. Pycnia and uredinoid aecia associated on slightly hypertrophied areas are inferred from studies by Jackson (Mycol. 23: 466. 1931) to belong in the cycle of development.

1. **BUBAKIA CROTONIS.** Fig. 88.

(N. A. F. 7: 104, 674, 814, 817.)

Trichobasis crotonis Cooke, Grev. **6:** 137. 1878.
Melampsora crotonis Burr., Bot. Gaz. **9:** 189. 1884.
Pucciniastrum crotonis De-T., in Sacc., Syll. Fung. **7:** 763. 1888.
Bubakia crotonis (Cooke) Arth., Rés. Sci. Congr. Bot. Vienne 339. 1906.
Schroeteriaster crotonis Diet.; Sydow, Monog. Ured. **3:** 401. 1914.
Phakopsora crotonis Arth., Bull. Torrey Club **44:** 508. 1917.

Pycnia and aecia unknown. Uredia amphigenous, subepidermal, round, soon dehiscent, without peridium or paraphyses, cinnamon-brown, pulverulent; urediospores obovate, 16–21 by 22–32 μ; wall yellowish, 1–1.5 μ thick, closely echinulate, the pores 4, equatorial, indistinct. Telia amphigenous and caulicolous, roundish, confluent, chocolate-brown or blackish, indehiscent; teliospores with 3–7 superposed cells at center of sorus, each cell ellipsoid, obovoid or cuboid, 10–15 by 24–40 μ, the outermost longest; wall cinnamon-brown, 2–3 μ thick at sides, thrice as thick above, smooth.


88

On Euphorbiaceae: **Croton argyranthemus** Michx., Fla.—**C. californicus** Muell.-Arg., Calif.—**C. capitatus** Michx., Ark., Ill., Ky., Miss., Mo., Okla., Tex.—**C. engelmannii** Ferguson, Ark.—**C. monanthogynus** Michx., Ala., Ark., Ill., Ind., Kans., Ky., La., Miss., Mo., Okla., Tenn., Tex.—**C. punctatus** Jacq., Fla.—**C. texensis** (Kl.)Muell.-Arg., Ariz., Kans., Neb., Tex. —**Crotonopsis linearis** Michx., Ark., Fla., Ill., Tenn. **Range:** Indiana to Nebraska, southward to Florida and Texas, and central California southward to the border; also in Mexico, Central and South America.

13. PHYSOPELLA Arth., 1906.

A genus of warm climates, of somewhat uncertain limits. Only uredia and telia known, which are subepidermal.

Uredia round, with peripheral incurved paraphyses more or less united at their bases, often forming a pseudo-peridium with the tips of the paraphyses projecting into the sorus; urediospores sessile, ellipsoid or obovate-globoid, with echinulate walls. Telia forming lenticular sori, tardily dehiscent; teliospores in chains of two to seven at center of sorus, the cells oblong or prismatic, with walls somewhat colored and smooth.

Telial host belonging to family Vitaceae. *. *P. vitis.*
Telial host belonging to family Artocarpaceae. 1. *P. fici.*

The limits of the genus have not been well defined. Similar species are sometimes referred to *Phakopsora* (uredia with paraphyses intermixed with the urediospores) or *Cerotelium* (uredia with a membraneous peridium or hyphoid paraphyses).

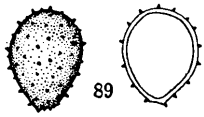
*. **Physopella vitis** (Thüm.) Arth. (*Phakopsora v.* Syd.) on **Vitis vinifera** L. from southern South Carolina southward and on **Muscadinia munsoniana** (Simpson) Small, and **Vitis teliaefolia** H. & B. in southern Florida; also in West Indies, South America and Japan. Telia, which like the uredia are hypophyllous, minute and inconspicuous, have only been collected in Japan, the reference to Florida (Phytop. **14:** 171. 1924) being an error. The uredia have been studied by the writer from the original South Carolina collection by Ravenel and named by Thümen. (N. A. F. **7:** 102, 673, 817.)

1. PHYSOPELLA FICI. Fig. 89.

(N. A. F. 7: 103, 696.)

Uredo fici Cast.; Desmaz., Pl. Crypt. (Fasc. 34) *1662*. 1848.
Uredo moricola P. Henn., Hedw. **41**: 140. 1902.
Physopella fici (Cast.) Arth., Rés. Sci. Congr. Bot. Vienne 338. 1906.
Kuehneola fici Butler, Ann. Myc. **12**: 76. 1914.
Cerotelium fici Arth., Bull. Torrey Club **44**: 509. 1917.

Pycnia and aecia unknown. Uredia hypophyllous, scattered, roundish, usually small, tardily dehiscent by central rupture, cinnamon-brown, pulverulent, with peripheral paraphyses, pale-brown and incurved, or hyphoid, erect and colorless, or wanting; urediospores ellipsoid or obovate-globoid, 14–23 by 18–32 μ; wall pale-yellowish or pale-fuscous, 1–1.5 μ thick, sparsely echinulate. Telia hypophyllous, minute, whitish; teliospores in chains of 2–7 cells, the cells broadly ellipsoid or oblong, 10–13 by 15–22 μ; wall colorless, 1–1.5 μ thick, smooth.


89

On Artocarpaceae: **Ficus carica** L., Ala., Fla., La., Miss., N.C., S.C., Tex.—**Toxylon pomiferum** Raf. (*Maclura aurantiaca* Nutt.), La., S.C. **Range**: North Carolina to Texas; also in Bermuda, West Indies, Central America, and in tropical regions throughout the world.

The telia have been seen only by Butler (*l.c.*), from whom the above description is taken. They were found in northern India, and only on *Ficus glomerata*. As uredia the species is common on various species of *Ficus*, especially so on the cultivated fig.

14. CEROTELIUM Arth., 1906.

Heteroecious rusts, the life history of only one species being fully known. The most abundant development of the genus occurs in warmer regions. Pycnia subcuticular, other sori subepidermal.

Pycnia applanate, without paraphyses. Aecia cupulate, with firm peridium, dehiscent at apex; aeciospores catenulate, globoid or ellipsoid, with verrucose walls. Uredia round, with delicate peridia, hyphoid paraphyses, or neither; urediospores borne singly, seemingly sessile, ellipsoid, with echinulate walls. Telia often arising from bed of uredia, waxy, or becoming pulverulent at maturity, whitish; teliospores 2–8-celled, the cells oblong or cuboid, with the wall colorless, thin and smooth.

Telial host belonging to family Urticaceae. 1. *C. dicentrae.*
Telial host belonging to family Malvaceae. *. *C. desmium.*

The genus is largely tropical, and has not been well studied. The uredia are usually the only form collected, the telia being inconspicuous and less often present.

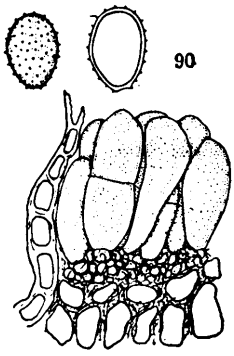
1. CEROTELIUM DICENTRAE. Fig. 90.

(N. A. F. 7: 697.)

(*Aecidium dicentrae* Trel., Trans. Wis. Acad. **6**: 136. 1884.)
Cerotelium dicentrae [Trel.] Mains & And.; Mains, Am. Jour. Bot. **8**: 445. 1921.
Cerotelium urticastri Mains, Am. Jour. Bot. **8**: 451, hyponym. 1921.

Pycnia amphigenous, usually bordering the margin of the leaf, conspicuous. Aecia hypophyllous, systemic, cupulate, with white peridium; aeciospores globoid or ellipsoid, 12–17 by 13–21 μ; wall colorless, 1 μ thick or less, finely verrucose.

On Fumariaceae: **Dicentra cucullaria** (L.)Bernh.(*Bicuculla c.* Millsp.), Ill., Ind., Iowa, Kans., Mo., Neb., N.J., N.Y., N.C., Pa., S.D., Wis.


90

Uredia hypophyllous, scattered or in small groups, not conspicuous, round, small, yellow, pulverulent, with peripheral paraphyses, colorless, hyphoid, not projecting above the ruptured epidermis; urediospores ellipsoid or obovoid, 18–21 by 20–26 μ; wall colorless, 1–1.5 μ thick, closely echinulate. Telia hypophyllous, at first arising within or surrounding the uredia, inconspicuous, tardily naked, waxy; teliospores 1–2- or 3-celled, ellipsoid or cylindric, 10–21 by 29–42 μ; wall colorless, 0.5 μ thick or less.

On Urticaceae: **Urticastrum divaricatum** (L.) Ktze.(*Laportea canadensis* Gaud.), Ill., Wis.

Range: Northern New York to South Dakota, southward to northwestern North Carolina and Kansas.

The alternate states were demonstrated in 1921 by Mains (Am. Jour. Bot. **8:** 445. 1921).

*. **Cerotelium desmium** (B. & Br.) Arth. (*Aecidium d., Uredo gossypii* Lagerh., *Kuehneola g.* Arth.), on various species of *Gossypium,* has been reported on cultivated cotton in southern Florida. It occurs in the West Indies, South America, India, Java, New Guinea and the Philippines. Only uredia are known, although first described by Berkeley & Broome under the generic name *Aecidium.* (N. A. F. **7:** 187, 698.)

15. BAEODROMUS Arth., 1905.

A microcyclic genus resembling *Puccinia* in the gross appearance and color of the sori, but with catenulate spores. The structure of the sorus is aecidioid, but without peridium, while the spores germinate upon maturity from an apical pore with a promycelium, like typical teliospores. Pycnia and telia subepidermal.

Pycnia globoid or flask-shaped; paraphyses usually present. Aecia and uredia wanting. Telia erumpent, pustular, without peridium; teliospores catenulate, 1-celled, ellipsoid, becoming pulverulent at surface of sorus; wall brownish or colorless, smooth.

Four species of the genus are known, found in California, Mexico, Guatemala and Ecuador, all on Carduaceae.

*. **Baeodromus californicus** Arth., with pycnia unknown, possibly not formed; telia amphigenous, crowded, pulvinate, pale golden-brown or nearly colorless, early naked; teliospores in loosely united chains of 4–6 spores, ellipsoid or obovate, 16–20 by 28–37 μ; wall pale cinnamon-brown, 2–3 μ thick at sides, 5–8 μ above, smooth; occurs on Carduaceae (tribe *Senecioneae*) : **Senecio douglasii** DC., in southern California. (N. A. F. **7:** 125, 700.)

PUCCINIACEAE.

Telia usually well circumscribed; teliospores pedicelled or sessile, free or fascicled, but not united laterally, except when borne on a stalk.

Teliospores borne on a compound pedicel, or on pedicels jointed to a fascicled base, or single on unjointed pedicels, the pedicels hyaline; aecia aecidioid or uredinoid; pycnia subcuticular or subepidermal; uredia without peridia, with discal paraphyses or none; urediospores echinulate or verrucose, often with wall thicker above: RAVENELIEAE.

- Teliospores united into a head on a compound pedicel with hyaline cysts; aecia aecidioid (§ *Neoravenelia*), or aecia uredinoid (§ *Euravenelia*). — 1. *Ravenelia.*
- Teliospores 1-celled, flattened vertically, on unjointed pedicels; aecia uredinoid. — 2. *Pileolaria.*
- Teliospores 2-celled, with jointed pedicels and fascicled base; aecia aecidioid. — 3. *Tranzschelia.*
- Teliospores 2-celled, with 2 lateral pores in each cell; teliospore-pedicel continuous, solid; aecia aecidioid. — 4. *Cumminsiella.*

Teliospores borne on simple, hyaline pedicels, smooth or verrucose, with pores lateral if more than one in a cell; aecia caeomoid or uredinoid; pycnia subcuticular; uredia with peripheral paraphyses or none: PHRAGMIDIEAE.

- Teliospores verrucose, with 2 pores in each cell; teliospore-pedicel continuous, inflated in water; aecia uredinoid. — 5. *Uropyxis.*
- Teliospores verrucose, with 4 pores in each cell; teliospore-pedicel solid above, delicate and evanescent below; aecia caeomoid. — 6. *Phragmopyxis.*
- Teliospores verrucose or smooth, with 2 or 3 pores in each cell; teliospore-pedicel continuous, a portion inflated in water (§ *Euphragmidium*), or solid (§ *Earlea*); aecia caeomoid. — 7. *Phragmidium.*
- Teliospores smooth, many-celled, 2 pores in each cell except the terminal with 1 pore; without uredia; aecia caeomoid. — 8. *Xenodochus.*
- Teliospores smooth, 1–many-celled, 1 pore in each cell; uredia with few or no paraphyses; aecia uredinoid. — 9. *Frommea.*
  - Teliospore with several firmly united cells. — 10. *Kuehneola.*
  - Teliospore with several articulated but readily separating cells. — 11. *Mainsia.*
  - Teliospore with only one cell.
- Teliospores smooth, 2-celled (or verrucose and 1-celled in *Kunkelia*); without uredia; aecia caeomoid. — 12. *Gymnoconia.*
- Teliospores tuberculate, 1-celled; without uredia; aecia uredinoid. — 13. *Trachyspora.*
- Teliospores verrucose, triquetrously 3-celled, 1 pore in each cell; uredia with peripheral paraphyses; aecia uredinoid. — 14. *Triphragmium.*
- Teliospores spinose, triquetrously 3-celled, 2 pores in each cell; uredia wanting; aecia uredinoid. — 15. *Nyssopsora.*

Teliospores pedicelled, (except in *Endophyllum*), 1- or 2-celled, rarely more, smooth or verrucose, the one or more pores apical or basal, or approximately so; aecia aecidioid or uredinoid; pycnia subepidermal; uredia without peridia or (usually) paraphyses: AECIDIEAE.

- Teliospores 1- or 2-celled, oblong or clavate, usually with a thickened apex, firm pedicel, smooth wall and apical pores; aecia aecidioid (§ *Eupuccinia*), or teliospores mostly ellipsoid or globoid with a papillate apex, fragile pedicel, verrucose wall and depressed pores; aecia aecidioid or uredinoid (§ *Bullaria*). — 16. *Puccinia* (*Uromyces*).
- Teliospores 2-celled, rarely more, the pedicels gelatinous; aecia cupulate (§ *Gymnotelium*), or cornute (§ *Eugymnosporangium*); with or usually without uredia. — 17. *Gymnosporangium.*

1. RAVENELIA Berk., 1853.

A large autoecious genus of tropical rusts, only a few species reaching northward into the United States. The genus is characterized by its

large, cyst-bearing teliospore-heads. Uredinoid aecia, which are scarcely distinguishable from the uredia, are most common, but aecia with catenulate spores are known in a few species (§ *Neoravenelia*). The occurrence of paraphyses among the urediospores in many species recalls the similar but more pronounced development in *Melampsora*.

Pycnia when present subcuticular, without paraphyses, or (on Fabaceae) subepidermal with paraphyses. Aecia when present aecidioid, with or without peridia, or uredinoid, and then in most species scarcely differing from the uredia. Uredia when present without peridia, the paraphyses when present either peripheral or more usually intermixed with the spores; urediospores pedicellate, globoid, ellipsoid or oblong, with the walls colored, echinulate or verrucose. Telia erumpent; teliospores fascicled on compound, colorless pedicels, forming colored heads, encircled by hyaline cysts.

Aecia with catenulate spores (§ *Neoravenelia* Long, 1903).
- Host belonging to family Mimosaceae.
  - Uredia present.
    - Urediospore-pores 4. *. *R. holwayi.*
    - Urediospore-pores 6. *. *R. subtortuosae.*
  - Uredia wanting. *. *R. hieronymi*(d).

Aecia with pedicellate spores (§ *Euravenelia*).
- Host belonging to family Mimosaceae.
  - Urediospore-pores in one zone.
    - Urediospore-wall thicker above, 3–6 μ.
      - Paraphyses abundant. *. *R. arizonica.*
      - Paraphyses wanting. *. *R. pithecolobii.*
    - Urediospore-wall not or slightly thicker above.
      - Paraphyses wanting. *. *R. siderocarpi.*
      - Paraphyses present.
        - Urediospores obovate, rounded above.
          - Urediospore-pores equatorial.
            - Paraphyses peripheral. *. *R. australis.*
            - Paraphyses intermixed. *. *R. gracilis.*
          - Urediospore-pores subequatorial. *. *R. leucanae.*
        - Urediospores ovate, acute above. *. *R. annulata.*
  - Urediospore-pores in two zones.
    - Urediospore-wall much paler below.
      - Urediospore-wall minutely echinulate. *. *R. versatilis.*
      - Urediospore-wall prominently echinulate. *. *R. roemerianae.*
    - Urediospore-wall concolorous.
      - Urediospore-wall echinulate. *. *R. siliquae.*
      - Urediospore-wall verrucose. *. *R. thornberiana.*
  - Urediospore-pores scattered.
    - Urediospore-wall thin, 1–1.5 μ.
      - Urediospore-wall echinulate-verrucose; teliospores tuberculate. *. *R. igualica.*
      - Urediospore-wall verrucose; teliospores smooth.
        - Paraphyses terete. *. *R. gooddingii.*
        - Paraphyses clavate or spathulate. *. *R. reticulatae.*
    - Urediospore-wall thicker, 1.5–2.5 μ.
      - Paraphyses clavate or capitate.
        - Urediospores 18–20 by 18–24 μ. *. *R. texensis.*
        - Urediospores 14–18 by 15–20 μ. *. *R. morongiae.*
      - Paraphyses cylindric. *. *R. fragrans.*
- Host belonging to family Caesalpiniaceae.
  - Uredia and urediospores wanting. 1. *R. opaca* (m).
  - Urediospore-pores scattered.
    - Paraphyses wanting. 2. *R. cassiaecola.*
    - Paraphyses present.
      - Paraphyses mostly-cylindric; thick walled. *. *R. mesillana.*
      - Paraphyses mostly clavate-capitate; thin walled. *. *R. papillifera.*
  - Urediospore-pores in 2 zones.
    - Urediospore-wall thin, 1–1.5 μ. *. *R. hoffmanseggiae.*
    - Urediospore-wall thick, 2–2.5 μ. *. *R. cassiae-covesii.*
- Host belonging to family Fabaceae.
  - Urediospore-wall thick, 2.5–3 μ. 3. *R. epiphylla.*
  - Urediospore-wall thin, 1–1.5 μ. *. *R. piscidiae.*

In the "Monographia Uredinearum" by Sydow 100 species are described. All the species here enumerated are on leguminous hosts, but a few species in other parts of the world occur on Euphorbiaceae, and one species on Tiliaceae.

In the majority of the species the pycnia are unknown and the same is true of the uredinoid aecia. At the time of writing the early portion of the rusts for the North American Flora (1907) the uredinoid aecia had not been recognized as distinct from the ordinary uredia, hence whenever present they were incorporated in the description of the uredia. In the supplement (1925) the uredinoid aecia are described as the "primary form" of the uredia. Uredia are wanting in only two species.

In some species the central spores of the telial-head are divided by transverse walls into two or three cells. Such species have been segregated under the genus *Haploravenelia* by Sydow (Ann. Myc. **19**: 165. 1921).

Only two species flourish in the temperate zone, and one other is rare. A number of species are found along the narrow semi-tropical area of the United States, a few extending northward to southern Ohio and northern Texas. The genus is best represented in the West Indies, Mexico, Central and South America, southern Africa, southern Asia, and Japan.

*. **Ravenelia holwayi** Diet. (*Neoravenelia h.* Long), with amphigenous pycnia and aecia on hypertrophied areas, the latter without peridium, aeciospores oblong, irregular, 13–21 by 24–42 μ, the wall golden-brown, 2–3.5 μ thick, verrucose, with 4 equatorial pores; uredia amphigenous, cinnamon- or chestnut-brown, urediospores ovoid or obovate-fusiform, 15–19 by 24–42 μ, with capitate paraphyses intermixed, the wall golden-brown, 2.5–4 μ thick at sides, nearly twice as thick above, echinulate-verrucose, with 4 equatorial pores; telia amphigenous, large, shining, the teliospore-heads dark chestnut-brown, 65–125 μ in diameter, 7–10 cells across, smooth, with 15–20 pendent cysts, the pedicel short, deciduous, occurs on MIMOSACEAE: **Prosopis glandulosa** Torr., in southern Texas, and **P. juliflora** (Sw.)DC., one locality in northern Texas, otherwise in southern Texas and southern California. (N. A. F. **7**: 130, 704.)

*. **Ravenelia subtortuosae** Long (*Neoravenelia s.* Arth.), possesses caulicolous aecia with short fragile peridia, and globoid aeciospores, 13–18 by 18–23 μ; urediospores with thin walls, 6 equatorial pores, and abundant paraphyses, peripheral, incurved; teliospore-heads 3–6 cells across, smooth; occurs on MIMOSACEAE: **Acacia tortuosa** (L.)Willd., in southernmost Texas, often forming witches' brooms. (N. A. F. **7**: 704.)

*. **Ravenelia hieronymi** Speg. (*Cystingophora h.* Arth.), possesses caulicolous aecia with firm, cylindric peridia, and irregularly globoid or ovoid aeciospores, 12–18 by 19–30 μ; uredia wanting; teliospore-heads 6–9 cells across, smooth, often forms witches' brooms; occurs on MIMOSACEAE: **Vachellia farnesiana** (L.)W.&A.(*Acacia f.* Willd., *A. cavenia* H.&A.), in southernmost Texas; also in Mexico and South America. (N. A. F. **7**: 131, 705.)

*. **Ravenelia arizonica** E. & E. (*R. prosopidis* Long), with pyncia and aecia unknown; uredia amphigenous, sometimes forming woody galls, cinnamon-brown, urediospores fusiform-ovoid, 16–22 by 28–42 μ, with capitate paraphyses intermixed, the wall cinnamon-brown, 2–3 μ thick, slightly if any thicker above, verrucose, with 4 equatorial pores; telia amphigenous, subepidermal, with paraphyses as in uredia but less abundant, the teliospore-heads chocolate-brown, 6–8 cells across, each cell bearing a central tubercle varying from a barely perceptible papilla (rarely none) up to a spine 4–6 μ long, the peripheral cysts pendent, not much united to one another; occurs on MIMOSACEAE: **Prosopis glandulosa** Torr., in southern parts of California, New Mexico and Texas, **P. juliflora** (Sw.)DC., nearly throughout Texas, and **P. velutina** Woot. in southern Arizona. (N. A. F. **7**: 133, 708.)

*. **Ravenelia pithecolobii** Arth., with amphigenous uredia, subepidermal, cinnamon-brown, without paraphyses, urediospores ellipsoid, 15–22 by 24–32 μ, the wall 2–3 μ thick, somewhat thicker above, sparsely echinulate, with 4–6 equatorial pores; teliospore-heads 6–8 cells across, each cell bearing 2 or 3 slightly curved tubercles, 5–7 μ long, the cysts appressed beneath the head and united laterally; occurs on MIMOSACEAE: **Pithecolobium unguis-cali** (L.)Benth., in the southernmost part of Florida; also in Cuba and Mexico. (N. A. F. **7**: 133, 708, 821.)

*. **Ravenelia siderocarpi** Long, with epiphyllous uredia, subcuticular, chestnut-brown, without paraphyses, urediospores obovoid, 15–18 by 25–37 μ, the wall 2.5–3.5 μ thick, echinulate, with 6 equatorial pores; teliospore heads 2–4 cells across, each cell bearing 3–6 short hyaline tubercles, the cysts globoid, pendent, not cohering; occurs on MIMOSACEAE: **Pithecolobium flexicaule** (Benth.)Coult.(*Siderocarpus f.* Small), in southernmost Texas. (N. A. F. **7**: 708.)

*. **Ravenelia australis** Diet. & Neg., with amphigenous uredia, subepidermal, very small, cinnamon-brown, with abundant, peripheral, incurved paraphyses, urediospores obovate, 13–20 by 25–32 μ, the wall 1.5–2 μ thick, echinulate, with 4–6 equatorial pores; teliospore-heads 7–11 cells across, smooth, the cysts subappressed in two rows; occurs on MIMOSACEAE: **Vachellia farnesiana** (L.)W.&A. (*Acacia f.* Willd., *A. cavenia* H.&A.), in southern Texas; also in South America. (N. A. F. **7:** 711.)

*. **Ravenelia gracilis** Arth., with subcuticular pycnia and uredinoid aecia like the uredia; uredia subepidermal, small, cinnamon-brown, with numerous peripheral or intermixed paraphyses, urediospores ellipsoid, 16–21 by 30–40 μ, the wall 1.5–2.5 μ thick, echinulate, with 4–6 equatorial pores; teliospore-heads 5–7 cells across, each cell bearing 4–7 slender tubercles, 3–4 μ long, the cysts appressed and united laterally; occurs on MIMOSACEAE: **Pithecolobium brevifolium** Benth. (*Havardia b.* Small), in southernmost Texas; also in Mexico. (N. A. F. **7:** 135, 712.)

*. **Ravenelia leucaenae** Long, with subcuticular uredia, cinnamon-brown, with clavate paraphyses, mostly peripheral, urediospores linear-oblong, 15–18 by 30–50 μ, the wall pale cinnamon-brown above, nearly colorless below, 1–2 μ thick, sparsely echinulate-verrucose, with 4 subequatorial pores; teliospore-heads 5–6 cells across, each cell bearing 4 or 5 tubercles, 3–6 μ long, the cysts appressed; occurs on MIMOSACEAE: **Leucaena pulverulenta** (Schl.)Benth., in southernmost Texas; also in Mexico. (N. A. F. **7:** 134, 710.)

*. **Ravenelia annulata** Long, with epiphyllous, subepidermal, cinnamon-brown uredia, with few clavate paraphyses, urediospores ovate, acute above, 17–23 by 27–37 μ, the wall 1–2 μ thick, cinnamon-brown, sparsely echinulate, with 6 equtorial pores in a hyaline band; teliospore-heads 4–7 cells across, smooth, the cysts appressed and united laterally; occurs on MIMOSACEAE: **Lysiloma bahamensis** Benth., in southern Florida. (N. A. F. **7:** 709.)

*. **Ravenelia versatilis** (Peck) Diet. (*Uromyces v., Haploravenelia v.* Syd.), with amphigenous uredia, often forming witches' brooms, subcuticular, dark cinnamon-brown, urediospores oblong, 12–17 by 24–33 μ, with numerous capitate paraphyses intermixed, the wall golden-brown above, paler below, 1–1.5 μ thick, sparsely echinulate, with 8 pores in two zones of 4 each, one in the equator, the other near the base; telia amphigenous, subcuticular, the teliospore-heads chestnut-brown, 5–8 cells across, smooth or with very faint tubercles on the marginal cells, the peripheral cysts pendent; occurs on MIMOSACEAE: **Acacia greggii** Gray, in southern parts of Arizona, California, New Mexico and Texas. (N. A. F. **7:** 136, 713, 821.)

*. **Ravenelia roemerianae** Long, with amphigenous, or more usually fructicolous, subcuticular pycnia surrounded by uredinoid aecia, like the uredia; uredia subcuticular, yellowish-brown, urediospores linear-oblong, 10–14 by 27–38 μ, with abundant clavate-capitate paraphyses intermixed, the wall golden-brown above, paler or colorless below, 1–1.5 μ thick, sparsely echinulate below, much less so above, with 8 pores in two zones of 4 each, equidistant from the equator; teliospore-heads 5–7 cells across, each cell bearing 3–10 small colorless papillae, the cysts appressed and united laterally; occurs on MIMOSACEAE: **Acacia roemeriana** Scheele, in southern Texas. (N. A. F. **7:** 712.)

*. **Ravenelia siliquae** Long (*Haploravenelia s.* Syd.), with hypophyllous, or more usually fructicolous uredia, subcuticular, cinnamon-brown, urediospores oblong, 11–15 by 20–33 μ, with a few, small, clavate paraphyses intermixed, the wall light cinnamon-brown, 1.5–2 μ thick, with 8 pores in two irregular zones of 4 each, equidistant from the equator; telia unknown; occurs on MIMOSACEAE: **Vachellia farnesiana** (L.)W.&A.(*Acacia f.* Willd., *A. cavenia* H.&A.), in southern Texas; also in the West Indies, Mexico, Central America and Hawaii. (N. A. F. **7:** 135, 713, 821.)

*. **Ravenelia thornberiana** Long, with amphigenous, caulicolous and fructicolous uredia, forming witches' brooms, subcuticular, cinnamon-brown, urediospores ovoid, 16–18 by 20–27 μ, with clavate or subcapitate paraphyses intermixed, the wall cinnamon-brown, 1.5–2 μ thick, verrucose, with 8–12 pores in two zones of 4–6 each, equidistant from the equator; telia with paraphyses as in the uredia; teliospore-heads 4 or 5 cells across, smooth, the cysts globose, pendent in two rows; occurs on MIMOSACEAE: **Acacia constricta** Benth., in southern Arizona and southern Texas; also in Mexico. (N. A. F. **7:** 713.)

*. **Ravenelia igualica** Arth. (*Haploravenelia i.* Syd.), with uredia and telia chiefly hypophyllous, subcuticular, the uredia cinnamon-brown, urediospores globoid or ellipsoid, 14–16 by 16–19 μ, with capitate paraphyses intermixed, the wall pale cinnamon-brown, about 1 μ thick, finely verrucose, with 8–11 scattered pores; teliospore-heads chestnut-brown, 4–7 cells across, each cell bearing 5–7 short, semihyaline tubercles, the cysts pendent, globoid or ovoid; occurs on MIMOSACEAE: **Acacia angustissima** (Mill.)Ktze., in southern Texas; also in Mexico and Guatemala. The host *Acacia filicioides* (Cav.)Trel.(*A. filicina* Willd.), reported for this rust, does not occur in Texas or northern Mexico, and all collections said to be on it most likely are on *A. angustissima.* (N. A. F. **7:** 136, 714, 821.)

*. **Ravenelia gooddingii** Long, with hypophyllous uredia, subcuticular, cinnamon-brown, urediospores globoid, 12–16 by 16–19 μ, with narrowly clavate paraphyses intermixed, the wall pale-fulvous, 1–1.5 μ thick, verrucose, with 6–8 scattered pores; teliospore-heads chestnut-brown, 5–6 cells across, smooth, the cysts appressed in two rows; occurs on MIMOSACEAE: **Acacia suffrutescens** Rose, in southernmost Arizona. (N. A. F. **7:** 714.)

*. **Ravenelia reticulatae** Long, with hypophyllous uredia, subcuticular, cinnamon-brown, urediospores globoid, 16 by 16–19 μ, with clavate paraphyses intermixed, the wall pale-fulvous, 1–1.5 μ thick, verrucose, with 6–8 scattered pores; teliospore-heads light chestnut-brown, 7–9 cells across, smooth, the cysts appressed; occurs on MIMOSACEAE: **Calliandra humilis** (Schl.) Benth., and **C. reticulata** Gray, both in southern Arizona. (N. A. F. **7:** 712.)

*. **Ravenelia texensis** Ellis & Gall., with pycnia and aecia unknown; uredia amphigenous, subcuticular, cinnamon-brown, urediospores globoid, 18–20 by 18–24 μ, with capitate paraphyses intermixed, the wall golden-yellow, 2–2.5 μ thick, verrucose, the pores 6–8, scattered; teliospore-heads chestnut-brown, 5 or 6 cells across, smooth, or each cell bearing 2–4 very inconspicuous papillae, the cysts appressed, slightly cohering; occurs on MIMOSACEAE: **Desmanthus jamesii** T.&G. (*Acuan j.* Ktze.), nearly throughout Texas. (N. A. F. **7:** 137, 714.)

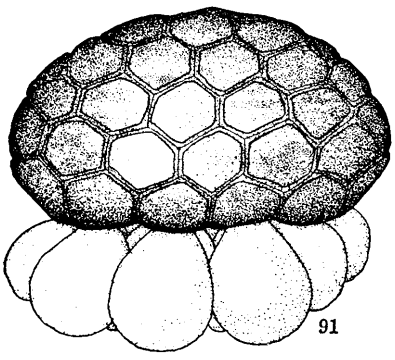
*. **Ravenelia morongiae** Long, with amphigenous and caulicolous uredia, subcuticular, light cinnamon-brown, urediospores globoid, 14–18 by 15–20 μ, with clavate or subcapitate paraphyses intermixed, the wall fulvous, 1.5–2 μ thick, densely verrucose-spinulose, with 8–12 scattered pores; teliospore heads chestnut-brown, 4–6 cells across, smooth, the cysts appressed; occurs on MIMOSACEAE: **Morongia uncinata** (Willd.) Britt. (*Schrankia u.*), in southern Texas; also in Mexico. (N. A. F. **7:** 714.)

*. **Ravenelia fragrans** Long, with amphigenous uredia, subcuticular, cinnamon-brown, urediospores globoid or ellipsoid, 13–15 by 18–23 μ, with abundant clavate paraphyses intermixed, the wall pale cinnamon-brown, 1.5–2 μ thick, minutely echinulate, with 8 or more scattered pores; teliospore-heads chestnut-brown, 5–7 cells across, each cell bearing 3 or 4 short papillae, and in addition a peripheral row of large tubercles, nearly colorless, about 2 to each marginal cell, somewhat capitate, 5–7 μ long, the cysts oblong, pendent; occurs on MIMOSACEAE: **Mimosa biuncifera** Benth., in southern Arizona, and **Mimosa fragrans** Gray, in southern Texas; also in Mexico. (N. A. F. **7:** 137, 715.)

1. RAVENELIA OPACA. Fig. 91.

(N. A. F. 7: 145.)

Ravenelia opaca Diet., Hedw. **34:** 291. 1895.
Dendroecia opaca Arth., N. Am. Flora **7:** 145. 1907.


91

Pycnia few, amphigenous, in crowded groups, subcuticular. Aecia and uredia wanting. Telia chiefly epiphyllous, subepidermal; teliospore-heads blackish, 5–7 cells across, smooth, with globoid, pendent cysts.

ON CAESALPINIACEAE: **Gleditsia triacanthos** L., Ill. **Range:** known only by the original collection made at Clear Creek, in Union County, the southernmost part of Illinois. It was issued in Seymour and Earle's "Economic Fungi," number 203.

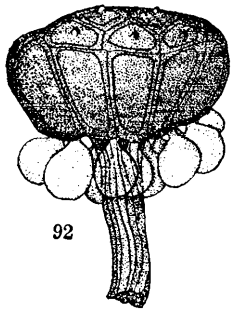
No correlated form has been found for this microcyclic species.

2. RAVENELIA CASSIAECOLA. Fig. 92.

(N. A. F. 7: 138, 715, 821.)

Ravenelia cassiaecola Atk., Bot. Gaz. **16:** 313. 1891.
Haploravenelia cassiaecola Syd., Ann. Myc. **19:** 165. 1921.

Pycnia and aecia unknown. Uredia amphigenous, subcuticular, cinnamon-brown, without paraphyses; urediospores globoid or broadly ellipsoid, 12–17 by 13–20 μ; wall cinnamon-brown, 2–3 μ thick, verrucose, the pores 6–8, scattered. Telia amphigenous or caulicolous, subcuticular, without paraphyses; teliospore-heads chestnut-brown, 4–6 cells across, smooth or with an indistinct papilla in center of each cell, the cysts globose, pendent, not cohering.



92

On Caesalpiniaceae: **Chamaecrista aspera** (Muhl.) Greene, Fla.—**C. fasciculata** (Michx.)Greene(*Cassia chamaecrista* Am.auth.), Ohio.—**C. multipinnata** (Pollard)Greene, Ala., Ga., Miss. **Range:** Southern Ohio and Georgia southward to Florida and Mississippi; also in the West Indies.

*. **Ravenelia mesillana** Ellis & Barth. (*R. longiana* Syd., *Haploravenelia m.* Syd.), with subcuticular pycnia surrounded by uredinoid aecia; aecia like the uredia; uredia subcuticular, amphigenous, cinnamon-brown, urediospores broadly ellipsoid or globoid, 15–22 by 20–26 μ, with a few capitate paraphyses intermixed, the wall cinnamon-brown, 2–2.5 μ thick, sparsely echinulate, with 6–8 scattered pores; teliospore-heads chocolate-brown, 5–8 cells across, smooth, or rarely with a few short tubercles, the cysts globoid, pendent; occurs on Caesalpiniaceae: **Cassia bauhinioides** Gray, in southern New Mexico, and **C. roemeriana** Scheele, in southern Texas. (N. A. F. **7:** 139, 140, 716.)

*. **Ravenelia papillifera** Syd. (*Haploravenelia p.* Syd.), with subcuticular pycnia surrounded by uredinoid aecia; aecia like the uredia; uredia subcuticular, amphigenous, cinnamon-brown, urediospores broadly ellipsoid, 15–21 by 20–30 μ, with a few capitate paraphyses intermixed, the wall cinnamon-brown, 2–2.5 μ thick, sparsely echinulate, with 6–10 scattered pores; teliospore-heads chestnut-brown, 5–7 cells across, each cell with a prominent papilla, the cysts globoid, pendent; occurs on Caesalpiniaceae: **Cassia lindheimeriana** Scheele, in southern Texas; also in the Bahamas and Mexico. (N. A. F. **7:** 140, 716, 821.)

*. **Ravenelia hoffmanseggii** Long, with amphigenous uredia, subepidermal, reddish-brown, without paraphyses, urediospores ellipsoid, 16–25 by 25–30 μ, the wall golden-brown, 1–1.5 μ thick, minutely echinulate, appearing smooth when wet, with 8 pores in two zones of 4 each, one near upper end, the other subequatorial; telia unknown; occurs on Caesalpiniaceae: **Hoffmanseggia oxycarpa** Benth., in southernmost Texas. (N. A. F. **7:** 715.)

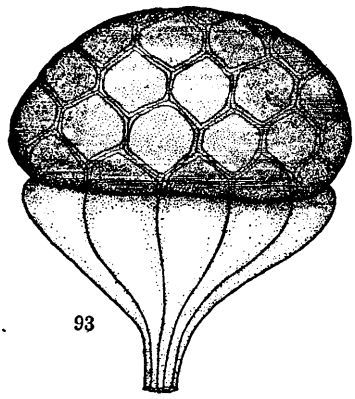
*. **Ravenelia cassiae-covesii** Long & Goodd., with amphigenous uredia, subcuticular, cinnamon-brown, urediospores globoid or broadly ellipsoid, 15–20 by 17–23 μ, with few capitate paraphyses intermixed, the wall cinnamon-brown, 2–2.5 μ thick, echinulate, with 8 pores in two zones of 4 each, equidistant from the equator, or sometimes scattered; teliospore-heads chocolate-brown, 5–7 cells across, smooth, or with part of the cells bearing a single low papilla, the cysts in two or three rows, globoid; occurs on Caesalpiniaceae: **Cassia covesii** Gray, in southern Arizona. (N. A. F. **7:** 717.)

3. RAVENELIA EPIPHYLLA. Fig. 93.

(N. A. F. 7: 142, 717, 814, 821.)

Sphaeria epiphylla Schw., Schr. Nat. Ges. Leipzig **1:** 40. 1822.
Ravenelia glandulosa B. & C., Gard. Chron. **1853:** 132. 1853.
Ravenelia epiphylla (Schw.) Diet., Hedw. **33:** 27. 1894.
Pleoravenelia epiphylla Long, Bot. Gaz. **35:** 128. 1903.

Pycnia chiefly epiphyllous, punctiform, in small groups, subepidermal. Aecia amphigenous, surrounding the pycnia, uredinoid; aeciospores like the urediospores. Uredia amphigenous, subepidermal, scattered, ferruginous, without paraphyses; urediospores obovate-globoid, 19–26 by 28–35 μ; wall golden-brown, 2.5–3 μ thick, verrucose, the pores 6, equatorial. Telia amphigenous, subepidermal; teliospore-heads chestnut-brown, 4–7 cells across, smooth, the cysts decurrent on the pedicel.



93

On Fabaceae: **Cracca ambigua** (Curtis) Ktze.(*Tephrosia a.* Chapm.), La.—**C. hispidula** (Michx.)Ktze.(*T. h.* Pers.), Ala., N.Y., S.C.—**C. spicata** (Walt.)Ktze.(*T. s.* T.&G.), Ala., Fla., S.C.—**C. virginiana** L.(*T. v.* Pers.), Ala., Conn., Del., Fla., Ga., Ill., Ind., Ky., La., Mich., Mo., Miss., N.J., N.Y., N.C., Pa., S.C., Tenn., Va., W.Va. **Range:** New York to northern Illinois, southward nearly to the Gulf of Mexico; also in Central America.

This species is the only one of the genus that flourishes extensively in the temperate zone. It does not occur along the southernmost boundary of the United States, and only one locality is known outside the United States.

*. **Ravenelia piscidiae** Long, with amphigenous uredia, subepidermal, cinnamon-brown, urediospores ellipsoid, 15–17 by 17–29 μ, with a few cylindric paraphyses intermixed, the wall pale cinnamon-brown, 1–1.5 μ thick, echinulate, with 7–10 scattered pores; teliospore-heads dark chestnut-brown, 4–6 cells across, smooth, the cysts appressed; occurs on Fabaceae: **Piscidia erythrina** L. (*Ichthyomethia piscipula* Hitchc.), in southernmost Florida; also in Cuba. (N. A. F. **7:** 144, 718, 821.)

2. PILEOLARIA Cast., 1842.

A genus of autoecious species, in America confined to a single family of hosts. The aecia are uredinoid, and so slightly different from the uredia that they have only occasionally been recognized even as "primary uredo." The pycnia are subcuticular, and the other sori subepidermal.

Pycnia without paraphyses. Aecia when present resembling the uredia, but with aeciospores less fusiform, and the wall thinner and more closely verrucose. Uredia when present erumpent, without paraphyses; urediospores pedicellate, oblong-fusiform, the wall golden-brown, usually paler below, verrucose, generally in longitudinal or spiral lines, the pores equatorial. Telia erumpent; teliospores 1-celled, borne singly on colorless pedicels, at first globoid, becoming discoid by being flattened above and below, the wall colored, verrucose.

The species have sometimes been assigned to the genus *Uromyces* (Sydow, Monog. Ured. **2**: 60–62, 143–151. 1910), from which the subcuticular pycnia and the form and surface markings of the urediospores are differential characters, as well as the form of the teliospores.

Urediospore-wall verrucose in spiral lines.	1. *P. toxicodendri.* *P. effusa*(m).
Urediospore-wall verrucose in longitudinal lines.	
Urediospores fusiform-ellipsoid.	2. *P. patzcuarensis.*
Urediospores oval or obovate.	*. *P. mexicana.*

About 15 species are now included in *Pileolaria,* two thirds of them occurring upon the genus *Rhus,* and the remainder upon *Acacia.* They extend into Mexico, southern Asia, Japan and Australia.

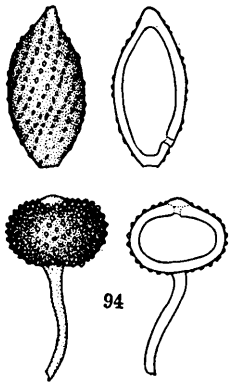
1. PILEOLARIA TOXICODENDRI. Fig. 94.

(N. A. F. 7: 147, 719, 821.)

Uromyces toxicodendri Berk. & Rav., Grev. **3:** 56. 1874.
Pileolaria brevipes Berk. & Rav., Grev. **3:** 58. 1874.

Uromyces punctato-striatus Cooke & Hark., Grev. **14:** 8. 1885.
Pileolaria toxicodendri (Berk. & Rav.) Arth., N. Am. Flora **7:** 147. 1907.

Pycnia epiphyllous, small. Aecia uredinoid, chiefly hypophyllous, round, crowded on hypertrophied areas, cinnamon-brown, pulverulent; aeciospores broadly ellipsoid or globoid, 23–28 by 29–35 μ, acute and somewhat semihyaline below, rounded above; wall golden-brown, uniformly 2–3 μ thick, verrucose in spiral rows 1–1.5 μ apart. Uredia chiefly hypophyllous, small, cinnamon-brown, pulverulent; urediospores fusiform-ellipsoid, 18–25 by 36–48 μ, acute or obtuse and somewhat semihyaline at both ends; wall golden-brown, 3–3.5 μ thick, verrucose in spiral rows 2–3 μ apart, umbonate and somewhat thicker above, 4–6 μ, the pores 2, large, near the base, indistinct. Telia chiefly epiphyllous, round, chocolate-brown; teliospores discoid when mature, 26–32 μ broad by 21–27 μ long; wall dark chocolate-brown, 4–5 μ thick, slightly thicker at apex, often with a hyaline umbo, closely verrucose; pedicel colorless, 5 μ thick, long.


94

On Anacardiaceae: **Rhus aromatica** Ait.(*Schmaltzia crenata* Greene, *S. a.* Desv.), Ont.—**R. diversiloba** T.&G.(*S. malacophylla* Greene), Calif., Ore.—**R. floridana** Mearns, Miss.—**R. radicans** L.(*R. toxicodendron radicans* Torr.), Ala., Ark., Conn., D.C., Ga., Ind., Ill., Iowa, Kans., Ky., La., Mass., Mich., Minn., Miss., Mont., Neb., N.J., N.Y., N.C., N.D., Ohio, Okla., Pa., S.D., Tenn., Tex., Va., W.Va., Wis.; Man., Ont., Queb.—**R. rydbergii** Small, Colo., Kans., Mo., Mont., Neb., N.D., Okla., S.D., Tex., Wash., Wyo. **Range:** Nearly throughout the United States and Canada east of the Rocky Mountains, and along the Pacific Coast region from Washington to southern California; also in Japan.

Pileolaria effusa.

(N. A. F. 7: 149, 719.)

Pileolaria effusa Peck, Bot. Gaz. **7:** 55. 1882.
Uromyces effusus De-T., in Sacc., Syll. Fung. **7:** 576. 1888.
Discospora effusa Arth., N. Am. Flora **7:** 149. 1907.

Pycnia amphigenous and caulicolous, numerous, conspicuous. Aecia and uredia wanting. Telia amphigenous and caulicolous, thickly grouped on more or less hypertrophied young branches, petioles and veins, chocolate-brown, pulverulent; teliospores soon becoming discoid, 21–26 μ broad by 17–19 μ long; wall cinnamon-brown, 2–2.5 μ thick, thicker above, 3–5 μ, with a pale umbo, indistinctly verrucose; pedicel colorless, short.

On Anacardiaceae: **Rhus cismontana** Greene, Ariz.—**R. rhomboidea** Small, Okla.—**R. rydbergii** Small, Colo. **Range:** Foothills of the Rocky Mountains from Colorado to Oklahoma, and in southernmost Arizona.

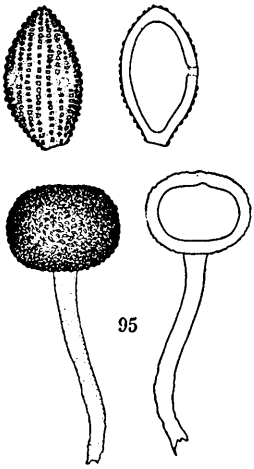
Although evidently correlated with *P. toxicodendri,* this rust has somewhat smaller and thinner walled teliospores.

2. PILEOLARIA PATZCUARENSIS. Fig. 95.

(N. A. F. 7: 148, 719.)

Uromyces patzcuarensis Holw., Ann. Myc. **2:** 393. 1904.
Pileolaria patzcuarensis (Holw.) Arth., N. Am. Flora **7:** 148. 1907.

Pycnia epiphyllous, subcuticular, noticeable. Aecia uredinoid, in crowded groups opposite the pycnia, cinnamon-brown; aeciospores ellipsoid, 24–29 by 29–35 μ; wall golden-brown, 3 μ thick, sometimes slightly thicker above, finely verrucose in longitudinal lines 1.5 μ apart. Uredia amphigenous, scattered, cinnamon-brown; urediospores fusiform-ellipsoid, 23–29 by 34–45 μ; wall golden-brown, somewhat paler above and below, 3–4 μ thick at sides, twice as thick above, coarsely verrucose in longitudinal lines 2–3 μ apart, the pores small, 3, equatorial. Telia chiefly epiphyllous, chocolate-brown; teliospores discoid when mature, 30–38 μ broad by 12–15 μ long; wall chocolate-brown, uniformly 5–6 μ thick, indistinctly verrucose; pedicel colorless, 50–75 μ long.



95

On Anacardiaceae: **Rhus trilobata** Nutt.(*Schmaltzia emoryi* Greene), Colo., N.M., Okla. **Range:** Northern Colorado southward to southern New Mexico; also in Mexico.

*. **Pileolaria mexicana** Arth., with pycnia, aecia and telia unknown; uredia chiefly hypophyllous, chestnut-brown, pulverulent, urediospores oval or obovate, 25–30 by 38–52 μ, rounded above, obtuse or narrowed and semi-hyaline below, the wall dark golden-brown, 3–6 μ thick, verrucose in longitudinal rows, with 3 somewhat sub-equatorial pores; occurs on Anacardiaceae: **Rhus chloriophylla** W.&S., in southern Texas; also in Mexico. (N. A. F. **7:** 149, 719.)

3. TRANZSCHELIA Arth., 1906.

A genus of four macrocyclic and three microcyclic species, one heteroecious, the others autoecious, with the pycnia subcuticular, and the other sori subepidermal.

Pycnia hemispheric, without paraphyses. Aecia when present cupulate, with recurved peridium; aeciospores catenulate, globoid, the wall colored, verrucose. Uredia when present pulverulent; urediospores stipitate, ellipsoid or obovate, with capitate paraphyses intermixed, the wall colored, usually paler below, the pores equatorial. Telia pulverulent; teliospores with two easily separable cells, with one pore in each cell, the upper apical, the lower near the pedicel, verrucose, borne on jointed pedicels, the lower portions being short and united to form compound bases.

Teliospores 28–52 μ long; verrucose.	1. *T. pruni-spinosae.* *T. cohaesa.* *T. tucsonensis*(d). *T. fusca*(m). *T. suffusca*(m). *T. thalictri*(m).
Teliospores 29–35 μ long; echinulate-verrucose.	*. *T. viornae.*

A very distinctive genus. It is allied to *Ravenelia* by the union of the pedicels of the teliospores into a compound base; and is sharply separated from *Puccinia* by the absence of a common membrane enclosing the two cells of the teliospore.

1. TRANZSCHELIA PRUNI-SPINOSAE. Fig. 96.

(N. A. F. 7: 151, 720, 821.)

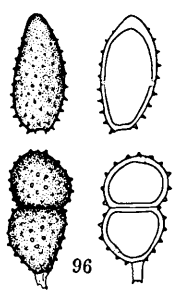
(*Aecidium punctatum* Pers., Ann. Bot. Usteri **20:** 135. 1796.)
Puccinia pruni-spinosae Pers., Syn. Fung. 226. 1801.
Puccinia pruni DC., Fl. Fr. **2:** 222. 1805.

(*Aecidium quadrifidum* DC., in Poir., Encycl. Meth. Bot. **8:** 235. 1808.)
(*Aecidium hepaticatum* Schw., Trans. Am. Phil. Soc. II. **4:** 293. 1832.)
Uromyces prunorum Fckl., Jahrb. Ver. Nat. Nass. **15:** 20. 1861.
Tranzschelia punctata Arth., Rés. Sci. Congr. Bot. Vienne 340. 1906.
Tranzschelia pruni-spinosae (Pers.) Diet., Ann. Myc. **20:** 31. 1922.

Pycnia chiefly epiphyllous, evenly and remotely scattered, conspicuous. Aecia hypophyllous, scattered, cupulate, dehiscent into few (often 4) widely spreading lobes; aeciospores globoid or oblong-globoid, 15–23 by 18–26 μ; wall cinnamon-brown, 1.5–2.5 μ thick, verrucose.

On Ranunculaceae: **Anemone caroliniana** Walt., Kans., La., Neb., Tex. —**A. coronaria** L., Calif.—**A. quinquefolia** L., Ala., Conn., Del., Ill., Ind., Iowa, Mass., Mich., N.J., N.Y., Tenn., Vt., W.Va., Wis.; Ont., Queb.—**Hepatica acutiloba** DC.(*H. acuta* Britt.), Ala., Ill., Ind., Iowa, N.Y., Pa., W.Va., Wis.; Queb.—**H. triloba** Chaix.(*H. hepatica* Karst.), Conn., Del., N.Y., Pa.—**Ranunculus recurvatus** Poir., B.C.—**Thalictrum dasycarpum** Fisch.& Lall.(*T. purpurascens* Auth., not L.), Colo., Iowa, Kans., Neb., N.D., S.D.—**T. dioicum** L., Ind., Iowa, Pa.—**T. polygamum** Muhl.(*T. cornuti* T.&G.), Ohio.

Uredia hypophyllous, cinnamon-brown, pulverulent; urediospores oblong-clavate or oblong-fusiform, 15–23 by 28–42 μ, with capitate paraphyses intermixed; wall brownish-yellow above, paler below, 1–1.5 μ thick at sides, 5–9 μ above, smooth above, sharply echinulate below, the pores 3–5, equatorial. Telia hypophyllous, dark chestnut-brown, somewhat pulverulent; teliospores oblong or obovate-oblong, 18–27 by 30–39 μ, the two cells globoid or oblong-globoid and easily separable; wall chestnut-brown, often paler below, uniformly 1.5–2.5 μ thick, coarsely verrucose; pedicel colorless, readily detached from the spore.


96

On Amygdalaceae: **Amygdalus persica** L., Ala., Calif., Fla., Miss., S.C., Ore., Tex.—**Armeniaca vulgaris** Lam., Miss., N.M., Tex.—**Padus nana** (DuRoi)Roem.(*P. virginiana* Roem., not *Prunus virginiana* L.), Conn., Ill., N.Y., W.Va., Wis.; Ont.—**P. virginiana** (L.)Mill.(*P. serotina* Ag., *Prunus s.* Ehrh., *P. v.*), Ark., Conn., Ga., Ill., Ind., Iowa, Md., Mass., Mich., Mo., Neb., N.Y., S.C., Tenn., Tex., W.Va.—**Prunus,** 16 species, reported from various parts of the United States east of the Rocky Mountains, and one locality each in California and Oregon.

Range: Eastern half of the United States and Canada, and sparingly along the Pacific Coast, especially abundant southward; also in Mexico, Central and South America, and throughout the world wherever peaches and plums are grown.

The close relationship of this species with the following autoecious and short cycle forms has been discussed at some length by Grove (New Phytologist **12:** 89. 1913), who would derive them from a primitive autoecious ancestor represented by *T. cohaesa,* and also by Jackson (Mem. Torrey Club **18:** 1. 1931), who derives them from a heteroecious ancestor represented by *T. pruni-spinosae.*

Cultures were made in 1904 by Tranzschel (Beitr. Biol. Ured. 4. 1905), by sowing aeciospores from *Anemone coronaria* on *Amygdalus communis, Prunus spinosa* and *P. divaricata,* and from *A. ranunculoides* on *P. spinosa.* In 1905 aeciospores from *Hepatica acuta* were successfully sown by Arthur (Jour. Myc. **12:** 20. 1906) on *Prunus serotina,* but failed to infect *Prunus americana, P. cerasus* and *Amygdalus persica;* and again in 1906 (same **13:** 199. 1907) aeciospores from *H. acuta* infected *P. serotina* and *P. nana,* but failed to infect *A. persica.* In 1906 Krieg (Centr. Bakt. **17:** 209. 1906) obtained successful results by sowing aeciospores from *A. coronaria* on *Amygdalus armeniaca, Prunus domestica* and *P. spinosa.* In 1923 aeciospores from *Anemone quinquefolia* sown by Clinton (Ann. Rep. Conn. Agric. Exp. Sta. **47:** 498.

1924) gave success on *P. serotina,* but did not infect *A. persica.* Scott & Stout (Phytop. **21:** 998. 1931) report successful cultures in Petri dishes by sowing aeciospores from a cultivated *Anemone* [*A. coronaria*] on almond, apricot, nectarine, peach, plum and prune, but not on cherry, urediospores being produced in each instance.

Tranzschelia cohaesa.

(N. A. F. 7: 150, 720.)

Puccinia cohaesa Long, Bull. Torrey Club **29:** 111. 1902.
Tranzschelia cohaesa (Long) Arth., Rés. Sci. Congr. Bot. Vienne 340. 1906.

Pycnia as in *Tranzschelia pruni-spinosae,* but chiefly hypophyllous. Aecia as in *T. pruni-spinosae,* but aeciospores slightly smaller and thinner walled. Uredia as in *T. pruni-spinosae,* except the urediospores somewhat shorter and sparsely and sharply echinulate throughout. Telia as in *T. pruni-spinosae,* except the teliospores 30–45 μ long.

On Ranunculaceae: **Anemone decapetala** Ard., Tex.—**A. tuberosa** Rydb. (*A. sphenophylla* Britt., not Poepp.), Tex. **Range:** Nearly throughout Texas; also in Japan.

*. **Tranzschelia tucsonensis** (Arth.) Diet. (*Lipospora t.*), autoecious, with epiphyllous pycnia, and other sori hypophyllous; the aecia like those of *T. pruni-spinosae,* with slightly smaller aeciospores, the walls paler and thinner; uredia wanting; telia accompanying the aecia, teliospores oblong, 18–24 by 32–38 μ, the two cells alike, or the lower one smaller and narrower, not readily separable, the wall dark chestnut-brown, or paler in lower cell, 1–2 μ thick, verrucose; occurs on Ranunculaceae: **Anemone tuberosa** Rydb. (*A. sphenophylla* Britt., not Poepp.), in southern Arizona. (N. A. F. **7:** 721.)

Tranzschelia fusca.

(N. A. F. 7: 152, 721, 822.)

Aecidium fuscum Pers., in Gmel., Syst. Nat. **2:** 1473. 1791.
Puccinia anemones Pers., Obs. **2:** 24. 1799; Syn. Fung. 226. 1801.
Puccinia fusca Wint., in Rabh., Krypt.-Fl. **1:** 199. 1881.
Polythelis fusca Arth., Rés. Sci. Congr. Bot. Vienne 341. 1906.
Tranzschelia fusca (Pers.) Diet., Ann. Myc. **20:** 31. 1922.

Pycnia amphigenous, papillose, conspicuous. Aecia and uredia wanting. Telia as in *T. pruni-spinosae.*

On Ranunculaceae: **Anemone lithophila** Rydb., Wyo.—**A. oregana** Gray, Ore.—**A. parviflora** Michx., Ida.—**A. piperi** Britt., Ida.—**A. quinquefolia** L., Calif., Conn., Del., Ill., Ind., Iowa, Mass., Mich., Minn., N.J., N.Y., Ore., Ohio, Vt., W.Va., Wis.; Ont.—**A. tetonensis** Porter, Utah. **Range:** Vermont to Michigan and western Oregon, southward to Delaware, Iowa and northern California; also in Europe.

The prominent telial sori, surrounded by the everted epidermis, give a general appearance of cupulate aecia, which explains Persoon's early use of the generic name "*Aecidium.*" The correlation of this microcyclic species with *T. pruni-spinosae* was first pointed out by Tranzschel (Beitr. Biol. Ured. 4. 1905).

Tranzschelia suffusca.

(N. A. F. 7: 153, 721, 822.)

Puccinia pulsatillae Rostr.; Vesterg., Bot. Notiser **1902:** 169. 1902. Not *P. pulsatillae* Kalchb., 1865.
Puccinia suffusca Holw., Jour. Myc. **8:** 171. 1902.
Polythelis pulsatillae Arth., Rés. Sci. Congr. Bot. Vienne 341. 1906.
Polythelis suffusca Arth., Bull. Torrey Club **48:** 34. 1921.
Tranzschelia pulsatillae Diet., Ann. Myc. **20:** 31. 1922.
Tranzschelia suffusca (Holw.) n. comb.

Pycnia epiphyllous, few and widely scattered, small. Aecia and uredia wanting. Telia as in *T. pruni-spinosae* except teliospores elliptic-obovate, 15–28 by 30–60 μ, the upper cell globoid, the lower cell globoid to obovate or cuneate, 10–26 by 20–30 μ.

On Ranunculaceae: **Pulsatilla ludoviciana** (Nutt.)Heller(*P. hirsutissima* Britt., *Anemone patens nuttalliana* Gray), Alas., Colo., Iowa, Mont., N.D., S.D.; Sask. **Range:** North Dakota to southeastern Alaska, southward to Iowa and Colorado; also in Europe and Asia.

Tranzschelia thalictri.

(N. A. F. 7: 153, 721, 822.)

Puccinia thalictri Chev., Fl. Paris **1:** 417. 1826.
Caeoma (Uredo) thalictri Schw., Trans. Am. Phil. Soc. II. **4:** 291. 1832.
Polythelis thalictri Arth., Rés. Sci. Congr. Bot. Vienne 341. 1906.
Tranzschelia thalictri (Chev.) Diet., Ann. Myc. **20:** 31. 1922.

Pycnia hypophyllous, few and widely scattered, prominent. Aecia and uredia wanting. Telia as in *T. pruni-spinosae* except teliospores ellipsoid or oblong-obovate, 17–26 by 26–52 μ, the upper cell usually globoid, the lower cell globoid, obovate or broadly cuneate, 16–26 by 18–26 μ. Mesospores usually plentiful.

On Ranunculaceae: **Thalictrum dasycarpum** Fisch.&Lall.(*T. purpurascens* Auth., not L.), Ky., Mich., S.D., Vt., Wis.—**T. dioicum** L., Ind., Iowa, Mich., Minn., Miss., N.J., N.Y., N.D., Pa., Wis.—**T. fendleri** Engelm., Calif., Colo., N.M., Utah, Wyo.—**T. megacarpum** Torr., Mont.—**T. occidentalis** Gray, Ida., Nev., Wyo.—**T. polygamum** Muhl.(*T. cornuti* T.&G.), Conn., Mass., N.H., N.J., N.Y., Pa., Vt.; N.S., Ont.—**T. revolutum** DC., N.Y.—**T. sparsiflorum** Turcz., Colo., Utah, Wyo.—**T. venulosum** Trel.(*T. thyrsoideum* Greene), Mont., Wyo.—**T. wrightii** Gray, N.M. **Range:** Nova Scotia to Idaho, southward to New Jersey, Mississippi, New Mexico and central California; also in Europe and Japan.

*. **Tranzschelia viornae** (Arth.) n. comb. (*Puccinia v.*), with only uredia and telia known; urediospores ellipsoid, 16–19 by 23–30 μ, with paraphyses intermixed, wall 1–1.5 μ at sides, 3–6 μ above, closely echinulate throughout, the pores indistinct, probably 3 or 4 and equatorial; teliospores ellipsoid or oblong, 16–21 by 29–35 μ, the two cells nearly alike, the wall dark cinnamon-brown, uniformly 1.5–2 μ thick, coarsely echinulate-verrucose; occurs on Ranunculaceae: **Viorna** sp., in west-central Texas, but known only from one locality. (N. A. F. **7:** 592.)
Too little is known about this species to establish its relationship, but it is doubtfully correlated with *T. pruni-spinosae.*

4. CUMMINSIELLA Arth., 1933.

A genus of autoecious species, with two-celled teliospores; the species often included in the genus *Puccinia.* The pycnia and other sori subepidermal.

Pycnia punctiform, with paraphyses. Aecia aecidioid, cupulate; aeciospores globoid or oblong. Uredia pedicellate, with or without paraphyses; urediospores obovate or somewhat fusiform, with the walls yellow, verrucose, and the pores in one or two zones, distinct. Telia dark-brown; teliospores ellipsoid, of two equal cells, with two lateral pores in each cell, not noticeably laminate, verrucose, the pedicel long, solid, sometimes inserted obliquely.

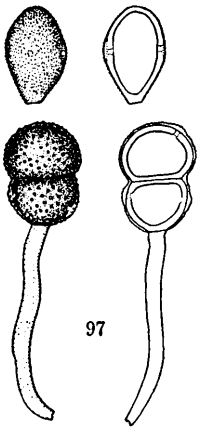
Host belonging to family Berberidaceae.
Urediospore-pores 4, equatorial. 1. *C. sanguinea.*
Urediospore-pores 8 or more, in two zones.
Urediospores ovate-fusiform. *. *C. wootoniana.*
Urediospores obovate or globoid. *. *C. texana.*

1. CUMMINSIELLA SANGUINEA. Fig. 97.

(N. A. F. 7: 155, 722, 822.)

Uromyces sanguinea Peck, Bot. Gaz. **4:** 128. 1879.
Puccinia mirabilissima Peck, Bot. Gaz. **6:** 226. 1881.
Uropyxis mirabilissima Magn., Ber. Deuts. Bot. Ges. **10:** 193. 1892.
Uropyxis sanguinea Arth., N. Am. Flora **7:** 155. 1907.
Cumminsiella sanguinea (Peck) Arth., Bull. Torrey Club **60:** 475. 1933.

Pycnia punctiform, epiphyllous; aecia hypophyllous, in groups, cupulate; aeciospores globoid, 16–22 by 16–24 μ; wall uniformly 1.5–2 μ thick, verrucose. Uredia hypophyllous, cinnamon-brown, without paraphyses; urediospores obovate or ellipsoid, 18–23 by 21–32 μ; wall golden-yellow, 2.5–3 μ thick, finely verrucose, the pores 4, equatorial. Telia hypophyllous, usually not plentiful, pulvinate, chestnut-brown; teliospores ellipsoid, 20–25 by 30–35 μ, much constricted at septum; wall chestnut-brown, 3–5 μ thick, finely verrucose; pedicel persistent, long.



97

On Berberidaceae: **Berberis atrocarpa** Schneid., Ore. —**Mahonia aquifolium** (Pursh)Nutt.(*M. diversifolia* Sweet, *Berberis a., Odostemon nutkanus* Rydb.), Calif., Ore., Wash. —**M. dictyota** (Jepson)Fedde(*B. d.*), Calif.—**M. nervosa** (Pursh)Nutt.(*B. n.*), Calif.—**M. pinnata** (Lag.)Fedde(*B. p.*), Calif.—**M. pumila** (Greene)Fedde(*B. p.*), Calif., Oreg. —**M. repens** (Lindl.)Don(*B. r., Odostemon aquifolium* Rydb.), Ariz., Colo., Ida., Mont., Neb., N.M., S.D., Utah, Wash., Wyo. **Range:** From Montana and Washington, southward to New Mexico and Arizona; also in Central America and northern Europe.

Cultures using aeciospores on *M. repens* were made in 1930 by Hammarlund (Bot. Notiser **1930:** 380. 1930), and later using both aeciospores and teliospores (same **1932:** 406. 1932) with abundant infection. Aecia have not yet been reported from America.

There is much diversity among phanerogamic botanists in the application of Latin names to the upright and trailing mahonias. The tall upright species is here called *M. aquifolium* and the trailing species *M. repens,* while in the N. Am. Flora (**7:** 155) *M. aquifolium* is applied to the trailing species. *Berberis atrocarpa* is an upright, evergreen shrub, native of China, with thick, coriaceous leaves, having the structural characteristics of *Mahonia.* The appearance of the rust in northern Europe is of recent date (Wilson, Ann. Myc. **28:** 225–229. 1930), yet it appears to have become wide spread (Poeverlein, Ann. Myc. **28:** 421. 1930; same **30:** 402. 1932).

*. **Cumminsiella wootoniana** Arth. (*Uropyxis w.* Arth.), with pycnia and aecia unknown; uredia hypophyllous, cinnamon-brown, without paraphyses, urediospores terete-fusiform or ovate-fusiform, 13–19 by 35–45 μ, wall pale-yellow or colorless, 2–4 μ thick at sides, twice as thick above, with hyaline umbo, closely verrucose, the pores 8–12, in two zones of 4–6 each; teliospores broadly ellipsoid, 19–23 by 23–27 μ, the wall chestnut-brown, 3–5 μ thick; occurs on Berberidaceae: **Mahonia fremontii** (Torr.)Fedde(*Berberis f.*), in Arizona, and **M. haematocarpa** (Woot.)Fedde(*B. h.*), in Arizona and New Mexico. (N. A. F. **7:** 723.)

*. **Cumminsiella texana** (Holw. & Long) Arth. (*Puccinia t., Uropyxis t.* Arth., *Aecidium butlerianum* Rosen & Arth.), with pycnia epiphyllous; aecia hypophyllous, the peridial cells polygonal, having the outer wall 5–7 μ thick, the inner 1.5–2 μ, aeciospores ellipsoid, 20–26 by 29–37 μ, wall 2.5–3.5 μ thick, verrucose; uredia hypophyllous, cinnamon-brown, with few peripheral paraphyses, urediospores obovate or globoid, 17–22 by 21–32 μ, wall golden-yellow, 2–3 μ thick, closely verrucose, the pores 8, in two zones of 4 each; teliospores ellipsoid, 21–25 by 27–34 μ, the wall chestnut-brown, 2.5–3.5 μ thick, minutely verrucose, appearing smooth; occurs on Ber-

BERIDACEAE: **Mahonia trifoliolata** (Moric.)Fedde(*Berberis t., B. trifoliata* Hartw.), in southern Texas. (N. A. F. **7:** 155, 624, 722.)

5. UROPYXIS Schroet., 1875.

A genus of autoecious species, with two-celled teliospores, which ally it to *Puccinia,* under which genus the species are sometimes placed, and with a gelatinous layer in the wall of the teliospores, more or less hygroscopic, which relates it to *Phragmidium.* The pycnia are subcuticular, other sori subepidermal.

Pycnia punctiform, paraphyses sometimes present. Aecia when present uredinoid, closely resembling the uredia. Uredia when present pedicellate, with peripheral paraphyses or none; urediospores ellipsoid or globoid, with the walls pale-yellow, verrucose, and the pores scattered and indistinct. Telia erumpent, sometimes with peripheral paraphyses; teliospores of two equal cells, rounded, with two lateral pores in each cell, the wall laminate, usually with a hygroscopic layer, verrucose, the pedicel persistent, sometimes hygroscopic.

Teliospore-pedicel firm, short.	1. *U. petalostemonis.* *U. affinis*(m).
Teliospore-pedicel swelling to bursting in water.	
Teliospore-wall verrucose.	2. *U. amorphae.*
Teliospore-wall smooth.	*. *U. holwayi*(m).

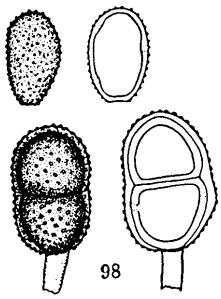
Other species of the genus occur in Mexico.

1. UROPYXIS PETALOSTEMONIS. Fig. 98.

(N. A. F. 7: 156, 723, 822.)

Puccinia petalostemonis Farl.; Trelease, Trans. Wis. Acad. **6:** 129. 1884.
Uropyxis petalostemonis (Farl.) De-T., in Sacc., Syll. Fung. **7:** 735. 1888.

Pycnia hypophyllous, scattered among the aecia, with paraphyses. Aecia hypophyllous, scattered, similar to the uredia, but without paraphyses. Uredia hypophyllous, cinnamon-brown, pulverulent, with peripheral incurved paraphyses; urediospores oblong or obovate, 18–21 by 21–26 μ; wall pale-yellow, 1.5–2 μ thick, verrucose, the pores 6–8, scattered. Telia hypophyllous, dark chocolate-brown, pulverulent, with paraphyses as in uredia; teliospores ellipsoid, 21–29 by 39–45 μ; wall verrucose, laminate, the inner layer chestnut-brown, 2–3 μ thick, the outer layer pale amber-color, gelatinous, 1.5–2 μ thick in water; pedicel short.


98

ON FABACEAE: **Petalostemon candidus** (Willd.) Michx., Kans., Minn., Neb., N.D., Wis.—**P. compactus** (Spreng.)Swezey, S.D.—**P. multiflorus** Nutt., Kans.—**P. oligophyllus** (Torr.) Rydb., Mont., N.M., Wyo.—**P. purpureus** (Vent.)Rydb.(*P. violaceus* Michx.), Colo., Iowa, Kans., Neb., N.D., Wis. **Range:** Western Wisconsin to eastern Montana, southward on the plains to New Mexico.

Uropyxis affinis.

(N. A. F. 7: 724.)

Calliospora petalostemonis Arth., Bull. Torrey Club **34:** 588. 1908.
Uropyxis affinis n. nom.

Pycnia chiefly hypophyllous, scattered, conspicuous. Aecia and uredia wanting. Telia and teliospores as in *U. petalostemonis*, but without paraphyses.

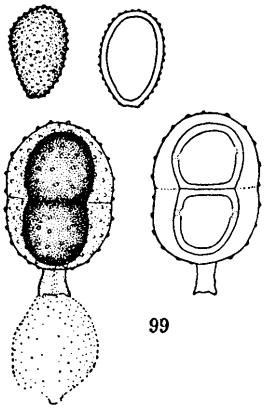
On Fabaceae: **Petalostemon oligophyllus** (Torr.)Rydb., N.M. **Range:** Northern New Mexico, in vicinity of Pecos.

2. UROPYXIS AMORPHAE. Fig. 99.

(N. A. F. 7: 158, 724, 814, 822.)

Puccinia amorphae Curt., Am. Jour. Sci. II. **6:** 353. 1848.
Uropyxis amorphae (Curt.) Schroet., Hedw. **14:** 165. 1875.
Aecidium amorphae Cooke, Grev. **6:** 137. 1878.
Uredo kansensis Kellerm. & Sw., Jour. Myc. **5:** 77. 1889.

Pycnia chiefly epiphyllous, crowded in small groups, with paraphyses. Aecia hypophyllous, crowded in groups opposite the pycnia, with peripheral paraphyses; aeciospores resembling the urediospores. Uredia chiefly epiphyllous, scattered, pale-yellow, pulverulent, with abundant peripheral paraphyses, incurved; urediospores ellipsoid or obovate, 12–20 by 18–30 μ; wall pale-yellow, 2–2.5 μ thick, finely verrucose, the pores 10 or more, scattered, obscure. Telia epiphyllous, dark chocolate-brown, pulverulent, with paraphyses as in the uredia; teliospores ellipsoid, 28–36 by 35–48 μ; wall sparsely verrucose, laminate, the inner layer chocolate-brown, 2.5–3 μ thick, the outer layer colorless, gelatinous, swelling in water 7–15 μ thick at sides and 1–3 μ thick at apex and base, finally bursting and disappearing; pedicel colorless, as long as spore, deciduous or swelling in water and bursting.



99

On Fabaceae: **Amorpha angustifolia** (Pursh) Boynt., Colo., Kans., Wyo.—**A. californica** Nutt.(*A. laevigata* Nutt.), Ariz., Calif., N.M.—**A. canescens** Pursh, Ill., Ind., Iowa, Kans., Minn., Mo., Neb., N.D., S.D., Wis.—**A. fruticosa** L., Ala., Colo., Ga., Ill., Iowa, Kans., La., Minn., Miss., Mo., Neb., N.M., N.D., Okla., S.C., S.D., Tenn., Tex., Wis.—**A. herbacea** Walt., Fla., S.C.—**A. montana** Boynt., Ga., S.C.—**A. nana** Nutt. (*A. microphylla* Pursh), Iowa, Kans., N.M., N.D., S.D.—**A. occidentalis** Abrams, Ariz.—**A. virgata** Small, Fla., Ga. **Range:** Wisconsin to North Dakota, southward to Florida and New Mexico, and in Nevada and southern California.

*. **Uropyxis holwayi** n. comb. (*Calliospora h.* Arth.), with epiphyllous pycnia, with paraphyses; aecia and uredia wanting; telia epiphyllous, scattered, chocolate-brown, somewhat pulverulent; teliospores ellipsoid, 26–34 by 40–51 μ, the wall smooth, laminate, the inner layer chocolate-brown, 3–4 μ thick, or sometimes paler and thinner, the outer layer colorless, gelatinous, 2–3 μ thick in water, or scarcely swelling in light-colored spores, pedicel as long as spore, swelling in water to the diameter of the spore and bursting; occurs on Fabaceae: **Eysenhardtia polystachya** (Ort.) Sarg., (*E. amorphoides* H.B.K., *E. orthocarpa* Wats.), in southernmost Arizona; also in Mexico. Closely related to *U. amorphae*. (N. A. F. **7:** 159, 724, 822.)

6. PHRAGMOPYXIS Diet., 1897.

A genus of autoecious species with pycnia subcuticular and other sori subepidermal.

Pycnia punctiform, with paraphyses. Aecia when present caeomoid, with peripheral paraphyses; aeciospores with colorless, verrucose walls. Uredia when present pedicellate, with peripheral paraphyses; urediospores with pale verrucose wall and scattered pores. Telia with or without paraphyses; teliospores 3-celled with lateral pores, the wall laminate with a hygroscopic layer, verrucose, the pedicel solid near the spore, evanescent or hygroscopic below.

Phragmopyxis deglubens (B. & C.) Diet., the only macrocyclic member of the genus, occurs in northern Sonora, not far south of the Mexican boundary, and will doubtless eventually be found within the borders of the United States. It occurs on *Benthamantha.* (N. A. F. **7:** 154, 722.)

*. **Phragmopyxis acuminata** (Long) Syd. (*Tricella a.*), with amphigenous pycnia; aecia and uredia wanting; telia amphigenous, blackish brown, pulverulent, without paraphyses, teliospores ellipsoid or elliptic-ovoid, 25–40 by 50–75 μ, strongly acuminate above, the wall with 3 or 4 pores, verrucose, laminate, the inner layer dark-brown, 3–4 μ thick, the outer layer pale amber-color, gelatinous, 4–7 μ thick, pedicel as long as spore, one third of it next the spore thick-walled, pale-brown, persistent, the remainder colorless, with thin-walls, and the contents very hygroscopic, swelling and bursting in water; occurs on FABACEAE; **Coursetia glandulosa** Gray, in southernmost Arizona. (N. A. F. **7:** 722.)

7. PHRAGMIDIUM Link, 1815.

A genus of autoecious species with caeomoid aecia, and usually with large and conspicuous teliospores, especially when on *Rubus* and *Rosa,* the pores lateral. The pycnia are subcuticular, and the other sori subepidermal.

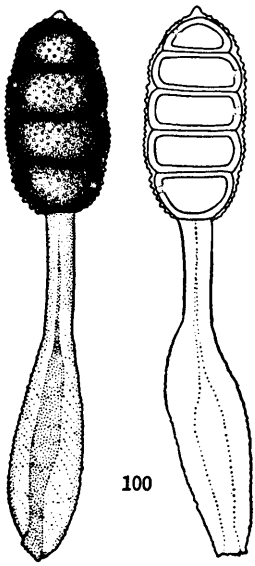
Pycnia with a flat hymenium, without paraphyses. Aecia when present with peripheral paraphyses or none; aeciospores catenulate, globoid or ellipsoid, the wall verrucose, or rarely echinulate. Uredia when present usually encircled with paraphyses; urediospores borne singly on pedicels, sometimes with paraphyses intermixed, the wall verrucose or echinulate, with indistinct, scattered pores. Telia without paraphyses; teliospores with one to ten cells, each with two or three lateral pores, the walls somewhat laminate, inner layer colored, the outer layer nearly or quite colorless, smooth or verrucose; pedicel colorless, except near the spore, often hygroscopic and swelling in lower portion.

Lower half of pedicel hygroscopic (§ *Euphragmidium*).
- Host belonging to family Rosaceae.
  - Of the tribe Potentilleae.
    - Teliospore-pedicel swollen in lower part.
      - Teliospores 3–5-celled; apiculus small. — 1. *P. andersoni.*
      - Teliospores 4–10-celled; apiculus large. — 2. *P. jonesii.*
    - Teliospore-pedicel not or slightly swollen. — 3. *P. potentillae.*
  - Of the tribe Rubeae.
    - Teliospores ellipsoid-cylindric, 4–6-celled. — 4. *P. peckianum.*
    - Teliospores cylindric, 6–10-celled.
      - Aecia epiphyllous; paraphyses-wall evenly thin. — 5. *P. rubi-idaei.*
      - Aecia amphigenous; paraphyses-wall thicker above. — 6. *P. rubi-odorati.*
      - Aecia hypophyllous; paraphyses-wall evenly thin. — 7. *P. occidentale.*
  - Of the tribe Roseae.
    - Teliospores 5–8-celled, 40–95 μ long.
      - Teliospores 40–60 μ long; apiculus smooth, 2–7 μ long. — 8. *P. rosae-arkansanae.*
      - Teliospores 64–90 μ long; apiculus rough, 7–13 μ long. — 9. *P. disciflorum.*
      - Teliospores 80–95 μ long; apiculus verrucose, 14–16 μ long. — 10. *P. subcorticinum.*

Teliospores 5–10-celled, 48–96 μ long.
Teliospores inclined to fusiform; pedicel long. 11. *P. rosae-acicularis.*
Teliospores inclined to ellipsoid; pedicel short. 12. *P. montivagum.*
Teliospores 8–11-celled; 64–125 μ long.
Teliospores rounded or acutish above, pedicel long. 13. *P. americanum.*
Teliospores attenuate above, pedicel short. 14. *P. rosae-californicae.*
Pedicel firm, not hygroscopic (§ *Earlea* Arth., 1906).
Host belonging to family Rosaceae.
Of the tribe Roseae.
Teliospores 4–8-celled. 15. *P. speciosum* (d).
Teliospores 1-celled. 16. *P. rosicola* (m).
Of the tribe Potentilleae.
Teliospores usually 3-celled; uredia present. 17. *P. ivesiae.*
Teliospores usually 2-celled, uredia wanting.
Teliospore-pedicel longer than spore. 18. *P. horkeliae* (d).
Teliospore-pedicel shorter than spore. 19. *P. biloculare* (d).
Of the tribe Rubeae. 20. *P. alaskanum* (d).

The species of *Phragmidium* are difficult to delimit. This is especially true of the species on *Rubus*, and even more so of those on *Rosa*. The native rusts belonging to the first section of *Phragmidium*, which occur on species of *Rosa*, appear to have geographic or physiographic boundaries, as well as a certain amount of adaptation to hosts. The collections on which the distribution is founded have been carefully studied as to hosts, with the aid of the revision in parts 5 and 6 of the 22nd volume of the North American Flora, which was not available at the time the earlier part of the 7th volume of that work was issued, in which the rusts occur.

The genus *Earlea* was established at a time when the absence of uredia in the life cycle was considered a sufficient warrant for generic distinction. Emphasis was then placed upon the succession of spore-forms, whereas at the present time with a better understanding of the development of the rusts emphasis is transferred to the vegetative states. As uredia belong to the same state as the telia, their presence or absence is considered a minor character. However, there are other characters which might be used to set off *Earlea* as a genus, such as the rarity of paraphyses in the aecia, the usually smoother teliospores, and especially the firm, non-hygroscopic pedicels of the teliospores. These characters are now used to constitute *Earlea* a section of the genus *Phragmidium*. One species, *P. ivesiae*, upon careful study, although possessing uredia, appears to be a true representative of *Earlea*, and is accordingly transferred to that section.



100

Over 50 species are known to belong to the genus *Phragmidium*. The genus is almost exclusively found in the temperate or boreal regions of the northern hemisphere, the one notable exception being *P. disciflorum*, which occurs throughout the world where cultivated roses can flourish.

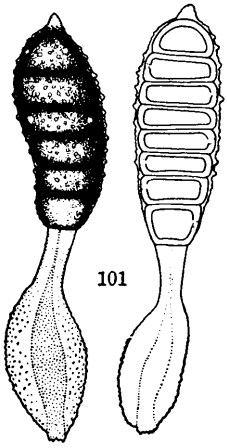
1. PHRAGMIDIUM ANDERSONI. Fig. 100.

(N. A. F. 7: 173, 727, 823.)

Phragmidium andersoni Shear, Bull. Torrey Club **29**: 453. 1902.

Pycnia not seen. Aecia hypophyllous, pulvinate, bright-orange when fresh, with a few peripheral paraphyses; aeciospores broadly ellipsoid, 15–20 by 21–26 μ, the wall pale-yellow, 1.5–2 μ thick, coarsely verrucose. Uredia chiefly hypophyllous, with abundant peripheral paraphyses; urediospores globoid or

broadly ellipsoid, 16–22 by 19–26 μ; wall pale-yellow, 1.5–2.5 μ thick, finely verrucose. Telia amphigenous, blackish-brown; teliospores cylindric, 25–35 by 44–74 μ, 3–5-celled; wall blackish-brown, often nearly opaque, moderately verrucose, with a small hyaline apiculus; pedicel longer than spore, colorless, except near spore, the lower part swelling in water to lanceolate.



101

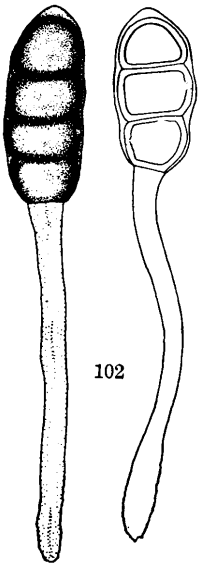
On Rosaceae (tribe *Potentilleae*): **Dasiphora fruticosa** (L.)Rydb.(*Potentilla f.*), Calif., Colo., Ida., Iowa, Minn., Mont., N.M., N.Y., N.D., S.D., Utah, Wis., Wyo.; Alta., B.C., N.B., Ont., Sask. **Range:** New Brunswick to British Columbia, southward to New York, northern New Mexico and northern California; also in eastern Siberia and northern Europe.

2. PHRAGMIDIUM JONESII. Fig. 101.

(N. A. F. 7: 173, 727.)

Phragmidium jonesii Diet., Hedw. **44:** 128. 1905.

Pycnia amphigenous, few. Aecia amphigenous, bright-yellow when fresh, with few or no paraphyses; aeciospores ellipsoid or obovate, 15–18 by 21–26 μ; wall pale-yellow, 1–1.5 μ thick, finely verrucose. Uredia amphigenous, with numerous peripheral paraphyses; urediospores ellipsoid or obovate, 13–19 by 18–26 μ; wall light-yellow or colorless, 1.5–2 μ thick, echinulate, with scattered pores. Telia amphigenous; teliospores clyindric, 21–27 by 50–95 μ, 4–10-celled; wall dark chestnut-brown or blackish, 2.5–5 μ thick, coarsely verrucose in upper part, nearly smooth below, with a subhyaline apiculus, 3–10 μ; pedicel about as long as spore, colorless, except near spore, the lower part swelling greatly in water.



102

On Rosaceae (tribe *Potentilleae*): **Ivesia baileyi** Wats., Ore.—**I. gordonii** (Hook.)T.&G.(*Horkelia g.*), Utah. —**I. setosa** (Wats.)Rydb.(*I. baileyi setosa* Wats.), Nev.—**I.** sp., Calif. **Range:** Oregon to Nevada in the central plateau of the Rocky Mountains.

3. PHRAGMIDIUM POTENTILLAE. Fig. 102.

(N. A. F. 7: 174, 728, 823.)

Puccinia potentillae Pers., Syn. Fung. 229. 1801.
Aregma obtusata Fries, Obs. Myc. **1:** 225, in part. 1815.
Phragmidium obtusum S.&K., Deuts. Schwämme **5:** 5. 1816.
Phragmidium potentillae (Pers.)Karst., Bidr. Finl. Nat. Folk **31:** 49. 1879.

Pycnia amphigenous, few, usually surrounded by aecia. Aecia amphigenous, orange-yellow when fresh, with peripheral paraphyses, inconspicuous; aeciospores globoid or broadly ellipsoid, 18–23 by 23–26 μ; wall nearly colorless, 1.5–2 μ thick, finely verrucose, with scattered pores. Uredia hypophyllous, pulverulent, with abundant peripheral paraphyses; urediospores ellipsoid or obovate, 15–21 by 19–26 μ; wall pale-yellow, 1.5–2 μ thick, sparsely echinulate, the pores indistinct, about 8, scattered. Telia hypophyllous, blackish, pulvinate; teliospores cylindric, 23–30 by 48–89 μ, rounded or somewhat acutish above, 3–5-celled; wall chocolate-brown, 3–4 μ thick, some-

times twice as thick at apex, smooth; pedicel colorless, once or twice length of spore, or more, sometimes swelling slightly in water in lower part.

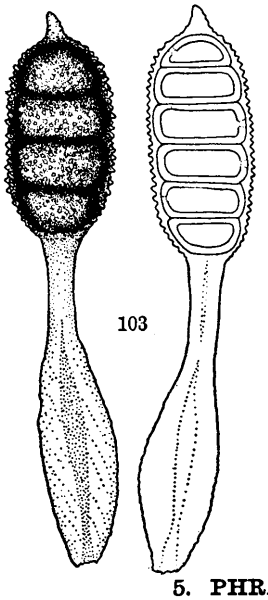
On Rosaceae (tribe *Potentilleae*): **Potentilla arachnoidea** Dougl., Colo., Ore.—**P. bipinnatifida** Dougl., Mont., N.D.; Alta., N.W.Terr.—**P. divisa** Rydb., S.D.—**P. glabrella** Rydb., Man.—**P. hippiana** Lehm., Sask.—**P. monspeliensis** L.(*P. norvegica* Gray, not L.), Conn., Me., Pa.—**P. pectinata** Raf.(*P. litoralis* Rydb.), Me., N.H.; Newf.—**P. pennsylvanica** L., Mont., Neb., N.D.; Man., Sask.—**P. strigosa** Pall., Colo., Mont., Neb., N.M., N.D., S.D., Wyo.; Alta., Man. **Range:** Newfoundland southward to New Hampshire and Pennsylvania, and on the plains from Manitoba to northern Alberta, southward to New Mexico, and in eastern Oregon; also in Europe, Asia and Japan.

4. PHRAGMIDIUM PECKIANUM. Fig. 103.

(N. A. F. 7: 164, 726, 822.)

Lecythea speciosa Peck, Bot. Gaz. **3:** 34. 1878. Not *Phragmidium speciosum* Cooke, 1875.
Phragmidium peckianum Arth., N. Am. Flora **7:** 164. 1912.

Pycnia epiphyllous, inconspicuous, in small groups. Aecia hypophyllous, orange-yellow when fresh, pulvinate, with inconspicuous, peripheral paraphyses, the wall evenly thin; aeciospores broadly ellipsoid, 19–24 by 23–31 μ; wall pale-yellow, 1.5–2.5 μ thick, coarsely verrucose with irregular warts. Uredia hypophyllous, with peripheral paraphyses, abundant and conspicuous, the wall slightly thicker above; urediospores broadly ellipsoid or obovate, 15–19 by 19–26 μ; wall pale-yellow, 1–1.5 μ thick, echinulate, the pores 6 or more, scattered, indistinct. Telia hypophyllous; teliospores ellipsoid-cylindric, 32–35 by 64–90 μ, 4–6-celled; wall chocolate-brown, closely verrucose, with a hyaline apiculus, 5–12 μ long; pedicel about once and a half length of spore, colorless, except near spore, swelling in water to broadly lanceolate in lower part.


103

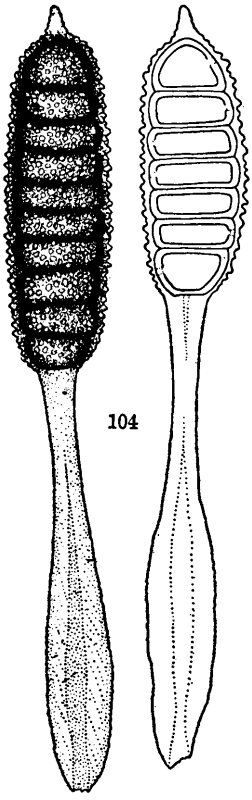
On Rosaceae (tribe *Rubeae*): **Oreobatus deliciosus** (Torr.)Rydb.(*Rubus d.*), Ariz., Colo., N.M., Wyo.—**O. neomexicanus** (Gray)Rydb.(*R. n.*), Ariz., N.M.—**O. rubicundus** W.&S., N.M. **Range:** Wyoming southward to New Mexico and Arizona.

5. PHRAGMIDIUM RUBI-IDAEI. Fig. 104.

(N. A. F. 7: 165, 726, 822.)

(*Ascophora limbiflora* Tode, Fungi Meckl. **1:** 15. 1790.)
Ascophora disciflora β *byssina* Tode, Fungi Meckl. **1:** 16. 1790.
(*Uredo rubi-idaei* Pers., Obs. Myc. **2:** 24. 1799; Syn. Fung. 218. 1801.)
Puccinia rubi-idaei DC., Fl. Fr. **6:** 54. 1815.
Phragmidium gracile Cooke, Handb. Brit. Fungi 491. 1871.
Phragmidium rubi-idaei (DC.) Karst., Bidr. Finl. Nat. Folk **31:** 52. 1879.
Phragmidium byssinum Sacc. & Trav., Broteria **25:** 56. 1910.
Phragmidium imitans Arth., N. Am. Flora **7:** 165. 1912.

Pycnia epiphyllous, few, in groups surrounded by aecia, inconspicuous. Aecia epiphyllous, in small annular groups, pulvinate, orange-yellow when



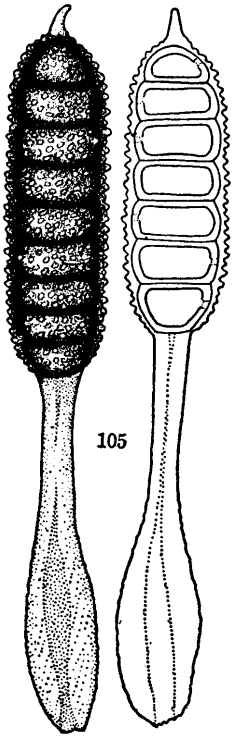
104

fresh, with peripheral paraphyses, few and inconspicuous, the wall evenly thin; aeciospores globoid or broadly ellipsoid, 14–20 by 16–24 μ; wall pale-yellow, 1.5–2.5 μ thick, sparsely echinulate-verrucose. Uredia hypophyllous, with numerous peripheral paraphyses, incurved; urediospores broadly ellipsoid, 15–18 by 18–23 μ; wall pale-yellow, about 1.5 μ thick, strongly echinulate, the pores obscure. Telia hypophyllous, blackish; teliospores cylindric, 26–30 by 80–120 μ, 6–10-celled; wall dark chocolate-brown, 6–7 μ thick, coarsely verrucose, with a hyaline apiculus 3–13 μ long; pedicel colorless, except near spore, swelling in water to lanceolate in lower part.

On Rosaceae (tribe *Rubeae*): **Rubus arizonicus** (Greene)Rydb., N.M.—**R. leucodermis** Dougl., Calif., Ore., Wash.; B.C.—**R. melanolasius** Focke, Colo.; Sask.—**R. neglectus** Peck(cult.), Ore.—**R. occidentalis** L., Mass.; Newf.—**R. strigosus** Michx.(*R. idaeus aculeatissimus* Rob.&Fern., *R. idaeus canadensis* Rich.), Calif. (cult.), Colo., Ida., Ill., Iowa, Me., Minn., Mont., N.H., N.M., N.D., Ore., S.D., Utah, Wash. (cult.), Wyo.; Alta., B.C., Man., N.B., N.S., Ont., Queb.; Labr., Newf. **Range:** Labrador to British Columbia, southward to Massachusetts, northern New Mexico and central California; also in Europe, Siberia and Japan.

Persoon's description of his *Uredo rubi-idaei* applies only to the aecia, while Tode describes and also illustrates the telia, but as a variety of the species *disciflora*, hence this varietal name does not displace the specific name given by DeCandolle.

The American form of this species has been considered distinct from the one in the eastern hemisphere, but a more extended and careful comparison of collections representing a wide distribution affords no substantial reason for their separation. It has been claimed that the American form possesses thinner walls in the aeciospores and urediospores, and thicker and more verrucose walls in the teliospores, but these distinctions are limited and not of general application. No differences can be established for the hosts.



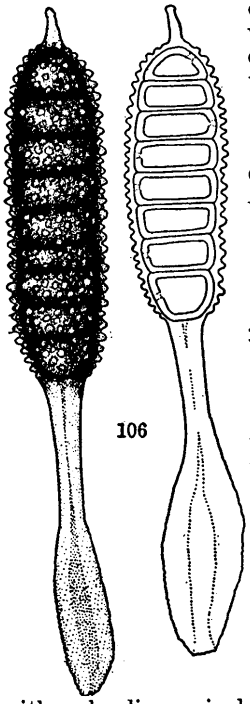
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6. PHRAGMIDIUM RUBI-ODORATI. Fig. 105.

(N. A. F. 7: 166.)

Phragmidium rubi-odorati Diet., Hedw. **44:** 120. 1905.

Pycnia not seen. Aecia amphigenous, orange-yellow when fresh, pulverulent, with peripheral paraphyses, numerous but inconspicuous, thin at sides, thicker above; aeciospores globoid or broadly ellipsoid, 15–19 by 18–24 μ; wall nearly colorless, 2–2.5 μ thick, coarsely verrucose with irregular warts. Uredia hypophyllous, small, with peripheral incurved paraphyses, abundant and conspicuous; urediospores ellipsoid, 15–18 by 18–23 μ; wall pale-yellow, about 1 μ thick, sparsely and strongly echinulate, the pores scattered, indistinct. Telia hypophyllous; teliospores cylindric, 29–34 by 80–110 μ, 7–10-celled; wall


106

dark chocolate-brown, 5–7 μ thick, moderately verrucose, with a hyaline apiculus 7–17 μ long; pedicel about length of spore, colorless, except near spore, swelling in water to lanceolate in lower part.

On Rosaceae (tribe *Rubeae*): **Rubus odoratus** L. (*Rubacer o.* Small), Conn., Me., N.Y., N.C., Vt., W.Va.; Ont. **Range:** Maine to eastern Ontario, southward to western North Carolina.

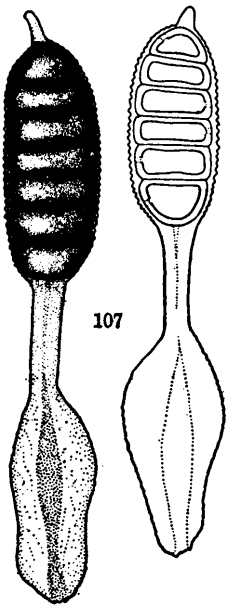
7. PHRAGMIDIUM OCCIDENTALE. Fig. 106.

(N. A. F. 7: 166, 726, 822.)

Phragmidium occidentale Arth.; Earle, in Greene, Pl. Baker. **2:** 3. 1901.

Pycnia epiphyllous, few, in small groups. Aecia hypophyllous, orange-yellow when fresh, pulvinate, with peripheral paraphyses, few and inconspicuous, incurved, the wall uniformly thin; aeciospores broadly ellipsoid, 16–20 by 20–29 μ; wall pale-yellow, 1.5–2.5 μ thick, moderately verrucose with irregular warts. Uredia hypophyllous, small, with peripheral paraphyses, abundant and conspicuous, the wall 1–1.5 μ thick at sides, 4–8 μ above; urediospores broadly ellipsoid, 15–19 by 19–25 μ; wall pale-yellow, 1–1.5 μ thick, moderately echinulate, the pores about 6, scattered, indistinct. Telia hypophyllous; teliospores cylindric, 26–29 by 65–110 μ, 6–9-celled, wall dark chocolate-brown, 5–6 μ thick, coarsely verrucose, with a hyaline apiculus 8–11 μ long; pedicel about length of spore, colorless, except near spore, swelling in water to broadly clavate in lower part.

On Rosaceae (tribe *Rubeae*): **Rubus parviflorus** Nutt. (*R. nutkanus* Moc., *Rubacer p.* Rydb.), Alas., Ariz., Calif., Colo., Ida., Mich., Minn., Mont., N.M., Ore., Utah, Wash., Wyo.; B.C. **Range:** Michigan to southeastern Alaska, southward to New Mexico and southern California; also in Central America.


107

8. PHRAGMIDIUM ROSAE-ARKANSANAE. Fig. 107.

(N. A. F. 7: 170, 727, 823.)

Phragmidium rosae-arkansanae Diet., Hedw. **44:** 333. 1905.

Pycnia chiefly epiphyllous, few, in groups surrounded by aecia, inconspicuous. Aecia amphigenous, in circular groups, or massed on the petioles and veins, orange-yellow when fresh, with peripheral paraphyses, few and inconspicuous; aeciospores globoid or broadly ellipsoid, 16–23 by 23–27 μ; wall colorless, 1.5–2 μ thick, sparsely verrucose-echinulate, the pores 8, scattered, evident. Uredia hypophyllous, small, scattered, with peripheral paraphyses, incurved, abundant and conspicuous; urediospores obovate-globoid, 15–19 by 18–23 μ; wall pale-yellow, 1.5 μ thick, closely echinulate, the pores about 8, scattered, indistinct. Telia hypophyllous; teliospores ellipsoid-cylindric, 26–29 by 62–80 μ, 5–8-celled; wall blackish-brown, 5–7 μ thick,

finely verrucose, with a smooth hyaline apiculus, 1–5 μ long; pedicel about once and a fourth length of spore, colorless except near spore, swelling greatly in water in lower part.

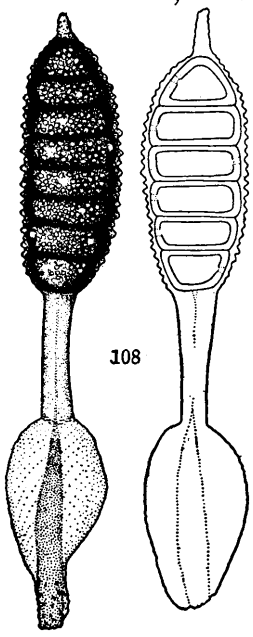
On Rosaceae (tribe *Roseae*): **Rosa arkansana** Porter, Iowa, Kans., Mo., Neb., N.D., S.D.—**R. fendleri** Crépin, Iowa, Kans., S.D., Wyo.—**R. suffulta** Greene(*R. arkansana* Wats., not Porter, *R. pratincola* Greene, not R.Br., *R. heliophila* Greene), Iowa, Kans., S.D.; Alta. **Range:** North Dakota to Alberta, southward to Missouri and Kansas.

9. PHRAGMIDIUM DISCIFLORUM. Fig. 108.

(N. A. F. 7: 171, 727, 823.)

Ascophora disciflora (*a solida*) Tode, Fungi Meckl. **1:** 16. 1790.
Puccinia mucronata a rosae Pers., Roemer's Neues Mag. **1:** 118. 1794.
Uredo rosae-centifolia Pers., Syn. Fung. 215. 1801.
Puccinia rosae Schum., Enum. Pl. Saell. **2:** 235. 1803.
Aregma mucronata Fries, Obs. Myc. **1:** 225. 1815.
Phragmidium mucronatum Schl., Fl. Berol. **2:** 156. 1824.
Phragmidium disciflorum (Tode) J. F. James, Contr. U. S. Nat. Herb. **3:** 276. 1895.
Phragmidium rosae Rostr., Plantepatologi 277. 1902.

Pycnia chiefly epiphyllous, gregarious, inconspicuous. Aecia hypophyllous and caulicolous, usually confluent, orange-yellow when fresh, with numerous peripheral paraphyses; aeciospores broadly ellipsoid or globoid, 16–24 by 25–32 μ; wall pale yellow, 1–2 μ thick, finely verrucose-echinulate, the pores indistinct. Uredia hypophyllous, scattered, with abundant peripheral paraphyses, strongly incurved; urediospores obovate or obovate-globoid, 16–19 by 20–26 μ; wall pale-yellow, about 2 μ thick, closely echinulate, the pores 8 or more, scattered, indistinct. Telia hypophyllous, blackish; teliospores cylindric, 22–33 by 64–90 μ, 5–9-celled; wall blackish-brown, 5–7 μ thick, coarsely verrucose with semihyaline tubercles, the apiculus semihyaline, distinctly roughened, prominent, 7–13 μ long; pedicel once and a half length of spore, upper half colored, lower half colorless, swelling in water.



108

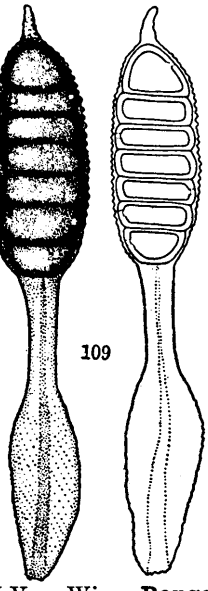
On Rosaceae (tribe *Roseae*): **Rosa alba** L., Md., Neb.—**R. gallica** L.(*R. centifolia* L.), Calif., Neb.—**R.** sp., Conn., Del., Mass., Mich., N.Y., Tex., Vt., Wash., W.Va.; N.B. **Range:** The United States east of the Rocky Mountains, as well as in California and Washington, on cultivated roses, especially derivatives of *Rosa alba* and *R. gallica* and those having large and firm leaflets; also in Mexico, South America, and throughout the Eastern hemisphere.

10. PHRAGMIDIUM SUBCORTICINUM. Fig. 109.

(N. A. F. 7: 172, 727, 823.)

(*Lycoperdon subcorticinum* Schr., Bot. Tasch. Hoppe **1793:** 68. 1793.)
(*Uredo miniata a eglanteriae* Pers., Syn. Fung. 216. 1801.)
(*Uredo elevata* Schum., Enum. Pl. Saell. **2:** 229. 1803.)
(*Coleosporium miniatum* Bon., Coniom. 60, in part. 1860.)
Phragmidium subcorticinum [Schr.] Wint., in Rab., Krypt. Fl. **1:** 228. 1881.
Phragmidium rosae-pimpinellifoliae Diet., Hedw. **44:** 339. 1905.

Pycnia chiefly caulicolous, usually abundant, irregularly scattered, often in groups, inconspicuous. Aecia chiefly caulicolous, usually confluent in large masses, orange-yellow when fresh, with peripheral paraphyses sometimes abundant but usually few or none; aeciospores broadly ellipsoid or globoid, 13–19 by 19–25 μ; wall nearly colorless, 2–2.5 μ thick, finely verrucose, the pores indistinct. Uredia hypophyllous, scattered, with abundant peripheral paraphyses, strongly incurved; urediospores obovate-globoid, 16–18 by 21–24 μ; wall nearly or quite colorless, 2–2.5 μ thick, closely echinulate, the pores scattered, indistinct. Telia hypophyllous, chestnut-brown; teliospores oblong-cylindric or obovate-cylindric, 28–31 by 80–95 μ, 5–7-celled, usually rounded above; wall chestnut-brown, not very opaque, 3–5 μ thick, finely verrucose especially in upper part, usually nearly or quite smooth below, the apiculus prominent, 14–16 μ long, colored and roughened except apex; pedicel once and a half length of spore, colorless except next the spore, swelling in water somewhat in lower part.


109

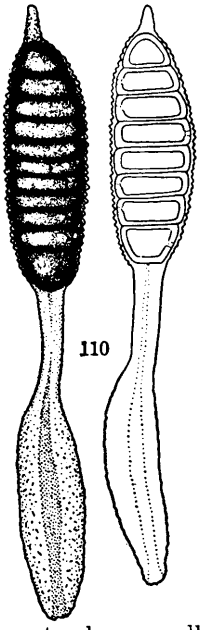
On Rosaceae (tribe *Roseae*): **Rosa eglanteria** L. (*R. lutea* Mill.), Mass., Neb.—**R. hemisphaerica** Herrm. (*R. sulphurea* Ait.), Alas., Neb.—**R. rubiginosa** L.(*R. eglanteria* Mill., not L.), Neb., N.Y., Vt.—**R. rugosa** Thunb., Alas.—**R. spinosissima** L.(*R. pimpinellifolia* L.), W.Va., Wis. **Range:** Northern United States east of the Rocky Mountains and in southern Alaska, especially on cultivated roses having small leaflets; also in Europe, Australia and New Zealand.

In an extensive series of experiments in 1902, carried out at Bern, Switzerland, by W. Bandi (Hedw. **42:** 118–136. 1903), under the guidance of Ed. Fischer, using aeciospores, it was shown that this species is biologically distinct from *P. disciflorum* and from the European *P. tuberculatum*. It was also found that repeating aecia occur in this species.

11. PHRAGMIDIUM ROSAE-ACICULARIS. Fig. 110.

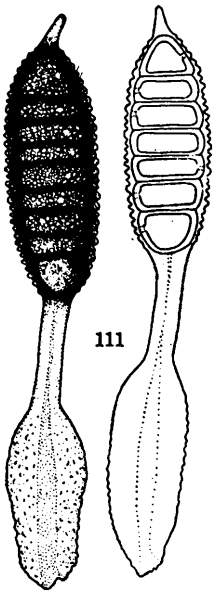
(N. A. F. 7: 168, 726, 814, 823.)

Phragmidium rosae-acicularis Liro, Bidr. Finl. Nat. Folk **65:** 428. 1908.


110

Pycnia chiefly epiphyllous, in small groups surrounded by aecia, inconspicuous. Aecia hypophyllous and caulicolous, on leaves in annular groups surrounding pycnia, on veins and stems coalescent into elongate masses 2–15 mm. long, orange-yellow when fresh, with abundant peripheral paraphyses, overtopping the spore-mass; aeciospores broadly ellipsoid or obovate-ellipsoid, 18–21 by 24–30 μ; wall nearly or quite colorless, 2–3 μ thick, moderately verrucose, the pores indistinct. Uredia hypophyllous, small, scattered, with peripheral paraphyses, incurved, abundant and conspicuous, urediospores obovate-globoid or broadly ellipsoid, 15–21 by 18–26 μ; wall pale-yellow, 1.5–2 μ thick, closely echinulate, the pores 6 or more, indistinct. Telia hypophyllous; teliospores cylindric or fusiform-cylindric, 19–29 by 48–93 μ, 5–11-celled, acute above; wall chocolate-brown but not dense, 4–5 μ thick, closely verrucose, with a brownish, subhyaline apiculus 7–12 μ long, rough; pedicel once and a half to twice length of spore, colorless except in upper part, swelling in water somewhat in lower part.

On Rosaceae (tribe *Roseae*): **Rosa acicularis** Lindl. (*R. sayi* Schw.), Alas., Minn., Mont., N.D.; Alta., B.C., Man., Ont.—**R. bourgeauiana** Crépin(*R. sayi* Wats., not Schw.), Mont.; Alta., B.C.—**R. gymnocarpa** Nutt., Mont.—**R. macdougali** Holz., Ida., Mont.—**R. nutkana** Presl, Alas., Ida., Mont., Ore., Wash.; Alta.—**R. pisocarpa** Gray, Ida.—**R. suffulta** Greene(*R. arkansana* Wats., not Porter, *R. pratincola* Greene, not R.Br., *R. heliophila* Greene), Ont. **Range:** Northern Manitoba to southeastern Alaska, southward to western Ontario and west-central Oregon; also in eastern Siberia and Japan.


111

12. PHRAGMIDIUM MONTIVAGUM. Fig. 111.

(N. A. F. 7: 169, 726, 814, 823.)

Phragmidium montivagum Arth., Torreya **9:** 24. 1909.

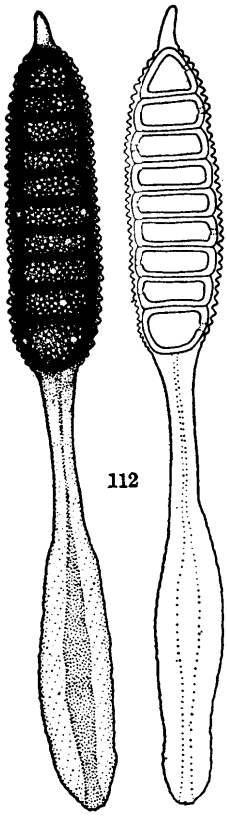
Pycnia chiefly epiphyllous, in small groups surrounded by aecia, inconspicuous. Aecia hypophyllous and petiolicolous, solitary or in groups, often confluent and causing hypertrophy and distortion, orange-yellow when fresh, with abundant peripheral paraphyses, overtopping the spore-mass; aeciospores globoid or broadly ellipsoid, 16–19 by 21–26 μ; wall colorless, 2–3 μ thick, sparsely verrucose-echinulate, the pores about 8, scattered, indistinct. Uredia hypophyllous, small, scattered, with peripheral paraphyses, incurved, abundant and conspicuous; urediospores obovate-globoid, 16–20 by 18–24 μ; wall pale-yellow, 1.5–2 μ thick, closely echinulate, the pores 6 or more, scattered, indistinct. Telia hypophyllous; teliospores cylindric, or ellipsoid-cylindric, 24–29 by 64–96 μ, 6–9-celled, more or less acute above; wall chocolate-brown, 5–7 μ thick, closely verrucose, with a smooth, subhyaline apiculus, 7–10 μ long; pedicel somewhat more than once length of spore, colorless except near spore, swelling greatly in water in lower part.

On Rosaceae (tribe *Roseae*): **Rosa aciculata** Cockerell, Colo., Utah.—**R. acicularis** Lindl.(*R. sayi* Schw.), Colo., Mont., Wyo.—**R. bourgeauiana** Crépin(*R. sayi* Wats., not Schw.), Colo., Wyo.; Alta.—**R. bridgesii** Crépin(*R. gymnocarpa pubescens* Wats.), Calif.—**R. engelmannii** Wats., Colo., Ida., Mont., S.D., Utah, Wyo.—**R. fendleri** Crépin, Ariz., Colo., Mont., N.M., Utah, Wash., Wyo.—**R. gymnocarpa** Nutt., Mont., Ore.—**R. macounii** Greene(*R. grosseserrata* E.Nels.), Colo., Ida., Mont., Nev., N.M., S.D., Utah, Wyo.—**R. manca** Greene, Colo.—**R. neomexicana** Cockerell, Utah.—**R. nuttallii** Presl, Ida.—**R. oreophila** Rydb.(*R. bakeri* Rydb.), Colo.—**R. pulverulenta** Rydb., Nev., Utah.—**R. suffulta** Greene(*R. arkansana* Wats., not Porter, *R. pratincola* Greene, not R.Br., *R. heliophila* Greene), S.D.—**R. underwoodii** Rydb., Colo.—**R. woodsii** Lindl.(*R. maximiliana* Nees), Mont., N.M., Wyo. **Range:** Rocky Mountain region from western Montana and Alberta to Washington, southward to New Mexico and central California, and in the Black Hills of South Dakota.

13. PHRAGMIDIUM AMERICANUM. Fig. 112.

(N. A. F. 7: 167, 726, 822, 823.)

Phragmidium mucronatum americanum Peck, Ann. Rep. N. Y. State Mus. **28:** 86. 1876.
Phragmidium americanum (Peck) Diet., Hedw. **44:** 124. 1905.
Phragmidium rosae-setigerae Diet., Hedw. **44:** 125. 1905.



112

Pycnia chiefly epiphyllous, usually few, gregarious, inconspicuous. Aecia hypophyllous or petiolicolous, usually confluent in groups 1–5 mm. across, orange-yellow when fresh, with inconspicuous peripheral paraphyes not rising above the spore-mass; aeciospores ellipsoid or globoid, 18–26 by 20–27 μ; wall pale-yellow, 1–1.5 μ thick, finely verrucose, the pores obscure. Uredia hypophyllous, small, scattered, with peripheral paraphyses, incurved, abundant and conspicuous; urediospores obovate-globoid, 15–23 by 18–26 μ; wall pale-yellow, 1–1.5 μ thick, closely echinulate, the pores about 8, scattered, indistinct. Telia hypophyllous; teliospores cylindric, 23–30 by 64–125 μ, 8–11-celled, round or acutish above; wall blackish-brown, 3–7 μ thick, coarsely verrucose, with an apiculus 10–13 μ long; pedicel once and a half length of spore, colorless except near spore, swelling in water somewhat in lower part, which is usually somewhat longer than upper part.

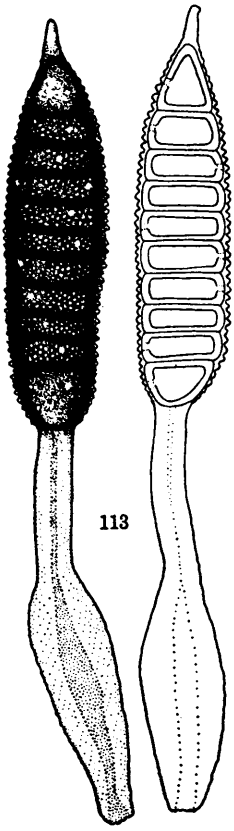
On Rosaceae (tribe *Roseae*): **Rosa blanda** Ait., N.Y., Vt., Wis.; Ont.—**R. carolina** L.(*R. humilis* Marsh.), Del., D.C., Md., Mass., Miss., N.H., N.Y., R.I., Wis.—**R. setigera** Michx., Ill., Ind., Kans., Mo., Ohio, Tenn.—**R. virginiana** Mill.(*R. lucida* Ehrh.), Conn., Del., Ind., Ill., Me., Mass., N.H., N.J., N.Y.; N.S., Ont.—**R.** sp. (cult.), D.C., Ind., Iowa, Ky., Mass., Mich., Neb., N.J., N.Y., W.Va., Wis.; Ont. **Range**: Maine to central Nebraska, southward to Maryland and northern Mississippi; also in Japan.

The spores from the more vigorous growing hosts, and especially from *Rosa setigera*, usually are larger and thicker walled, but do not differ otherwise.

14. PHRAGMIDIUM ROSAE-CALIFORNICAE. Fig. 113.

(N. A. F. 7: 170, 727, 823.)

Phragmidium rosae-californicae Diet., Hedw. **44:** 125. 1905.
(*Caeoma rosae-gymnocarpae* Diet., Hedw. **44:** 334. 1905.)
(*Gymnoconia rosae-gymnocarpae* Arth., N. Am. Flora **7:** 181. 1912.)



113

Pycnia chiefly epiphyllous, scattered opposite or among the aecia. Aecia hypophyllous and caulicolous, on young shoots often systemic from perennial mycelium, causing hypertrophy and chlorosis, confluent over the whole under surface of the leaflets, pulvinate, orange-yellow when fresh, with few or numerous peripheral paraphyses, inconspicuous; aeciospores globoid or globoid-ellipsoid, 13–20 by 18–27 μ in sori from annual mycelium, 18–24 by 27–40 μ in sori from perennial mycelium; wall nearly or quite colorless, 2–3.5 μ thick, minutely verrucose, the pores about 8, scattered. Uredia hypophyllous, scattered, with peripheral paraphyses, strongly incurved,

abundant and conspicuous; urediospores obovate or broadly ellipsoid, 16–19 by 19–25 μ; wall pale-yellow, 2–2.5 μ thick, closely echinulate, the pores 6 or more, scattered, indistinct. Telia hypophyllous; teliospores cylindric, 26–30 by 90–112 μ, 8–11-celled, acuminate above; wall blackish-brown, about 5 μ thick, moderately verrucose, with a somewhat colored apiculus, 7–12 μ long, roughened about the base; pedicel about once length of spore, colorless except next spore, swelling in water in lower part.

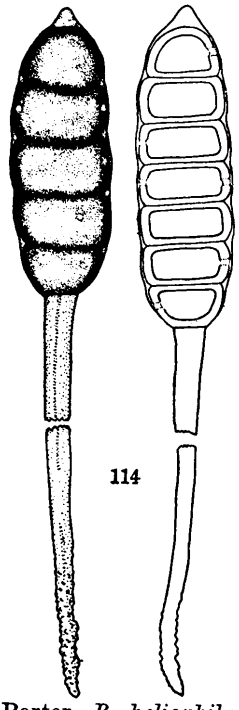
On Rosaceae (tribe *Roseae*): **Rosa arizonica** Rydb., Ariz.—**R. bridgesii** Crépin(*R. gymnocarpa pubescens* Wats.), Calif.—**R. californica** C.&S., Calif., Nev., Ore.; B.C.—**R. gymnocarpa** Nutt., Calif., Ore., Wash.; B.C.—**R. minutifolia** Engelm., Calif.—**R. nutkana** Presl, Alas., Calif., Ore., Wash.; B.C.—**R. pilifera** Rydb., Calif.—**R. pisocarpa** Gray, Calif., Ore., Wash.; B.C.—**R. sonomensis** Greene, Calif. **Range**: Along the Pacific slope from British Columbia to southern California.

15. PHRAGMIDIUM SPECIOSUM. Fig. 114.

(N. A. F. 7: 175, 728, 824.)

Aregma speciosa Fries, Syst. Myc. **3:** 496. 1832.
Phragmidium speciosum (Fries) Cooke, Grev. **3:** 171. 1875.
Earlea speciosa Arth., Rés. Sci. Congr. Bot. Vienne 341. 1906.

Pycnia epiphyllous and caulicolous, inconspicuous. Aecia hypophyllous and caulicolous, on leaflets in small groups, on petioles, stems and fruits confluent over distorted areas 10 mm. or more long, orange-yellow when fresh, with occasionally few peripheral paraphyses; aeciospores oblong-elliptic or obovate, 16–24 by 24–35 μ; wall pale-yellow, 1–1.5 μ thick, sparsely and finely verrucose, the pores indistinct, scattered. Uredia wanting. Telia caulicolous, confluent in masses 10–30 mm. long, causing a somewhat fusiform hypertrophy, at first crust-like, becoming felty, grayish-black; teliospores cylindric, 21–27 by 58–102 μ, 4–8-celled, rounded above, with a semihyaline apiculus 3–7 μ long; wall smoky-brown, 3–5 μ thick, smooth, with 2 or 3 pores in each cell; pedicel colorless, except near the spore, 7–9 μ in diameter, three to five times length of spore, usually tapering downward and somewhat rugose below.



114

On Rosaceae (tribe *Roseae*): **Rosa arvensis** Huds., Neb.—**R. blanda** Ait., Iowa, N.Y., Wis.; N.S.—**R. bourgeauiana** Crépin(*R. sayi* Wats., not Schw.), Colo.—**R. carolina** L.(*R. humilis* Marsh.), Ala., Conn., Ind., Ky., Mass., Miss., Mo., N.Y., N.C., Pa., Vt., W.Va.—**R. chinensis** Jacq., Pa.—**R. fendleri** Crépin, Colo.—**R. foliosa** Nutt., Tex.—**R. macounii** Greene(*R. grosseserrata* E. Nels.), Colo., Mont., N.D.—**R. palustris** Marsh.(*R. corymbosa* Ehrh.), Ind., Pa.—**R. pecosensis** Cockerell, N.M.——**R. pisocarpa** Gray, Ore., Wash.—**R. rugosa** Thunb., S.D., Wis.—**R. suffulta** Greene(*R. arkansana* Wats., not Porter, *R. heliophila* Greene, *R. pratincola* Greene, not R.Br.), Iowa, Kans., Minn., Neb., N.D., S.D.—**R. virginiana** Mill.(*R. lucida* Ehrh.), Conn., Mass., N.J., N.Y., Pa.; N.S.—**R. woodsii** Lindl.(*R. maximiliana* Nees), Colo., Kans.,

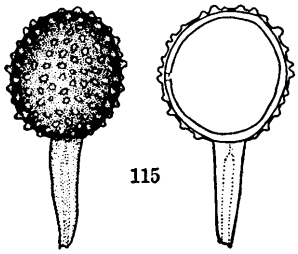
Neb., S.D.—**R.** sp.(cult.), Calif., Conn., Iowa, Mo., N.J., N.D., Wis.; Man. **Range:** Nova Scotia to Manitoba and Montana, southward to North Carolina and New Mexico, and from Washington to southern California.

16. PHRAGMIDIUM ROSICOLA. Fig. 115.

(N. A. F. 7: 179, 824.)

Uromyces rosicola E. & E., Am. Nat. **31:** 427. 1897.
Ameris rosicola Arth., Rés. Sci. Congr. Bot. Vienne 342. 1906.
Phragmidium rosicola (E. & E.) n. comb.

Pycnia unknown, and may be obsolete. Aecia and uredia wanting. Telia hypophyllous, without paraphyses, systemic from perennial mycelium, causing hypertrophy and chlorosis, confluent over the whole under surface of the leaflets, pulvinate, tardily naked; teliospores globoid, 29–34 by 32–39 μ, 1-celled, rounded above and below, without apiculus, the pores 2 or 3, lateral; wall dark chestnut-brown, 2–3 μ thick, closely and somewhat unevenly verrucose with semihyaline warts; pedicel colorless except next spore, about length of spore or shorter, firm, 7–12 μ in diameter, somewhat attenuate downward.


115

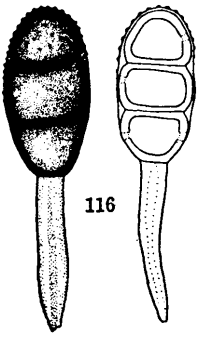
On Rosaceae (tribe *Roseae*): **Rosa engelmannii** Wats., Neb., Mont.—**R. suffulta** Greene(*R. arkansana* Wats., not Porter, *R. pratincola* Greene, not R. Br., *R. heliophila* Greene), Alta.—**R.** sp., Sask. **Range:** Plains and foothills of Saskatchewan and Alberta, southward to northwestern Nebraska and southern Montana.

This microcyclic species has been collected only a few times. It bears some resemblance to *Trachyspora* in the possession of 1–celled verrucose teliospores with firm pedicels, as has been pointed out by Dietel (Ann. Myc. **21:** 88. 1923). However, the gross appearance and habit of the telia closely resemble those of *Phragmidium speciosum*. The teliospores have pedicels like *P. speciosum*, but the color of the spores, the appearance of the warts and their close investiture of the spore, and especially the number and position of the pores, as well as the hosts and the geographic distribution ally it to *P. rosae-arkansanae*. The most peculiar character is the one cell instead of two or more cells in the teliospore.

17. PHRAGMIDIUM IVESIAE. Fig. 116.

(N. A. F. 7: 174, 823.)

Phragmidium ivesiae Syd., Ann. Myc. **1:** 329. 1903.


116

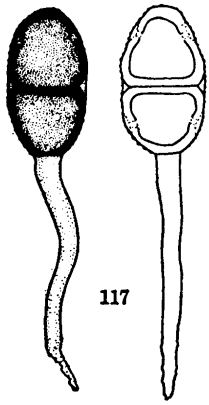
Pycnia unknown. Aecia hypophyllous, scattered, orange-yellow when fresh, without paraphyses; aeciospores broadly ellipsoid or globoid, 18–20 by 20–26 μ; wall pale-yellow, 1.5–2 μ thick, finely and sparsely verrucose, the pores indistinct, scattered, 4 or more. Uredia hypophyllous, scattered, yellowish, with few peripheral paraphyses or none; urediospores broadly ellipsoid or globoid, 16–22 by 19–26 μ; wall pale-yellow, 1.5–2 μ thick, finely and sparingly echinulate, the pores indistinct, scattered, 4 or more. Telia hypophyllous, blackish-brown; teliospores cylindric, 19–26 by 35–51 μ, rounded at both ends, usually 3-celled, occasional spores 2- or 4-celled; wall chocolate-brown, 2.5–3.5 μ thick, smooth or minutely verrucose about the apex; pedicel colorless except next the spore, firm, 5–9 μ in diameter, as long as spore or less, slightly attenuate below.

On Rosaceae (tribe *Potentilleae*): **Acaena californica** Bitter(not *A. tridactyla* Presl), Calif.—**Horkelia tridentata** Torr., Calif.—**Ivesia sericoleuca** Rydb., Calif.—**Potentilla bakeri** Rydb., Colo., Ida.—**P. blaschkeana** Turcz., Calif., Mont., Ore.—**P. breweri** Wats., Calif.—**P. coloradensis** Rydb., Colo.—**P. concinna** Richards., Alta.—**P. diversifolia** Lehm., Alta.—**P. effusa** Dougl., Colo., Wyo.—**P. elmeri** Rydb., Calif.—**P. fastigiata** Nutt., Colo.—**P. filipes** Rydb.(*P. gracilis* Port.&Coult.), Calif., Colo., Nev., Ore., Utah, Wyo.—**P. flabelliformis** Lehm., Ida., Mont., Wash., Wyo.; Alta.—**P. glaucophylla** Lehm., Colo., Wyo.; Alta.—**P. glomerata** Nels., Mont., Ore.; Alta.—**P. grosseserrata** Rydb., Calif.—**P. hallii** Rydb., Calif.—**P. hippiana** Lehm., Mont.; Sask.—**P. monspeliensis** L.(*P. norvegica* Gray, not L.), Colo., Mont.—**P. nuttallii** Lehm., Colo., Ida., Mont., Wash., Wyo.; Alta.—**P. paradoxa** Nutt., Iowa, Neb., S.D.—**P. parishii** Rydb., Calif.—**P. propinqua** Rydb., Colo.—**P. pulcherrima** Lehm., Colo., Mont., Utah.—**P. rubripes** Rydb., Mont.—**P. viridescens** Rydb., Mont., Utah. **Range:** Plains and mountains from Saskatchewan and Alberta, southward to western Iowa and central California.

18. PHRAGMIDIUM HORKELIAE. Fig. 117.

(N. A. F. 7: 177.)

Phragmidium horkeliae Garrett, Fungi Utah. *112*. 1907.
Earlea horkeliae Arth., N. Am. Flora **7**: 177. 1912.



117

Pycnia and aecia unknown. Uredia wanting. Telia amphigenous, pulvinate, blackish-brown; teliospores ellipsoid, 23–27 by 37–58 μ, mostly 2-celled, rounded or often narrowed above; wall light chestnut-brown, 1.5–2.5 μ thick, often twice as thick above, inconspicuously and sparsely verrucose, often appearing smooth, the pores 2 in each cell; pedicel nearly or quite colorless, 3–5 μ in diameter, twice or thrice length of spore, tapering downward and somewhat rugose at base.

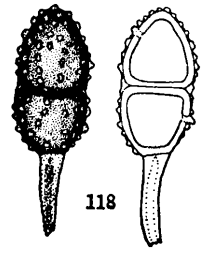
On Rosaceae (tribe *Potentilleae*): **Ivesia gordonii** (Hook.)T.&G.(*Horkelia g.*), Utah. **Range:** Known only from Salt Lake County, Utah.

19. PHRAGMIDIUM BILOCULARE. Fig. 118.

(N. A. F. 7: 177, 728.)

Phragmidium biloculare D. & H.; Diet., Bot. Gaz. **19**: 305. 1894.
Gymnoconia biloculare Arth., Rés. Sci. Congr. Bot. Vienne 342. 1906.
Earlea biloculare Arth., N. Am. Flora **7**: 177. 1912.

Pycnia not seen. Aecia hypophyllous and caulicolous, orange-yellow when fresh, somewhat pulverulent; aeciospores globoid or broadly ellipsoid, 18–21 by 20–30 μ; wall colorless, 1.5–2 μ thick, sparsely verrucose, the pores about 6, indistinct. Uredia wanting. Telia hypophyllous and caulicolous, dull chestnut-brown, somewhat pulverulent; teliospores ellipsoid, 19–26 by 30–40 μ, rounded at both ends, mostly 2-celled; wall cinnamon-brown, 3–4 μ thick, closely verrucose with colorless tubercles, the pores usually 3 in each cell, obscure; pedicel nearly colorless, firm, tapering downward, once length of spore.



118

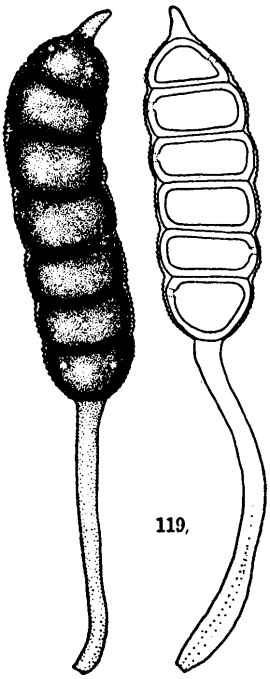
On Rosaceae (tribe *Potentilleae*): **Potentilla flabelli-**

folia Hook.(*P. gelida* Wats.), Calif., Wash.—**P. nuttallii** Lehm., Wash.—**P. trina** Nels., Ida. **Range**: Idaho to central Washington.

20. PHRAGMIDIUM ALASKANUM. Fig. 119.

(N. A. F. 7: 176.)

Earlea alaskana Arth., N. Am. Flora **7**: 176. 1912.
Phragmidium alaskanum (Arth.) Syd., Monog. Ured. **3**: 155. 1912.



119.

Pycnia unknown. Aecia amphigenous and caulicolous, often confluent into irregular masses, orange-yellow when fresh, with peripheral paraphyses, not much exceeding the height of the spore-mass; aeciospores ellipsoid, 15–20 by 20–28 μ; wall nearly colorless, 1–1.5 μ thick, closely verrucose with irregular warts, the pores indistinct, scattered. Uredia wanting. Telia hypophyllous, teliospores cylindric, 26–31 by 79–108 μ, 6–8-celled, rounded above, with a prominent apiculus 5–10 μ long; wall blackish- or chocolate-brown, 2.5–3.5 μ thick, finely verrucose, the pores usually 3 in each cell; pedicel colorless, except near spore, 7–9 μ in diameter, firm.

On Rosaceae (tribe *Rubeae*): **Rubus stellatus** Smith, Alas. **Range**: Southern Alaska in vicinity of Yakutat Bay.

8. XENODOCHUS Schl., 1826.

A genus of two known species related to *Phragmidium,* but differing in the arrangement of the pores in the teliospores. The pycnia subcuticular, and the other sori subepidermal.

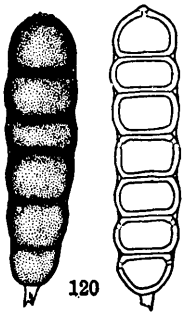
Pycnia without paraphyses. Aecia without paraphyses or peridia; aeciospores catenulate, globoid or ellipsoid, the wall verrucose. Uredia wanting. Telia with 3–many-celled teliospores borne singly on fragile pedicels, the pores 2 in a cell, opposite and in upper part near the septum, except in terminal cell with 1 apical pore, the wall colored, smooth.

Teliospores 3–7-celled. 1. *X. minor* (m?).
Teliospores 5–20-celled. 2. *X. carbonarius* (d).

1. XENODOCHUS MINOR. Fig. 120.

(N. A. F. 7: 182, 729.)

Xenodochus minor Arth., N. Am. Flora **7**: 182. 1912.
Phragmidium minor Syd., Monog. Ured. **3**: 158. 1912.



120

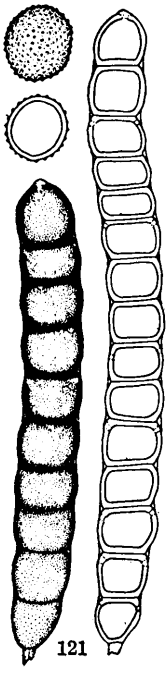
Pycnia and aecia unknown. Uredia wanting. Telia amphigenous and caulicolous, pulvinate, blackish-brown; teliospores cylindric, 3–7-celled, often curved, 16–21 by 40–140 μ, lower cells sometimes narrower and longer than upper ones; wall chestnut-brown, in basal cells often paler, 1.5–2 μ thick, smooth, or sometimes with a few small hyaline papillae at apex; pedicel colorless, 6–9 μ in diameter, as long as lowest cell or shorter, slightly narrowed downward.

On Rosaceae: **Sanguisorba sitchensis** C.A.Mey.(*S. latifolia* Cov.), Alas. **Range:** One collection from Kadiak Island, southwestern Alaska; also in northern Japan.

The species is considered by Hiratsuka (Trans. Tottori Soc. Agr. Sci. **2:** 243. 1931) to be a microform.

2. XENODOCHUS CARBONARIUS. Fig. 121.

Xenodochus carbonarius Schl., Linnaea **1:** 237. 1826.
Phragmidium carbonarium Wint., in Rab., Krypt.-Fl. **1:** 227. 1881.


121

Pycnia not seen. Aecia hypophyllous, on veins or petioles, elongate, 1–8 mm., orange-yellow; aeciospores globoid or obovoid, 16–20 by 17–24 μ; wall colorless, 1.5 μ thick, finely and evenly verrucose, the pores indistinct. Uredia wanting. Telia amphigenous, pulvinate, becoming confluent, blackish-brown; teliospores long-cylindric, 18–24 by 60–275 μ, 5–22-celled, often curved; wall chestnut-brown, in basal cells often nearly colorless, 2 μ thick, smooth, often with a small, hyaline papilla at apex; pedicel colorless, short.

On Rosaceae: **Sanguisorba microcephala** Presl, Alas. **Range:** Southeastern Alaska; also in Europe, Siberia and Japan.

The American host was at first erroneously reported as *S. latifolia,* a species with white flowers, on which it has not been found.

9. FROMMEA Arth., 1917.

A genus related to *Phragmidium,* but differing materially both in the aecia and telia. The pycnia subcuticular, other sori subepidermal.

Pycnia with a flat hymenium, without paraphyses. Aecia usually epiphyllous, without peridium or paraphyses; aeciospores borne singly on pedicels, the wall colorless, finely verrucose-echinulate, with obscure pores. Uredia usually hypophyllous, with short peripheral paraphyses or none; urediospores borne singly on pedicels, the wall pale-yellow or colorless, finely echinulate, with lateral pores. Telia without paraphyses; teliospores 2–7-celled, cinnamon-brown, smooth, with one apical pore in each cell; pedicel colorless, except near the spore, firm.

A number of species have been described from Europe and North America, which can more properly be considered as more or less fixed varieties of a single variable species.

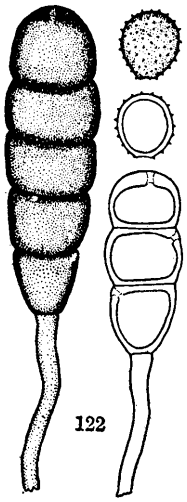
1. FROMMEA OBTUSA. Fig. 122.

(N. A. F. 7: 185, 731, 824.)

Uredo obtusa Str., Ann. Wett. Ges. **2:** 107. 1810.
Puccinia potentillae Schw., Trans. Am. Phil. Soc. II. **4:** 297. 1832. Not Pers. 1801.
Phragmidium tormentillae Fckl., Jahr. Nass. Ver. Nat. **23–24:** 46. 1870.
Aregma triarticulata B. & C.; Berk., Grev. **3:** 51. 1874.
Phragmidium potentillae-canadensis Diet., Hedw. Beibl. **42:** 179. 1903.
Xenodochus tormentillae Magn., Abh. Nat. Ges. Nürnberg **16:** 220. 1906.
Kuehneola tormentillae Arth., Rés. Sci. Congr. Bot. Vienne 342. 1906.

Kuehneola obtusa Arth., N. Am. Flora **7:** 185. 1912.
Frommea obtusa (Str.) Arth., Bull. Torrey Club **44:** 503. 1917.

Pycnia epiphyllous, in small groups on reddish and somewhat hypertrophied spots, inconspicuous. Aecia epiphyllous, oblong, surrounding the pycnia, orange-yellow when fresh, somewhat waxy; aeciospores obovoid, 15–18 by 19–26 μ; wall colorless, 1–1.5 μ thick, moderately verrucose-echinulate above, nearly smooth below, the pores obscure. Uredia hypophyllous, scattered, light-yellow when fresh, pulverulent, with few peripheral paraphyses, often wanting; urediospores globoid or obovoid, 13–16 by 16–23 μ; wall pale-yellow, 1–1.5 μ thick, finely echinulate, the pores 3 or 4, equatorial, indistinct. Telia hypophyllous, scattered, velvety, cinnamon-brown; teliospores cylindric-clavate, 20–27 by 44–90 μ, 2–7-celled, rounded or obtuse above, narrowed below; wall cinnamon-brown, paler below, 1–2 μ thick at sides, 5–8 μ at apex, smooth; pedicel colorless, except next spore, 7–10 μ in diameter, firm, one half to once length of spore.


122

On Rosaceae: **Potentilla canadensis** L., Ala., Ark., Conn., Del., Ill., Ind., Iowa, Kans., Ky., La., Me., Md., Mass., Mich., Miss., Mo., N.H., N.J., N.Y., N.C., Ohio, Pa., R.I., S.C., Tenn., Va., W.Va., Wis.; N.S., Ont. **Range:** Common and abundant from Nova Scotia to Wisconsin, southward to South Carolina and Missouri; also in Europe.

Strauss applied the name *Uredo obtusa* to the teliospores, with a figure.

(1) **Frommea obtusa duchesneae** (Arth.) n. comb. (*Kuehneola d., Frommea d.*). A less robust form, with urediospores 12–15 by 15–19 μ, the wall nearly or quite colorless, and teliospores 19–26 by 50–80 μ, 3–5-celled; on Rosaceae: **Duchesnea indica** (Andr.)Focke(*Fragaria i.*), Ala., Del., Fla., Ga., Ky., La., Md., Miss., N.H., N.J., N.Y., N.C., Tenn., S.C., Va. **Range:** New Hampshire to Kentucky, southward to Florida and Mississippi.

10. KUEHNEOLA Magn., 1898.

A genus with uredinoid aecia and distinctive telia. The pycnia subcuticular, other sori subepidermal.

Pycnia pustular with a flat hymenium, without paraphyses. Aecia usually epiphyllous, without paraphyses; aeciospores borne singly on pedicels, the wall pale-yellow or colorless, verrucose, with obscure pores. Uredia usually hypophyllous, with peripheral paraphyses or none; urediospores borne singly on pedicels, the wall pale-yellow, echinulate, with lateral pores. Telia hypophyllous, without paraphyses; teliospores 3–many-celled, with or without color, smooth or slightly roughened above, with one apical pore in each cell, each cell flattened and articulated with cell above; pedicel very short or obsolescent.

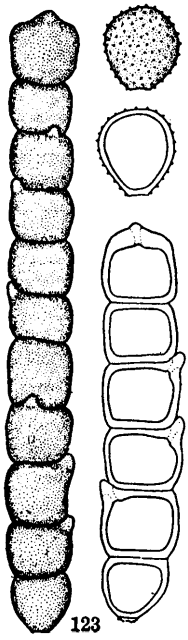
Teliospore-wall colorless; uredia without paraphyses. 1. *K. uredinis.*
Teliospore-wall colored; uredia with paraphyses. 2. *K. malvicola.*

1. KUEHNEOLA UREDINIS. Fig. 123.

(N. A. F. 7: 186, 730, 814, 824.)

Oidium uredinis Link, in Willd., Sp. Pl. **6**[1]: 123. 1824.
Chrysomyxa albida Kühn, Bot. Centr. **16**: 154. 1883.
(*Uredo muelleri* Schroet., Krypt. Fl. Schles. **3**[1]: 375. 1887.)
Phragmidium albidum Lagerh., Mitth. Bad. Bot. Ver. **1888**: 44. 1888.
Kuehneola uredinis (Link) Arth., N. Am. Flora **7**: 186. 1912.

Pycnia chiefly epiphyllous, on reddish spots, pustular, large, prominent. Aecia epiphyllous, surrounding the pycnia, irregularly elongated and often confluent into rings, orange-yellow when fresh; aeciospores globoid or obovoid, 18–19 by 19–23 μ; wall colorless, 2–2.5 μ thick, closely verrucose with rounded beads, the pores obscure. Uredia hypophyllous, scattered, pulverulent, pale lemon-yellow when fresh, without paraphyses; urediospores obovoid, 16–19 by 21–27 μ; wall nearly colorless, 1.5–2 μ thick, finely and closely verrucose-echinulate, the pores indistinct, probably 3 or 4, equatorial. Telia hypophyllous, scattered, velvety, white; teliospores cylindric, 18–24 by 85–110 μ, 5–13-celled, irregularly flattened or coronate above, narrowed below, the cells trapezoidal and articulated to the cell above by a projection at one side containing the pore; wall colorless, 1.5–2 μ thick at sides, the apical cell twice as thick above, the other cells somewhat thickened above, smooth, or slightly roughened at apex; pedicel colorless, very short or seemingly wanting.


123

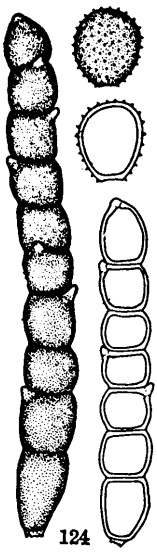
On Rosaceae: **Rubus argutus** Link(*R. andrewsianus* Blanch.), N.Y., Va.—**R. canadensis** L.(*R. millspaughii* Britt.), Me., N.Y., Tenn., W.Va., Wis., Va.—**R. cuneifolius** Pursh, Ala., Fla.—**R. floridus** Tratt., Ala., La.—**R. frondosus** Bigel.(*R. rossbergianus* Blanch.), Conn., Del., Va.—**R. hispidus** L., Conn., Ind., Me., Mass., N.H., N.Y., N.C., W.Va., Wis.—**R. lucidus** Rydb., Fla.—**R. nigricans** Rydb. (*R. abbrevians* Blanch.), Me., Vt.—**R. nigrobaccus** Bailey (*R. villosus* Auth., not Ait.), Ark., Conn., Del., D.C., Ill., Ind., Iowa, Ky., La., Me., Mass., Mich., Mo., Miss., N.Y., N.C., Ohio, R.I., S.C., Tenn., Va., W.Va., Wis.—**R. pergratus** Blanch., Me.—**R. plicatifolius** Blanch.(*R. multiformis* Blanch., *R. villosus* Ait., not Thunb.), Me.—**R. procumbens** Muhl.(*R. canadensis* T.&G., not L., *R. villosus* Bailey, not Thunb.), Ill., Mass., N.Y.; Ont.—**R. pubescens** Raf.(*R. triflorus* Richards.), Mass., N.Y.; N.S.—**R. recurvans** Blanch., Me.—**R. rubrisetus** Rydb., La.—**R. trivialis** Michx., Fla., La., Miss.—**R. ursinus** C.&S., Calif.—**R. vitifolius** C.&S., Calif. **Range**: Nova Scotia to Wisconsin, southward to Florida and Louisiana, and sparingly along the coast of southern California; also in Europe.

Cultures were made in 1904 by Jacky (Centr. Bak. II. **18**: 92. 1907) by placing teliospores from *Rubus fruticosus* on three plants of *R. fruticosus*, and obtaining pycnia followed by aecia. The name *Oidium uredinis* was applied by Link to the telial form.

2. KUEHNEOLA MALVICOLA. Fig. 124.

(N. A. F. 7: 187, 730, 824.)

Uredo malvicola Speg., Anal. Soc. Ci. Argent. **17**: 124. 1884.
Uredo hibisci Syd., Hedw. Beibl. **40**: 128. 1901.
Kuehneola malvicola (Speg.) Arth., N. Am. Flora **7**: 187. 1912.


124

Pycnia and aecia unknown. Uredia hypophyllous, scattered, cinnamon-brown, pulverulent, with few peripheral paraphyses; urediospores ellipsoid or broadly obovate, 15–21 by 19–29 μ; wall light golden-yellow, 1–1.5 μ thick, finely and closely echinulate, the pores 2, equatorial or slightly higher, indistinct. Telia hypophyllous, scattered, dark cinnamon-brown; teliospores cylindric, 15–19 by 77–150 μ, 4–12-celled, rounded above, narrowed below; wall cinnamon-brown, 1 μ thick or less, slightly or not thickened at apex, smooth; pedicel obsolescent.

On Malvaceae: **Hibiscus syriacus** L., Ala., La., Miss.—**Malvaviscus drummondii** T.&G., Tex.—**Pavonia lasiopetala** Scheele, Tex. **Range:** Central Alabama to southern Texas; also in Central America, West Indies and South America.

11. MAINSIA Jacks., 1931.

An autoecious genus, formerly called *Spirechina,* with uredinoid aecia and colorless 1-celled teliospores with thin walls; a genus closely related to *Kuehneola.* The pycnia subcuticular and other sori subepidermal.

Pycnia flattened-hemispheric, without paraphyses. Aecia usually epiphyllous, surrounding the pycnia or crowded on gall-like swellings of the leaf, without peridia or paraphyses; aeciospores borne singly on pedicels, the wall colorless, often thicker above, variously echinulate. Uredia hypophyllous, scattered, without paraphyses; urediospores ellipsoid, the wall pale-yellow, echinulate, with pores usually obscure. Telia usually hypophyllous; teliospores 1-celled, of various shapes, often inflated, the wall thin, sometimes thicker above with apical sculpturing; pedicel colorless, short.

Only one species has been reported north of the subtropic zone and within the scope of this manual. Fourteen other species occur in Central and South America, Europe and eastern Asia.

A careful study by Jackson (Mycol. **23**: 106. 1931) has made the name *Spirechina* a synonym of *Kuehneola,* and has also shown the mode of development by which the lateral walls of the epidermis are absorbed, forming cavities.

*. **Mainsia epiphylla** (Arth.) Jacks. (*Spirechina e.*), with teliospores arising from the interior of enlarged cavities between the hypertrophied epidermal cells on upper surface of the leaf, irregularly fusiform, 12–19 by 34–45 μ, the wall colorless, uniformly thin, smooth; urediospores ellipsoid or broadly obovate, 18–20 by 20–24 μ, with thin, colorless, finely echinulate walls, having 3 or 4 equatorial pores; pycnia and aecia unknown; occurs on Rosaceae: **Rubus trivialis** Michx., in southern Texas. (N. A. F. **7**: 184.)

12. GYMNOCONIA Lagerh., 1894.

A genus with a microcyclic form resembling aecia and with one demicyclic species. The genus is related to *Kuehneola* by the appearance of the cells in the teliospores and their pore characters, and to *Phragmidium,* especially the section *Earlea,* by the caeomoid aecia and nearly smooth pedicellate teliospores. The general appearance of the telia reminds one of *Puccinia.* Pycnia and other sori subepidermal.

Pycnia abundant, columnar, without paraphyses. Aecia when present without peridia or paraphyses; aeciospores catenulate, globoid or ellipsoid,

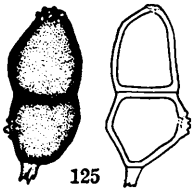
the wall colorless and verrucose. Uredia wanting. Telia in the demicyclic form with nearly smooth, 2-celled teliospores, the pores 1 in each cell, apical in upper cell and variously placed in lower cell; pedicel firm; telia in the microcyclic form resembling aecia, teliospores 1-celled, globoid.

1. GYMNOCONIA PECKIANA. Fig. 125.

(N. A. F. 7: 180, 729, 814, 824.)

(*Caeoma* (*Uredo*) *interstitiale* Schl., Horae Phys. Berol. 96. 1820.)
Puccinia peckiana Howe; Peck, Ann. Rep. N. Y. State Mus. **23:** 57. 1872.
Puccinia tripustulata Peck, Ann. Rep. N. Y. State Mus. **24:** 91. 1872.
Gymnoconia interstitialis Lagerh., Tromsø Mus. Aarsh. **16:** 140. 1894.
Gymnoconia peckiana (Howe) Trotter; Syd., Monog. Ured. **3:** 84. 1912.

Pycnia chiefly epiphyllous, abundant, scattered, prominent. Aecia chiefly hypophyllous on dwarfed leaves and shoots, from a perennial mycelium, usually crowded over part or all of the under surface of the leaflets, often confluent and tortuous, somewhat pulverulent, bright golden-yellow when fresh; aeciospores globoid or ellipsoid, 16–24 by 19–30 μ; wall colorless, about 1.5 μ thick, finely verrucose, the pores 6–10, scattered, indistinct. Uredia wanting. Telia hypophyllous, on small yellowish spots, dark-brown, pulverulent; teliospores variable in shape, nearly ellipsoid, 18–27 by 32–45 μ, somewhat narrowed above and below, lower cell more or less distorted; wall chestnut-brown with a hyaline papilla over each pore, uniformly 1.5–2 μ thick, smooth except near pores, which are often surrounded by hyaline beads, pore in upper cell apical, in lower cell lateral or near pedicel; pedicel colorless, 4–6 μ in diameter, short, fragile.


125

On Rosaceae: **Rubus arcticus** L., Alta.—**R. argutus** Link(*R. andrewsianus* Blanch.), N.C.—**R. canadensis** L.(*R. millspaughii* Britt.), Me., Mich., N.H., N.Y., N.C., Vt., W.Va., Wis.—**R. neglectus** Peck, N.Y.—**R. nigrobaccus** Bailey (*R. villosus* Auth., not Ait.), Ill., Ind., Ga., Me., Md., Mass., Mich., N.H., N.Y., N.C., Vt.; Ont.—**R. occidentalis** L., Conn., Ill., Me., Md., Mass., Mich., N.H., N.Y., N.C., Pa., Vt., Va.—**R. procumbens** Muhl.(*R. canadensis* T.&G., not L., *R. villosus* Bailey, not Thunb.), Me., Mass., N.H., N.Y.—**R. pubescens** Raf. (*R. triflorus* Richards.), N.H., Wis.—**R. randii** (Bailey)Rydb., N.S.—**R. setosus** Bigel., N.Y. Collections from all these localities except Alberta either possess teliospores or have been tested by germination of the aeciospores. **Range:** Nova Scotia to Wisconsin, southward to Georgia and Illinois, and in Alberta; also in Europe, Asia and Japan.

The range of this species is not fully known. It appears to be most abundant northward. No definite information is available regarding the western limits. It is necessary with collections of aecia to note the color of the sori, and to germinate the spores, in order to discriminate between this form and the following microcyclic form. This is especially true if no pycnia are present and if the sori have a pale-yellowish color.

Cultures were first made in 1893 by Tranzschel (Hedw. **32:** 258. 1893), using aeciospores, and in 1894 by Clinton (Bot. Gaz. **19:** 116. 1895), in 1906 by Liro (Acta Soc. Fauna Flora Fenn. **29**[7]: 57. 1907), in 1915 by Fischer (Mitt. Nat. Ges. Bern **1916:** (14). 1916), and in 1916 by Kunkel (Bull. Torrey Club **43:** 563. 1916), all using aeciospores. Infection with teliospores as well as aeciospores was effected in 1921 by Dodge (Jour. Agric. Res. **25:** 215. 1923).

Kunkelia nitens.

(N. A. F. 7: 731.)

Aecidium nitens Schw., Schr. Nat. Ges. Leipzig **1:** 69. 1822.
Caeoma luminatum Link, in Willd., Sp. Pl. **6**[2]: 61. 1825.

Kunkelia nitens (Schw.) Arth., Bot. Gaz. **63:** 504. 1917.
Gymnoconia nitens Kern & Thurston, Bull. Penn. State Coll. no. 239. 16. 1929.

Pycnia either abundant (when teliospores germinate with 4-celled promycelia), or absent (when teliospores germinate with 2-celled promycelia). Telia caeomoid, resembling aecia of *Gymnoconia,* waxy, deep reddish-yellow in races with 4-celled promycelia, or pale golden-yellow in races with 2-celled promycelia, otherwise as the aeciospores in *Gymnoconia.*

On Rosaceae: **Rubus argutus** Link(*R. andrewsianus* Blanch.), N.C.—**R. canadensis** L.(*R. millspaughii* Britt.), Me., N.Y.—**R. cuneifolius** Pursh, Fla., Md., Va.—**R. enslenii** Tratt., N.C.—**R. frondosus** Bigel.(*R. rossbergianus* Blanch.), N.Y.—**R. hispidus** L., Ga., Md.—**R. nigrobaccus** Bailey(*R. villosus* Auth., not Ait.), N.H., N.C., Ohio, Va., W.Va.—**R. parviflorus** Nutt.(*R. nutkanus* Moc., *Rubacer p.* Rydb.), Calif.—**R. procumbens** Muhl.(*R. canadensis* T.&G., not L., *R. villosus* Bailey, not Thunb.), Ga., Ind.—**R. pubescens** Raf.(*R. triflorus* Richards.), Va.—**R. trivialis** Michx., N.C.—**R. ursinus** C.&S., Calif.—**R. vitifolius** C.&S., Calif. Collections from all these localities have been tested by germination. **Range:** Maine to Indiana, southward to Florida, and along the coast of California.

The teliosporic method of germination in this rust was first demonstrated by Kunkel (Bull. Torrey Club **40:** 361–364. 1913), with spores from *Rubus frondosus,* gathered in the parks of New York City. Successful cultures were carried out in 1913 by Kunkel (Bull. Torrey Club **43:** 564. 1916), and in 1921 by Dodge (Jour. Agric. Res. **25:** 219. 1923).

The range of the microcyclic form of the orange rust of *Rubus,* although the limits are not definitely known, appears to extend further south than the demicyclic form. Even if the two are finally found to coincide in extent, yet the short cycle form will probably prove more abundant southward and possibly westward than the other form.

During extensive investigations by Dodge (Jour. Agric. Res. **28:** 1045. 1924) a uninucleated race was discovered, which was without pycnia and developed 2-celled promycelia. The sori of this race were light-yellow in color, in strong contrast with the bright-reddish sori of the usual form with pycnia.

13. TRACHYSPORA Fuckel, 1861.

An autoecious genus represented in North America by a single boreal species, which is usually treated as an *Uromyces.* Its affinities are, however, nearer to *Gymnoconia* and *Phragmidium.* Pycnia unknown, other sori subepidermal.

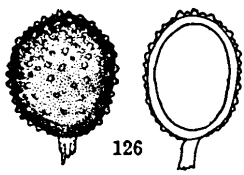
Aecia from a systemic mycelium, causing paler leaves with smaller blades and longer petioles, without peridia or paraphyses; aeciospores globoid or ellipsoid, sessile or somewhat catenulate; wall thin, verrucose, the pores obscure. Uredia wanting. Telia without paraphyses; teliospores 1-celled, globoid or oblong; wall thick, somewhat laminate, colored, verrucose, the pores obscure; pedicel hyaline.

1. TRACHYSPORA INTRUSA. Fig. 126.

(N. A. F. 7: 178, 728.)

(*Uredo alchemillae* Pers., Obs. Myc. **1:** 98. 1796.)
Uredo intrusa Grev., Fl. Edin. 436. 1824.
Uromyces intrusus Lév., Ann. Sci. Nat. III. **8:** 376. 1847.
Trachyspora alchemillae Fckl., Bot. Zeit. **19:** 250. 1861.
Uromyces alchemillae Wint., in Rab., Krypt.-Fl. **1:** 146. 1881.
Trachyspora intrusa (Grev.) n. comb.

Pycnia unkown, probably not formed. Aecia hypophyllous, irregular, crowded in large areas, orange-yellow when fresh; aeciospores globoid, 16–21 by


126

19–24 μ; wall nearly colorless, 1 μ thick, minutely verrucose, the pores obscure. Uredia wanting. Telia at first from a systemic mycelium, replacing the aecia and with the same distribution, later small, scattered, from a limited mycelium; teliospores globoid or broadly ellipsoid, 22–30 by 22–40 μ; wall cinnamon-brown, 3–4 μ thick or more, coarsely and unevenly verrucose, especially in upper part, or sometimes partially smooth; pedicel colorless, once length of spore or less, more or less deciduous.

On Rosaceae: **Alchemilla filicaulis** Buser, Greenl. **Range:** Both east and west coasts of Greenland; also in Europe and Asia.

The aecia are uredinoid in appearance, although no pedicels can be demonstrated, and have been taken for uredia by previous authors, including Persoon, who have considered the aecia wanting. Greville was the first to describe the telial form, which he placed under the genus *Uredo*.

No successful cultures with teliospores have yet been made although repeatedly attempted. Cultures with aeciospores resulting in telia were made by Ed. Fischer in 1893 and 1894 (Beitr. Krypt. Schweiz **1**[1]: 6. 1898), by Klebahn in 1905 and 1906 (Zeits. Pflanzenkr. **17**: 134. 1907) and by Liro in 1906 (Acta Soc. Fauna Flora Fenn. **29**[7]: 58. 1907).

14. TRIPHRAGMIUM Link, 1825.

An autoecious genus with distinctive uredinoid aecia, usually causing hypertrophy, and teliospores with cells in a head-like cluster. Pycnia subcuticular, other sori subepidermal.

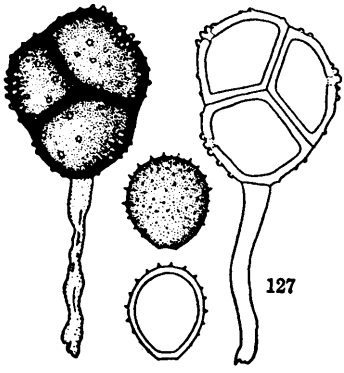
Pycnia flattish, without paraphyses. Aecia uredinoid, without paraphyses; aeciospores ellipsoid or obovoid, the wall colorless, echinulate. Uredia with peripheral paraphyses; urediospores globoid or obovoid, the wall pale-yellow, echinulate, the pores obscure. Telia hypophyllous or caulicolous; teliospores flattened laterally, triquetrously 3-celled, the walls colored, more or less verrucose, with one apical pore in each cell.

1. TRIPHRAGMIUM ULMARIAE. Fig. 127.

(N. A. F. 7: 178, 728.)

(*Uredo ulmariae* Schum., Enum. Pl. Saell. **2**: 227. 1803.)
(*Uredo spiraeae* Sow., Engl. Fungi *pl. 398*. 1803.)
Puccinia ulmariae Hedw. f., Poir., in Lam., Encyc. **8**: 245. 1808.
Triphragmium ulmariae (Hedw. f.) Link, in Willd., Sp. Pl. **6**[2]: 84. 1825.

Pycnia epiphyllous, few, flat, reddish-yellow, inconspicuous. Aecia uredinoid, amphigenous, usually on veins and petioles, large, indefinitely and irregularly extended, orange-yellow when fresh, slightly pulverulent, without paraphyses; aeciospores ellipsoid or obovoid, 18–25 by 26–33 μ; wall colorless, 2–3 μ thick, moderately and sharply echinulate, grading to smooth at base. Uredia hypophyllous, small, round, scattered, lemon-yellow when fresh, very pulverulent, with peripheral paraphyses; urediospores globoid or obovate, 19–25 by 23–29 μ; wall pale-yellow, 1–1.5 μ thick, moderately and sharply echinulate above, less so below, the pores obscure. Telia hypophyllous and caulicolous, large, on hard tissues up to 15 mm. long, small on soft tissues, 0.5 mm. long, chestnut-brown, pulverulent; teliospores flattened, more or less triangular with one cell below and two cells above, 35–48 μ long


127

and nearly same width; wall chestnut-brown, uniformly 1.5–2.5 μ thick, irregularly verrucose with hyaline beads, especially about the pores; pedicel colorless, once to once and a half length of spore, largely deciduous.

On Rosaceae: **Filipendula rubra** (Hill)B.L.Rob.(*Spiraea lobata* Gron., *Ulmaria r.*), Ind. **Range:** Central Indiana; also in Europe, Siberia and Japan.

Cultures with aeciospores were carried out in 1895 and 1906 by Klebahn (Zeits. Pflanzenkr. **5:** 327. 1896; same **13:** 143. 1907), and also at the latter date with teliospores (*l. c.*, p. 142). Similar cultures with aeciospores were made by Arthur in 1899 (Bot. Gaz. **29:** 271. 1900).

15. NYSSOPSORA Arth., 1906.

An autoecious genus related to *Triphragmium*. Only four species, two demicyclic and two microcyclic, are known.

Pycnia unknown. Aecia when present chiefly hypophyllous, uredinoid, without paraphyses; aeciospores globoid, the wall colored, sparsely verrucose. Uredia unknown or wanting. Telia amphigenous; teliospores flattened laterally, triquetrously 3-celled, the walls deeply colored, spinose, with two or more pores in each cell, usually near the angles.

Teliospores with sharply attenuate spines.	1. *N. echinata*(m).
Teliospores with blunt, bifurcated spines.	2. *N. clavellosa*(m).

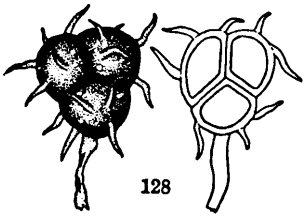
The two demicyclic species, occurring in Japan on *Meliaceae* and *Sapindaceae* respectively were placed in the genus *Oplophora* by Sydow in 1921. Only microcyclic species are known in America.

The present understanding of the genus was brought about in a revision of the genus *Triphragmium* in 1923 by Tranzschel (Journ. Soc. Bot. Russie 8: 123–132. 1925), who separated *Triphragmium* into two sections, the first having teliospores with one pore in each cell, *Triphragmium* Link, and the second having teliospores with two or more pores in each cell. The latter section was again divided into a group with light-brown teliospores, *Triphragmiopsis* Naumov *emend.*, and a group with very dark, nearly opaque teliospores, *Nyssopsora* Arthur *emend.* The last group, as interpreted by Tranzschel, includes not only the short-cycle species occurring in North America, but two Japanese long-cycle species which have been named *Oplophora cedrelae* Syd. and *O. koelreuteriae* Syd. No representative of the genus *Triphragmiopsis* has yet been found in America.

1. NYSSOPSORA ECHINATA. Fig. 128.

(N. A. F. 7: 179, 728, 824.)

Triphragmium echinatum Lév., Ann. Sci. Nat. III. **9:** 247. 1848.
Nyssopsora echinata (Lév.) Arth., Rés. Sci. Congr. Bot. Vienne 342. 1906.



128

Pycnia unknown, possibly not formed. Aecia and uredia wanting. Telia amphigenous, blackish, slightly pulverulent, teliospores flattened, more or less triangular, with one cell below and two above, 29–34 μ long and nearly same width; wall dark chocolate- or blackish-brown, uniformly 1.5–2.5 μ thick, with large attenuated spines, 6–13 μ long, sharply pointed, the pores 2 in each cell, usually near inner angles; pedicel colorless, short, more or less deciduous.

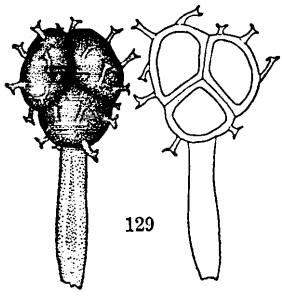
On Ammiaceae (*Umbelliferae*): **Coelopleurum gmelini** (DC.)Ledeb., Alas.—**Coneoselinum scopulorum** (Gray)C.&R.(*Ligusticum s.*), Colo.—**Ligusticum apiodorum** (Gray)C.&R., Calif.—**L. cusickii** C.&R., Ore.—**L. filicinum** Wats., Utah.—**L. leibergii** C.&R., Ida.—**L. porteri** C.&R., N.M.—**L. purpureum** C.&R., Ore., Wash.—**Oenanthe californica** Wats., Calif.—**O. sarmentosa** Presl, Wash.—**Selinum pacificum** Wats., Calif. **Range:** Mountains of southeastern Alaska, southward to New Mexico and southern California.

2. NYSSOPSORA CLAVELLOSA. Fig. 129.

(N. A. F. 7: 180, 728, 824.)

Triphragmium clavellosum Berk., Gard. Chron. **1857:** 21. 1857.
Nyssopsora clavellosa (Berk.) Arth., N. Am. Flora **7:** 180. 1912.

Pycnia unknown, possibly not formed. Aecia and uredia wanting. Telia epiphyllous, crowded in orbicular or irregular groups, blackish-brown; teliospores flattened, more or less triangular, with one cell below and two above, 26–31 μ long and nearly same width; wall blackish-brown, almost opaque, uniformly 1.5–2 μ thick, with large spines, 7–12 μ long, branched at ends, the pores 2 in each cell, usually near inner angles; pedicel colorless, 7–9 μ in diameter, once to twice length of spore.



129

On Araliaceae: **Aralia nudicaulis** L., Ida., Me., Mich., Minn., N.H., N.Y., Vt., Wis.; N.B., N.S., Ont., Queb., Sask.; Newf.—**A. racemosa** L., Ariz. **Range:** Newfoundland to Saskatchewan, southward to New York and northern Idaho, and in southern Arizona.

16. PUCCINIA Pers., 1794.

(Uromyces Link, 1816.)

A very large genus, embracing nearly one half of all the known species of rusts. The species are both autoecious and heteroecious.

When one-celled teliospores are predominant, the variety or species is customarily referred to the genus *Uromyces,* although otherwise conforming to the generic and specific characters of *Puccinia.* In the present work the genus *Uromyces* is maintained as a matter of convenience, but the species are treated the same as the two-celled forms.

The genus *Puccinia* readily falls into two sections of *Eupuccinia* and *Bullaria,* which correspond in some degree to the phylogenetic stage of development. In the first section the aecia are aecidioid, with the peridium rarely absent, the teliospores usually smooth, with firm persistent pedicels, and the pores inclined to be apical, while in the second section the aecia are largely uredinoid with no peridium, the aeciospores usually closely resembling the urediospores of the same species, and the teliospores usually verrucose, with fragile pedicels, and the pores more or less depressed.

The microcyclic (short-cycled) species, belonging under the genera *Endophyllum* (resembling aecidioid aecia, but the spores germinating with a promycelium) and *Micropuccinia* (or *Teleutospora,* when the teliospores are one-celled) have been placed under correlated macrocyclic species; when known, otherwise under the family of the host.

To conform further to the prevalent custom of mycologists, the species of *Micropuccinia* and *Teleutospora* are entered under the generic names *Puccinia* and *Uromyces* respectively, although other generic names are given in the synonymy and can be used by those who prefer them.

In the key demicyclic and microcyclic species are indicated by "d" and "m" respectively.

Pycnia subepidermal, more or less flask-shaped, with paraphyses. Aecia when present subepidermal, with or without peridium; aeciospores catenulate or pedicellate, globoid or ellipsoid, the wall verrucose or echinulate, the pores generally indistinct. Uredia when present with or more usually without peripheral paraphyses; urediospores borne singly on pedicels, one-celled, globoid or ellipsoid, the wall echinulate, or sometimes verrucose, with one to ten or more pores variously distributed, but never apical. Telia usually without paraphyses or peridium; teliospores free, one- or two-celled, rarely more, with one pore in each cell, or when in aecidioid telia catenulate, one-celled, with scattered pores.

Teliospores oblong or clavate, usually smooth and with the wall much thickened above, the pore of upper cell apical, of lower cell at septum, the pedicel usually firm and persistent; aecia aecidioid with verrucose aeciospores (§ *Eupuccinia*).
- Host belonging to family Sparganiaceae. — 1. *U. sparganii.*
- Host belonging to family Poaceae.
  - Of the tribe Maydeae.
    - Urediospore-pores 3 or 4; telia blackish-brown.
      - Urediospore-wall 1.5–2 μ thick; pores usually 4. — 2. *P. sorghi.*
      - Urediospore-wall 2–3 μ thick; pores usually 3. — 7. *P. tripsaci.*
    - Urediospore-pores 5, rarely 4; telia chocolate-brown. — 3. *P. polysora.*
  - Of the tribe Andropogoneae.
    - Urediospore-wall verrucose; pores equatorial.
      - Urediospores mostly obovate; with paraphyses. — 4. *P. virgata.*
      - Urediospores mostly globoid; without paraphyses. — 5. *P. ellisiana.* *U. andropogonis.*
    - Urediospore-wall echinulate.
      - Urediospores mostly globoid; without paraphyses.
        - Urediospore-pores 3–6, scattered. — 6. *P. andropogonis.* *P. a. pentstemonis.* *P. a. gerardiae.* *P. a. micropuncta.* *P. a. melampyri.* *P. a. polygalina.* *P. a. pustulata.* *P. a. onobrychidis.* *P. a. xanthoxyli.* *P. a. oxalidis.* *P. pentstemonis* (m). *P. seymeriae* (m). *P. comandrae* (m).
        - Urediospore-pores 5, rarely 4, equatorial. — 3. *P. polysora.*

Urediospore-pores 3 or 4, equatorial.	
Urediospore-wall 2–3 μ thick.	7. *P. tripsaci.*
Urediospore-wall 1.5–2 μ thick.	2. *P. sorghi.*
Urediospores mostly ellipsoid; with paraphyses.	
Urediospore-pores 5–10, scattered.	8. *P. purpurea.*
Urediospore-pores 4, sometimes 3, equatorial.	*. *P. kaernbachii.*
Of the tribe Paniceae.	
Urediospore-wall echinulate; pores scattered.	
Teliospores digitate above.	38. *P. coronata.*
Teliospores rounded or truncate above.	
Urediospore-pores 4–6.	9. *P. flaccida.*
Urediospore-pores 6–8.	*. *P. cameliae.*
Urediospore-wall echinulate; pores equatorial.	
Urediospores mostly globoid.	
Urediospore-pores 3, sometimes 4.	
Teliospore-wall thickened above.	10. *P. imposita.*
Teliospore-wall uniform.	*. *U. leptodermus.*
Urediospore-pores 2, sometimes 3.	*. *P. levis.*
Urediospores mostly ellipsoid.	
Urediospore-pores 2 or 3, distinct.	11. *P. cenchri.*
Urediospore-pores 3 or 4.	
Urediospore-wall colorless.	*. *P. paspalicola.*
Urediospore-wall brown.	
Urediospore-wall 1.5–2.5 μ; pores distinct.	12. *P. substriata.*
Urediospore-wall 1.5–2 μ; pores indistinct.	
Urediospores 18–23 by 19–26 μ.	13. *P. emaculata.*
Urediospores 19–27 by 21–30 μ.	14. *P. panici.* *U. graminicola.*
Urediospores 21–29 by 29–45 μ.	*. *P. chaetochloae.*
Urediospores mostly oblong.	60. *P. graminis.*
Urediospore-wall verrucose.	
Urediospore-pores 6–8, scattered.	*. *P. setariae.*
Urediospore-pores 4–6, equatorial..	*. *P. atra.*
Of the tribe Oryzeae.	15. *U. halstedii.*
Of the tribe Phalarideae.	
Teliospores digitate above.	38. *P. coronata.*
Teliospores rounded or truncate above.	
Urediospore-pores scattered, about 8.	
Paraphyses wanting.	16. *P. sessilis.*
Paraphyses present.	36. *P. poae-sudeticae.*
Urediospore-pores equatorial, 4.	60. *P. graminis.*
Of the tribe Agrostideae.	
Teliospores digitate above.	
Urediospore-pores equatorial, 3 or 4.	15. *U. halstedii.*
Urediospore-pores scattered, 6–8.	38. *P. coronata.*
Teliospores rounded or truncate above.	
Urediospores wanting; teliospores globoid or lanceolate.	17. *P. interveniens* (d). *P. graminella* (d). *P. sherardiana* (m). *E. tuberculatum* (m).
Urediospores verrucose; pores equatorial.	
Urediospore-wall golden-yellow; pores 4.	18. *P. burnettii* (d). *P. eurotiae* (m).
Urediospore-wall cinnamon-brown; pores 4–6.	43. *P. aristidae.*
Urediospores echinulate; pores equatorial or basal.	
Urediospore-wall colorless; pores 6–8.	19. *P. vilfae.*
Urediospore-wall colored.	
Urediospores globoid or flattened; pores 3–6, basal.	20. *P. sporoboli.*
Urediospores mostly ellipsoid.	
Urediospore-pores 3–5.	21. *P. simulans.* *U. sporoboli.*

Urediospore-pores 2–4.	22. *U. minimus.*
Urediospore-pores 4.	
Urediospores small, 19–23 by 21–26 μ.	*. *U. ignobilis.*
Urediospores large, 13–24 by 21–42 μ.	60. *P. graminis.*
Urediospore-pores 4–6.	42. *P. luxuriosa.*
Urediospores echinulate; pores scattered.	
Uredia with abundant paraphyses.	
Urediospore-wall thin, 1.5 μ.	
Urediospore-wall cinnamon-brown.	23. *P. pygmaea.*
Urediospore-wall light golden or colorless.	36. *P. poae-sudeticae.*
Urediospore-wall thick, 3–3.5 μ.	24. *U. aristidae.*
Uredia without paraphyses, or only hyphoid.	
Urediospore-wall thick, 2–3 μ.	25. *P. epicampis.* *. *U. epicampis.*
Urediospore-wall thin, 1–2 μ.	
Urediospores small, 15–18 by 18–22 μ.	26. *P. micrantha.*
Urediospores large, 17–29 by 19–32 μ.	
Urediospore-pores 4–6.	27. *P. scaber.*
Urediospore-pores 6–8.	
Urediospores mostly obovoid.	
Urediospore-wall darker and more echinulate above.	28. *P. stipae.* *P. grindeliae* (m).
Urediospore-wall evenly colored and echinulate.	
Uredia dark cinnamon-brown.	34. *P. monoica.*
Uredia light cinnamon-brown.	29. *P. schedonnardi.* *P. heterospora* (m).
Uredia orange-yellow.	32. *P. liatridis.*
Urediospores mostly globoid.	
Urediospore-wall cinnamon-brown.	30. *P. amphigena.*
Urediospore-wall pale golden-yellow.	
Uredia early naked.	62. *P. rubigo-vera.*
Uredia tardily naked.	63. *U. jacksonii.*
Of the tribe Aveneae.	
Teliospores rounded or truncate above.	
Urediospore-pores 4–6, paraphyses none.	31. *P. conspicua.*
Urediospore-pores 6–8, paraphyses few or none.	
Urediospore-wall 1–1.5 μ thick.	
Uredia orange-yellow.	32. *P. liatridis.*
Uredia cinnamon-brown.	
Uredia chiefly epiphyllous.	33. *P. eatoniae.* *P. e. ranunculi.* *P. e. myosotidis.*
Uredia chiefly hypophyllous.	62. *P. rubigo-vera.*
Urediospore wall 2 μ thick.	
Urediospores chiefly broadly ellipsoid.	
Uredia cinnamon-brown.	28. *P. stipae.*
Uredia yellow.	
Uredia early naked.	62. *P. rubigo-vera.*
Uredia tardily naked.	63. *U. jacksonii.*
Urediospores chiefly obovoid-ellipsoid.	34. *P. monoica.* *P. consimilis* (d). *P. holboellii* (m).

Urediospore-pores 4, equatorial. — 60. *P. graminis.*
Urediospore-pores 8–10, paraphyses numerous.
Urediospore-wall cinnamon-brown. — 35. *P. koeleriae.*
Urediospore-wall yellowish or colorless. — 36. *P. poae-sudeticae.* *P. p. airae.*

Teliospores digitate above. — 38. *P. coronata.*
Of the tribe Festuceae (also no. 184).
Uredial paraphyses abundant.
Urediospores globoid, 19–29 by 21–33 μ.
Teliospores narrow, 13–21 μ.
Urediospore-wall yellowish or colorless. — 36. *P. poae-sudeticae.*
Urediospore-wall cinnamon-brown. — 23. *P. pygmaea.*
Teliospores broad, 18–34 μ. — 37. *P. montanensis.*
Urediospores oblong-clavate, 18–19 by 26–42 μ. — 41. *P. magnusiana.* *P. anemones-virginianae* (m).

Uredial paraphyses wanting.
Teliospores digitate above.
Urediospores finely echinulate. — 38. *P. coronata.* *P. mesnieriana* (m).

Urediospores conspicuously echinulate. — 39. *P. festucae.*
Teliospores rounded or truncate above.
Urediospores obovoid or oblong.
Urediospore-pores equatorial.
Urediospore-wall thick, 3–4 μ. — 40. *P. phragmitis.* *P. ornata* (m).

Urediospore-wall thin, 1.5–2 μ.
Uredia cinnamon-brown. — 21. *P. simulans.*
Uredia reddish-brown. — 60. *P. graminis.*
Urediospore-pores scattered. — 42. *P. luxuriosa.*
Urediospores mostly globoid or broadly ellipsoid.
Urediospores finely verrucose.
Urediospore pores equatorial, 4–6. — 43. *P. aristidae.* *U. peckianus.*

Urediospore-pores equatorial, 4. — 44. *P. redfieldiae.*
Urediospore-pores scattered, 5 or 6. — 45. *P. windsoriae.*
Urediospores echinulate; pores scattered.
Urediospore-pores 4–6. — 46. *U. eragrostidis.*
Urediospore-pores 6–10.
Urediospore-wall 2–2.5 μ thick. — 47. *P. crandallii.* *P. symphoricarpi* (m).

Urediospore-wall 1.5–2 μ thick.
Urediospore-wall pale yellow or colorless.
Telia without subepidermal paraphyses. — 48. *P. cockerelliana.*
Telia with subepidermal paraphyses.
Teliospore-wall 1.5–2.5 μ thick at sides. — 49. *P. piperi.*
Teliospore-wall 1 – 1.5 μ thick at sides. — 50. *P. poarum.*
Urediospore-wall pale cinnamon-brown.
Telia with subepidermal paraphyses. — 62. *P. rubigo-vera.*
Telia without subepidermal paraphyses. — 29. *P. schedonnardi.*
Of the tribe Zoysieae. — 43. *P. aristidae.*

Of the tribe Chlorideae (also no. 186).
Teliospores rounded or truncate above.
Urediospores common; amphispores rare.
Urediospore-wall 2–3 μ thick.
Urediospore-wall strongly echinulate.
Urediospore-wall colorless, thicker above.
Urediospores obovoid. — 51. *P. peridermiospora.*
Urediospores broadly ellipsoid. — 52. *P. seymouriana.*
Urediospore-wall colored, evenly 3–4 μ thick. — 53. *P. distichlidis.*
U. acuminatus.
U. a. spartinae.
U. a. steironematis.
U. a. polemonii.
U. a. magnatus.
P. dayi(m).

Urediospore-wall minutely verrucose or echinulate.
Urediospore-pores equatorial.
Urediospore-pores 3, sometimes 4. — *. *U. argutus.*
Urediospore-pores 2, sometimes 3.
Teliospores ellipsoid or oblong. — 54. *P. cynodontis.*
Teliospores broadly ellipsoid. — *. *U. archerianus.*
Urediospore-pores scattered.
Urediospore-wall nearly colorless. — 55. *U. beckmanniae.*
Urediospore-wall colored.
Urediospore-wall evenly thick, pores 4–6. — *. *P. leptochloae.*
Urediospore-wall thicker above, pores 6–8. — 56. *P. chloridis.*
Urediospore-wall 1–2 μ thick.
Urediospore-wall nearly colorless. — 57. *P. bartholomaei.*
P. obliqua(m).

Urediospore-wall cinnamon-brown.
Urediospore-pores scattered, 6–8. — 29. *P. schedonnardi.*
Urediospore-pores equatorial, 4. — 60. *P. graminis.*
Urediospores rare; amphispores abundant.
Urediospore-wall 2–3 μ thick. — 58. *P. vexans.*
Urediospore-wall 1.5–2 μ thick. — 59. *P. boutelouae.*
Teliospores digitate above. — 38. *P. coronata.*
Of the tribe Hordeae (also no. 185).
Teliospores digitate above. — 38. *P. coronata.*
Teliospores rounded or truncate above.
Urediospore-pores equatorial. — 60. *P. graminis.*
P. g. phlei-pratensis.

Urediospore-pores scattered.
Urediospores broadly ellipsoid or globoid.
Urediospore-wall yellow or cinnamon-brown, 1–2 μ thick.
Mesospores abundant. — 61. *P. anomala.*
U. hordeinus.

Mesospores none.
Uredial paraphyses numerous, clavate. — 37. *P. montanensis.*
Uredial paraphyses few or none, hyphoid.
Uredia early naked. — 62. *P. rubigo-vera.*
P. r. agropyri.
P. r. agropyrina.
P. r. tritici.
P. r. secalis.
P. r. apocrypta.
P. r. impatientis.
U. alopecuri.

U. dactylidis.
U. amphidymus.
P. pulsatillae(m).
P. phaceliae(m).

Uredia tardily naked. 63. *U. jacksonii.*
Urediospore-wall colorless or pale yellow, 1–2 μ thick.
Uredia scattered. 64. *P. hordei.*
Uredia arranged in stripes. 65. *P. glumarum.*
Urediospore-wall golden-brown, 2–2.5 μ thick. 66. *U. mysticus.*
Urediospores obovoid. 67. *P. procera.*
Of the tribe Bambuseae.
Uredia dark-brown, without paraphyses. 68. *P. arundinariae.*
Uredia light-brown, with paraphyses. *. *P. melanocephala.*
Host belonging to family Cyperaceae.
Of the genera other than *Carex*.
Telia surrounded by subepidermal paraphyses.
Urediospore-pores equatorial, 2.
Urediospores echinulate.
Urediospores 25–35 μ long. 69. *P. obtecta.*
Urediospores 19–29 μ long. 70. *P. canaliculata.*
P. xanthii(m).
Urediospores verrucose or verrucose-echinulate. *. *P. cyperi-tagitiformis.*
Urediospore-pores superequatorial, 2. *. *P. fimbristylidis.*
Telia without subepidermal paraphyses.
Urediospore-pores equatorial.
Urediospore-pores mostly 3, occasionally 2 or 4.
Uredia dehiscent by longitudinal slit. 71. *P. cyperi.*
Uredia dehiscent by irregular rupture.
Uredia dark chestnut-brown. *. *P. fuirinae.*
Uredia cinnamon-brown. 72. *P. mcclatchieana.*
U. scirpi.
Urediospore-pores 4.
Urediospore-wall 2–2.5 μ thick. 73. *P. cladii.*
Urediospore-wall 1.5–2 μ thick.
Urediospores 15–22 by 19–26 μ. *. *P. scleriicola.*
Urediospores 17–24 by 26–40 μ. 74. *P. eleocharidis.*
P. tolimensis(m).
Urediospore-pores 2.
Urediospores mostly obovoid or ellipsoid. *. *P. liberta.*
Urediospores mostly broadly ellipsoid. 75. *U. eleocharidis.*
Urediospore-pores mostly superequatorial, 2.
Urediospores obovoid or broadly ellipsoid. 76. *P. angustata.*
P. a. typica.
P. a. eriophori.
P. a. angustatoides.
U. rhynchosporae.
P. recedens(m).
Urediospores oblong. *. *P. rosenii.*
Of the genus *Carex*.
Urediospore-pores superequatorial, 2.
Urediospores mostly broadly ellipsoid.
Urediospores 15–20 by 20–26 μ. 77. *P. extensicola.*
P. e. asteris.
P. e. erigerontis.
P. e. solidaginis.
P. e. euthamii.
P. e. rudbeckiae.
P. e. oenotherae.
P. e. hieraciata.
P. e. phrymae.
P. e. valerianae.
P. e. hydnoidea.
U. perigynius.
U. solidaginis(m).
U. rudbeckiae(m).

	P. rudbeckiae(m).
	P. asteris(m).
	P. virguareae(m).
	P. gigantea(m).
	P. maculosa(m).
Urediospores 12–18 by 16–21 μ.	78. *P. minutissima.*
Urediospores mostly ellipsoid or lenticular.	79. *P. bolleyana.*
Urediospore-pores equatorial.	
Urediospore-pores 2.	
Urediospore-wall 2.5–3 μ thick.	80. *P. macrospora.*
Urediospore-wall 1.5–2 μ thick.	
Amphispores with equatorial pores.	81. *P. atrofusca.*
	P. millefolii(m).
Amphispores with subequatorial pores.	82. *P. caricis.*
Urediospore-pores 3, occasionally, 2 or 4.	
Urediospores moderately and finely echinulate.	
Urediospores broadly ellipsoid.	82. *P. caricis.*
	P. c. urticata.
	P. c. caricis-strictae.
	P. c. grossulariata.
	P. c. uniporula.
	P. c. quadriporula?
	U. minutus.
	U. uniporulus.
	U. valens.
	P. parkerae(m).
Urediospores mostly obovoid-ellipsoid.	
Urediospore-wall cinnamon-brown.	
Urediospores large, 18–25 by 27–35 μ.	83. *P. caricis-shepherdiae.*
Urediospores small, 17–19 by 20–25 μ.	84. *P. limosae.*
Urediospore-wall chestnut-brown.	85. *P. uliginosa.*
Urediospores sparsely and strongly echinulate.	
Urediospore-wall thin, 1.5–2 μ.	86. *P. minuta.*
Urediospore-wall thick, 2–2.5 μ.	87. *P. spatiosa.*
Urediospore-pores 4.	88. *P. microsora.*
Urediospore-pores scattered, 2–5.	89. *P. karelica.*
Host belonging to family Araceae.	
Urediospore-pores 4.	90. *U. caladii.*
Urediospore-pores 2, sometimes 3.	91. *U. pyriformis.*
Host belonging to family Commelinaceae.	*. *U. commelinae.*
Host belonging to family Pontederiaceae.	92. *U. pontederiae.*
Host belonging to family Juncaceae.	
Uredia dark cinnamon-brown, tardily naked.	93. *P. littoralis.*
	U. junci.
	U. junci-effusi.
	U. silphii.
	P. silphii(m).
Uredia golden-brown, early naked.	94. *P. obscura.*
Host belonging to family Melanthaceae (also no. 187).	
Urediospore-pores superequatorial.	95. *P. atropuncta.*
Urediospore-pores scattered.	96. *P. grumosa.*
	U. zygadeni.
Host belonging to family Alliaceae (also nos. 188–93).	
Uredia present.	
Urediospore-pores scattered.	
Telial subepidermal paraphyses present.	
Urediospores 20–26 by 23–32 μ.	
Teliospores small, 32–37 μ long.	97. *P. porri.*
Teliospores large, 37–72 μ long.	98. *P. blasdalei.*
Urediospores 23–32 by 28–39 μ.	99. *P. granulispora.*
	U. bicolor.
Telial subepidermal paraphyses wanting.	100. *P. mutabilis.*
	U. aemulus.
Urediospore-pores equatorial.	104. *P. asparagi.*
Uredia wanting.	

Teliospore-wall thick, 2–3 μ. — 101. *U. aureus*(d).
Teliospore-wall thin, 1.5–2 μ. — 102. *U. brodiaeae*(d).
Host belonging to family Liliaceae (also nos. 193–96).
Teliospore-wall thick, 2–3 μ. — 101. *U. aureus*(d).
Teliospore-wall thin, 1.5–2 μ. — 103. *U. scillarum*(m).
Host belonging to family Convallariaceae (also no. 197). — 104. *P. asparagi.*
Host belonging to family Smilaceae. — 105. *P. smilacis.*
Host belonging to family Amaryllidaceae (also no. 198).
Urediospore-pores superequatorial. — 106. *P. aletridis.*
Urediospore-pores equatorial. — 107. *P. cooperiae.*
Host belonging to family Iridaceae.
Urediospore-wall thick, 2–3 μ.
Urediospore-pores 3 or 4,equatorial. — 108. *P. iridis.*
Urediospore-pores 5 or 6, scattered. — 109. *U. probus.*
Urediospore-wall thin, 1.5–2 μ. — 110. *U. houstoniatus.*
Host belonging to family Orchidaceae. — 111. *P. cypripedii.*
Host belonging to family Aristolochiaceae. — 112. *P. asarina*(m).
Host belonging to family Polygonaceae (also nos. 199–204). (See also correlated species under no. 40.)
Urediospore-pores scattered. — 113. *U. intricatus.*
Urediospore-pores equatorial.
Urediospore-wall verrucose. — 114. *U. polygoni.*
Urediospore-wall echinulate.
Urediospores 19–29 μ long.
Urediospore-pores 2–4, approximately equatorial.
Urediospores globoid or broadly ellipsoid. — 115. *P. septentrionalis.*
Urediospores oblong or ellipsoid. — 116. *P. parca.*
Urediospore-pores 2 or 3, near the apex. — 117. *P. polygoni-amphibii.* *P. p. persicariae.* *P. p. convolvuli.* *P. p. tovariae.*
Urediospores 26–37 μ long. — 118. *P. punctiformis.*
Host belonging to family Chenopodiaceae (also nos. 205–6). (See also correlated species under no. 18.)
Uredia present.
Urediospore-pores equatorial. — 119. *U. betae.*
Urediospore-pores scattered. — 120. *U. chenopodii.*
Uredia wanting. — 121. *U. shearianus*(d).
Host belonging to family Amaranthaceae. — *. *P. guillemineae.*
Host belonging to family Caryophyllaceae (also nos. 210–13).
Teliospores ellipsoid or obovoid. — 122. *U. silenes.*
Teliospores oblong-clavate. — 123. *P. arenariae*(m).
Host belonging to family Ranunculaceae (also nos. 214–19). (See also correlated species under nos. 41, 62.)
Uredia present.
Urediospore-wall echinulate.
Urediospore-wall conspicuously echinulate. — 124. *P. calthae.*
Urediospore-wall finely echinulate. — 125. *P. areolata.* *P. gemella*(m).
Urediospore-wall verrucose. — 126. *U. lycoctoni.*
Uredia wanting.
Teliospores 45–87 μ long. — 127. *P. gigantispora*(d).
Teliospores 26–32 μ long. — *. *P. stromatica*(m?).
Host belonging to family Brassicaceae (*Cruciferae*) (also nos. 222–27). (See also correlated species under no. 34.)
Teliospore pedicel long, persistent. — 128. *P. thlaspeos*(m).
Teliospore pedicel short, deciduous. — 129. *P. dentariae*(m).
Host belonging to family Crassulaceae (also nos. 228–29). — 130. *E. sempervivi*(m).
Host belonging to family Saxifragaceae (also nos. 230–32). — 131. *P. laurentiana*(m).
Host belonging to family Grossulariaceae (also no. 234). (See also correlated species under no. 82.)
Host belonging to family Rosaceae (also no. 235–36). — 132. *P. waldsteiniae*(m).

Host belonging to family Krameriaceae. — *. *U. krameriae* (m?).
Host belonging to family Fabaceae (*Leguminosae*) (also nos. 237–48).
Teliospore-wall verrucose. — 133. *U. hedysari-paniculati.*
Teliospore-wall smooth.
Uredia present.
Urediospore-pores scattered; occasionally approximately equatorial.
Uredial paraphyses present. — 134. *U. lespedezae-procumbentis.*
Uredial paraphyses wanting.
Urediospore-pores 3 or 4. — 135. *U. fabae.*
Urediospore-pores 6–8. — 136. *U. lupini.*
Urediospore-pores equatorial.
Uredial paraphyses wanting.
Urediospore-pores 3 or 4.
Teliospores globoid. — *. *U. indigoferae.*
Teliospores oblong — *. *U. dolicholi.*
Urediospore-pores 2. — *. *P. arachidis.*
Uredial paraphyses present. — *. *P. offuscata.*
Uredia wanting. — 137. *U. psoraleae* (d).
U. p. typica.
U. p. argophyllae.
U. abbreviatus (m).
Host belonging to family Geraniaceae (also no. 249). — 138. *U. geranii.*
Host belonging to family Oxalidaceae. — *. *P. oxalidis.*
Host belonging to family Polygalaceae. — 139. *P. pyrolae* (m).
Host belonging to family Sapindaceae. — *. *P. arechavaletae* (m).
Host belonging to family Rhamnaceae. (See correlated species under no. 38.)
Host belonging to family Malvaceae. (See also correlated species under nos. 17, 29.)
Teliospores fusiform or oblong-fusiform. — 140. *P. malvacearum* (m).
Teliospores broadly ellipsoid or obovate. — 141. *P. lobata* (m).
Host belonging to family Hypericaceae. — 142. *U. hyperici.*
Host belonging to family Onagraceae (also no. 256). (See also correlated species under no. 77.)
Teliospores large, 27–55 μ long.
Teliospore-wall chestnut-brown; uredia present. — 143. *P. oenotherae.*
P. o. heteranthae.
U. plumbarius.
Teliospore-wall cinnamon-brown; uredia wanting. — 144. *P. jussiaeae* (d).
Teliospores small, 25–39 μ long.
Apex thickened 2–3.5 μ. — 145. *P. glabella.*
Apex thickened 3–9 μ. — 146. *P. circaeae* (m).
Host belonging to family Haloragidaceae. — 147. *P. proserpinacae.*
Host belonging to family Cornaceae. — 148. *P. porphyrogenita* (m).
Host belonging to family Primulaceae (also nos. 270–71). (See also correlated species under no. 53.) — 149. *P. volkartiana* (m).
Host belonging to family Plumbaginaceae (*Armeriaceae*). — 150. *U. limonii.*
U. l. armeriae.
Host belonging to family Santalaceae. (See correlated species under no. 6.)
Host belonging to family Gentianaceae (also nos. 272–74). — 151. *P. haleniae* (m).
Host belonging to family Asclepiadaceae (see no. 276). (See also correlated species under no. 57.)
Host belonging to family Dichondraceae. — *. *P. dichondrae* (d).
Host belonging to family Convolvulaceae (also no. 277).
Teliospore-wall smooth.
Urediospore-wall thin, 1.5–2 μ; pores usually 2. — 152. *P. lithospermi.*
Urediospore-wall thick, 2–2.5 μ; pores usually 3. — 153. *P. convolvuli.*
Teliospore-wall verrucose. — *. *P. crassipes* (d).
Host belonging to family Hydrophyllaceae (see nos. 280–81). (See also correlated species under no. 62.)
Host belonging to family Polemoniaceae (also nos. 278–79).
Teliospore-wall thickened 7–12 μ above. — 154. *P. giliae.*
P. douglasii (d).

Teliospore-wall thickened 2–6 μ above.
Teliospore-wall chestnut-brown. 155. *P. yosemitana*(d).
Teliospore-wall pale cinnamon-brown. 156. *P. polemonii*(m).
Host belonging to family Boraginaceae (also no. 282). 157. *P. cryptanthes.*
Host belonging to family Verbenaceae.
Mesospores less abundant than teliospores. *. *P. urbaniana*(m).
Mesospores more abundant than teliospores. *. *P. lantanae*(m).
Host belonging to family Lamiaceae (*Labiatae*) (also nos. 283–87).
Teliospore-wall uniformly thick. *. *P. hyptidis.*
Teliospore-wall thickened above.
Teliospores broadly ellipsoid. 158. *P. mellifera*(d).
Teliospores clavate-oblong. 159. *P. hyssopi*(m).
Host belonging to family Scrophulariaceae (also nos. 292–300). (See also correlated species under no. 6.)
Teliospores broad, 19–23 μ.
Urediospore-wall cinnamon-brown or darker.
Teliospores 30–55 μ long. 160. *P. antirrhini.*
Teliospores 30–40 μ long. 161. *P. collinsiae.*
Urediospore-wall golden. 162. *P. castillejae.*
Teliospores narrow, 16–19 μ. 163. *P. veronicarum*(m).
Host belonging to family Plantaginaceae. 164. *P. pacifica.*
Host belonging to family Rubiaceae (also * no. 301).
Teliospore-wall much thickened above, 6–15 μ.
Teliospores ellipsoid or clavate. 165. *P. punctata.*
P. p. troglodytes.
P. difformis(d).
P. rubefaciens(m).
Teliospores broadly ellipsoid. 166. *U. spermacoces.*
Teliospore-wall only slightly thickened above, 4–7 μ. *. *P. lateritia*(m).
Host belonging to family Caprifoliaceae (see no. 302). (See also correlated species under no. 47.)
Host belonging to family Valerianaceae. 167. *P. commutata*(d).
Host belonging to family Campanulaceae. 168. *P. campanulae*(m).
P. c. novae-zembliae(m).
Host belonging to family Lobeliaceae. 169. *P. lobeliae*(m).
Host belonging to family Ambrosiaceae (also no. 303). (See also correlated species under no. 70.)
Teliospore-wall thick at sides, 2.5–5 μ. 170. *P. splendens.*
Teliospore-wall thin at sides, 1.5–2.5 μ. 171. *P. xanthiifoliae.*
Host belonging to family Carduaceae.
Of the tribe Eupatorieae (also nos. 305–7). (See also correlated species under no. 74.)
Teliospore-wall thick at apex, 5–7 μ. 172. *P. tenuis*(d).
Teliospore-wall thin at apex, 2–3 μ. *. *P. spegazzinii*(m).
Of the tribe Inuleae.
Teliospores ellipsoid or oblong.
Uredia abundant.
Cuticle slightly swollen over urediospore-pores. 173. *P. gnaphalii.*
Cuticle much inflated over urediospore-pores. *. *P. plucheae.*
Uredia wanting. 174. *P. investita*(d).
Teliospores broadly ellipsoid. 175. *U. amoenus*(m).
Of the tribe Astereae (also no. 308). (See also correlated species under nos. 28, 77.)
Teliospore - wall pale cinnamon - brown or lighter.
Teliospores large, 45–70 μ long.
Urediospore-wall golden-brown; pores distinct. 176. *P. evadens.*
Urediospore-wall nearly colorless; pores indistinct. *. *P. baccharidis.*
Teliospores small, 39–50 μ long. *. *P. pistorica.*
Teliospore-wall dark cinnamon- or chestnut-brown.
Teliospores one-celled. *. *U. compactus.*
Teliospores two-celled. *. *P. marianae*(m).
Of the tribe Heliantheae (also nos. 309–10). (See also correlated species under nos. 77, 93.)

Teliospore wall dark-chestnut-brown. 177. *P. verbesinae.*
Teliospore-wall chestnut-brown.
Urediospore-pores equatorial.
Urediospore-wall thin, 1–2 μ.
Urediospores rounded on pore-surface. *. *P. cognata.*
Urediospores flattened on pore-surface.
Urediospore-wall dark cinnamon-brown. 178. *P. helianthi.*
P. batesiana(d).
Urediospore-wall light cinnamon-brown. *. *P. parthenices.*
Urediospore-wall thicker, 2.5–3 μ. 179. *P. nuda.*
Urediospore-pores subequatorial. 180. *P. aemulans.*
Teliospore-wall cinnamon-brown. *. *P. melampodii*(m).
Of the tribe Anthemideae (also no. 311). (See correlated species under no. 81.) 181. *P. chrysanthemi.*
Of the tribe Helenieae (also nos. 312–13). 182. *P. flaveriae*(m).
Of the tribe Senecioneae (also nos. 314–16). (See also correlated species under no. 76.) *. *P. emiliae*(m).
Host belonging to family Cichoriaceae (also nos. 324–32). (See also correlated species under nos. 28, 77.) 183. *P. fraseri*(m).

Teliospores globoid or ellipsoid, less often oblong, usually verrucose, the wall uniform or only slightly thickened above by a differentiated umbo or papilla, the pore of upper cell apical or depressed, of lower cell usually depressed one-third or more, the pedicel short and fragile; aecia uredinoid with echinulate aeciospores, less often aecidioid with verrucose aeciospores (§ *Bullaria* DC., 1805).

Host belonging to family Poaceae (also nos. 1–68).
Teliospore-wall uniformly verrucose. 184. *P. paradoxica.*
Teliospore-wall striate. 185. *P. pattersoniana.*
P. moreniana(m).
Teliospore-wall smooth. 186. *P. kansensis.*
Host belonging to family Melanthaceae (also nos. 95–6). 187. *P. veratri.*
P. epilobii(m).
Host belonging to family Alliaceae (also nos. 97–102). (See also correlated species under no. 185.)
Teliospore-wall smooth. 188. *P. dichelostemmae*(d).
Teliospore-wall verrucose.
Teliospore-wall coarsely tuberculate. 189. *P. nodosa.*
P. carnegiana(d).
P. tumamocensis(m).
Teliospore-wall moderately verrucose.
Teliospore-wall verrucose in striae.
Teliospores 2-celled. 190. *P. subangulata*(d).
Teliospores 1-celled. 191. *U. primaverilis*(d).
Teliospore-wall uniformly verrucose. 193. *P. calochorti*(d?).
Teliospore-wall inconspicuously verrucose. 192. *P. pagana*(d?).
Host belonging to family Liliaceae (also nos. 101–3). 193. *P. calochorti*(d?).
Teliospore-wall uniformly verrucose.
Teliospore-wall striate-verrucose.
Teliospore - wall chestnut - brown, 2–2.5 μ thick. 194. *U. holwayi.*
Teliospore-wall golden-brown, 1.5–2 μ thick.
Teliospore-wall finely verrucose. 195. *U. miurae*(d).
Teliospore-wall coarsely verrucose. 196. *U. heterodermus*(m).
Host belonging to family Convallariaceae (also no. 104). 197. *P. mesomajalis*(m).
Host belonging to family Amaryllidaceae (also nos. 106–7). 198. *U. affinis.*
Host belonging to family Polygonaceae (also nos. 113–18).
Urediospore-pores scattered.
Pores covered by swollen cuticle. 199. *P. amphispilusa.*
Pores without swollen cuticle.
Urediospores 22–27 μ long.
Urediospore-wall golden, 1.5–2 μ thick. 200. *P. polygoni-alpini.*
P. poromera(m).
Urediospore-wall yellow, 2–2.5 μ thick. 201. *P. bistortae.*
P. ligustici(m).
Urediospores 27–35 μ long. 202. *P. oxyriae.*
Urediospore-pores equatorial or above.

Urediospore-wall echinulate.	203. *P. acetosae.*
Urediospore-wall verrucose.	204. *U. rickerianus.*
Host belonging to family Chenopodiaceae (also nos. 119–21).	
Urediospore-wall thin, 1.5–2 μ.	205. *P. dondiae.*
Urediospore-wall thick, 2–2.5 μ.	206. *P. grayiae.*
Host belonging to family Petiveriaceae.	*. *P. raunkaerii.*
Host belonging to family Portulacaceae.	
Teliospore-wall thin, 1.5–2 μ.	207. *P. mariae-wilsoni*(d). *U. claytoniae*(d). *P. agnita*(m).
Teliospore-wall thick, 2.5–3.5 μ.	
Teliospore-wall chestnut-brown.	208. *U. sprague ae*(d).
Teliospore-wall chocolate-brown.	209. *U. unitus*(d).
Host belonging to family Caryophyllaceae (also nos. 122–23).	
Teliospore-wall smooth.	210. *P. tardissima.*
Teliospore-wall verrucose.	
Urediospore-wall echinulate.	
Urediospore-wall thin, 1.5–2 μ.	211. *U. verruculosus.*
Urediospore-wall thick, 2.5–3 μ.	212. *U. caryophyllinus.*
Urediospore-wall verrucose.	213. *U. suksdorfii.*
Host belonging to family Ranunculaceae (also nos. 124–27).	
Uredia present.	214. *P. calthaecola.* *P. treleasiana*(m).
Uredia wanting.	
Teliospores obovoid or globoid.	215. *U. jonesii*(d).
Teliospores ellipsoid or broadly ellipsoid.	
Teliospore-wall irregularly tuberculate.	216. *P. ranunculi*(m).
Teliospore-wall uniformly verrucose or rugose.	
Teliospore-wall finely rugose.	217. *P. retecta*(m).
Teliospore-wall minutely verrucose.	218. *P. andina*(m).
Teliospore-wall verrucose in striae.	219. *P. delphinii*(m).
Host belonging to family Berberidaceae.	220. *P. podophylli*(d).
Host belonging to family Fumariaceae.	221. *P. brandegei*(m).
Host belonging to family Brassicaceae (*Cruciferae*) (also nos. 128–29).	
Teliospore-wall smooth.	222. *P. arabicola*(d).
Teliospore-wall verrucose.	
Teliospore-wall striate-verrucose.	
Teliospore-cells firmly united.	223. *P. oudemansii*(m).
Teliospore-cells readily separating.	224. *P. eutremae*(m).
Teliospore-wall uniformly verrucose.	
Teliospore-wall distinctly umbonate above.	225. *P. aberrans*(m).
Teliospore-wall uniform or nearly so.	
Telia chiefly caulicolous or fructicolous.	226. *P. drabae*(m).
Telia chiefly foliicolous.	227. *P. cruciferarum*(m).
Host belonging to family Crassulaceae (also no. 130).	
Teliospore-wall finely and evenly verrucose.	228. *P. rydbergii*(m).
Teliospore-wall smooth or sparsely verrucose.	229. *P. umbilici*(m).
Host belonging to family Saxifragaceae (also no. 131).	
Teliospore-wall striate or smooth.	230. *P. heucherae*(m).
Teliospore-wall verrucose-rugose.	231. *P. pazschkei*(m).
Teliospore-wall tuberculate.	232. *P. turrita*(m).
Host belonging to family Parnassiaceae.	233. *P. parnassiae*(m).
Host belonging to family Grossulariaceae.	234. *P. ribis*(m).
Host belonging to family Rosaceae (also no. 132).	
Teliospore pedicel long, persistent.	235. *P. agrimoniae.*
Teliospore pedicel short, fragile.	236. *P. sieversiae*(m).
Host belonging to family Fabaceae (*Leguminosae*) (also nos. 133–37).	
Teliospore-wall thick, 3–3.5 μ.	237. *U. phaseoli.* *U. p. typica.* *U. p. strophostylis.* *U. p. vignae.*
Teliospore-wall thin, 1–2.5 μ.	
Teliospore-wall striate-verrucose.	
Uredia present.	
Urediospore-pores scattered, 6–8.	238. *U. occidentalis.* *U. coördinatus*(d). *U. tranzschelii*(m).

Urediospore-pores equatorial, 3 or 4.
Urediospores 18–24 by 21–27 μ. — 239. *U. coluteae.*
Urediospores 16–20 by 18–23 μ. — 240. *U. striatus.*
U. s. medicaginis.
U. s. loti.

Uredia wanting.
Teliospore-pedicel enlarged above. — 241. *U. elegans.*
Teliospore-pedicel uniform.
Teliospore-wall closely striate. — 242. *U. coloradensis* (d).
U. c. campester (d).
U. c. montanus (d).
U. c. maritimus (d).
Teliospore-wall sparsely striate. — 244. *U. lapponicus* (d).
U. phacae-frigidae (m).

Teliospore-wall evenly and closely verrucose.
Teliospore-papilla inconspicuous. — 243. *U. punctatus.*
Teliospore-papilla conspicuous, 3–7 μ high. — 245. *U. hedysari-obscuri* (d).
Teliospore-wall very sparsely verrucose. — 246. *U. trifolii.*
U. t. trifolii-repentis.
U. t. hybridi.
U. t. fallens.
U. nerviphilus (d).
U. minor (d).

Teliospore-wall smooth.
Teliospore-wall chestnut-brown. — 247. *U. glycyrrhizae* (d?).
Teliospore-wall cinnamon-brown. — 248. *U. hyalinus* (d?).
Host belonging to family Geraniaceae (also no. 138). — 249. *P. leveillei* (m).
Host belonging to family Balsaminaceae. — 250. *P. argentata.*
P. adoxae (m).

Host belonging to family Euphorbiaceae. (See also correlated species under no. 238).
Teliospore-wall thin, 1.5–2.5 μ.
Teliospore-wall moderately verrucose. — 251. *U. proëminens.*
U. p. euphorbiicola.
U. p. typica.
U. p. myristica.
U. p. poinsettiae.
U. mayori (m).
Teliospore-wall coarsely tuberculate. — 252. *U. dictyosperma.*
Teliospore-wall thick, 3–4 μ. — *. *U. agnatus.*

Host belonging to family Violaceae.
Teliospore-wall uniformly verrucose, rarely smooth. — 253. *P. violae.*
P. effusa (d).
P. ornatula (m).
Teliospore-wall striate-verrucose. — 254. *P. canadensis* (m).
Teliospore-wall smooth. — 255. *P. fergussoni* (m).

Host belonging to family Onagraceae (also nos. 143–46). (See also correlated species under no. 187.) — 256. *P. vagans.*
P. v. epilobii-tetragoni.
P. v. gayophyti.
P. scandica (m).

Host belonging to family Araliaceae. — 257. *P. araliae* (m).

Host belonging to family Ammiaceae (*Umbelliferae*). (See also correlated species under nos. 200, 201.)
Teliospore-wall reticulate-verrucose.
Urediospore-wall uniformly echinulate. — 258. *P. marylandica.*
Urediospore-wall more strongly echinulate above. — 259. *P. pimpinellae.*
P. erigeniae (d).

Teliospore-wall striate-verrucose. — 260. *P. cicutae.*
Teliospore-wall coarsely verrucose.
Teliospore-wall finely verrucose. — 261. *P. pseudocymopteri.*
Teliospore-wall thin, 1–2 μ. — 262. *P. jonesii* (d).
Teliospore-wall thick, 2–3.5 μ. — *P. j. typica* (d).
P. j. cymopteri (d).
P. j. lindrothii (d).

Teliospore-wall uniformly verrucose.
Teliospore-wall coarsely and sparsely verrucose. — 263. *P. asperior* (d).
Teliospore-wall moderately and closely verrucose.
Apical pore covered by broad umbo. — 264. *P. musenii* (m).

Apical pore covered by indistinct papilla. 265. *P. ellisii.*
Teliospore-wall smooth.
Papilla over apical teliospore-pore, 1–3 μ high.
Urediospore-wall thicker above.
Teliospores mostly ellipsoid. 266. *P. angelicae.*
P. ziziae (m?).
Teliospores mostly oblong-cylindric. 267. *P. coelopleuri.*
Urediospore-wall uniformly thick. 268. *P. hydrocotyles.*
Papilla over apical teliospore-pore 4–7 μ high. 269. *P. microica* (d).
P. cryptotaeniae (m).
Host belonging to family Primulaceae (also no. 149).
Teliospore-wall smooth or sparsely striate. 270. *P. ortonii.*
P. melanconioides (d).
Teliospore-wall uniformly verrucose. 271. *U. apiosporus* (m).
Host belonging to family Gentianaceae (also no. 151).
Urediospore-pores equatorial, 2–4.
Urediospores 19–24 by 24–29 μ. 272. *P. gentianae.*
P. swertiae (d).
Urediospores 15–18 by 18–21 μ. 273. *U. gentianae.*
Urediospore-pores scattered, 3–6. 274. *U. speciosus.*
Host belonging to family Apocynaceae. 275. *P. vincae.*
Host belonging to family Asclepiadaceae. 276. *U. asclepiadis.*
Host belonging to family Convolvulaceae (also nos. 152–53). 277. *P. cressae.*
Host belonging to family Polemoniaceae (also nos. 154–56).
Teliospore-wall 2–2.5 μ thick. 278. *P. plumbaria* (d).
Teliospore-wall 1.5–2 μ thick. 279. *P. gulosa* (m).
Host belonging to family Hydrophyllaceae.
Teliospore-wall coarsely and irregularly verrucose. 280. *P. romanzoffiae* (m).
Teliospore-wall finely and evenly verrucose. 281. *P. hydrophylli* (m).
Host belonging to family Boraginaceae (also no. 157). 282. *P. mertensiae* (m).
Host belonging to family Lamiaceae (*Labiatae*) (also nos. 158–59).
Upper teliospore-pore apical, lower at septum.
Urediospores obovate or globoid.
Urediospore-wall pale-yellowish. 283. *P. menthae.*
Urediospore-wall golden- or cinnamon-brown.
Teliospore-wall thick, 3–6 μ. *. *P. salviicola.*
Teliospore-wall thinner, 2–3.5 μ. *. *P. ballotaeflorae.*
Urediospores oblate-sphaeroid.
Teliospores oblong or ellipsoid. 284. *P. caulicola.*
Teliospores broadly ellipsoid. 285. *P. farinacea.*
Teliospore-pores of both cells at septum. *. *P. vertisepta* (d).
Upper teliospore-pore apical, lower depressed.
Teliospore-wall appearing striolate. 286. *P. physostegiae* (m).
Teliospore-wall uniformly verrucose.
Teliospores 26–31 μ long. 287. *P. schneideri* (m).
Teliospores 29–40 μ long. *. *P. distorta* (m).
Host belonging to family Solanaceae.
Teliospore-pedicel much inflated.
Teliospore-wall very finely verrucose. 288. *P. tumidipes.*
Teliospore-wall coarsely verrucose-tuberculate. 289. *P. globosipes.*
Teliospore-pedicel cylindric.
Pore of lower teliospore-cell depressed. 290. *P. chamaesarachae* (d).
Pore of lower teliospore cell at septum.
Teliospores 28–38 μ long. 291. *P. physalidis* (m).
Teliospores 23–28 μ long. *. *P. incondita* (m).
Host belonging to family Scrophulariaceae (also nos. 160–63).
Teliospore with apical papilla small or wanting.
Teliospore-wall chestnut-brown.
Teliospore-wall minutely rugose. 292. *P. palmeri* (d).
Teliospore-wall coarsely rugose. *. *P. confraga* (m).
Teliospore-wall cinnamon-brown.
Teliospore-wall minutely rugose. 293. *P. chelonis* (m).
Teliospore-wall moderately verrucose. 294. *P. acrophila* (m).
Teliospore with apical papilla 4–7 μ high.
Teliospore-wall minutely rugose.

Telia localized. — 295. *P. wulfeniae*(m).
Telia systemic. — 296. *P. albulensis*(m).
Teliospore-wall smooth.
Teliospores narrow, 16–20 μ. — 297. *P. rhaetica*(m).
Teliospores broad, 23–27 μ. — 298. *P. probabilis.*
Teliospore-wall conspicuously rugose.
Teliospores narrow, 16–20 μ. — 297. *P. rhaetica*(m).
Teliospores broad, 19–29 μ. — 299. *P. rufescens*(d).
Teliospore-wall striate. — 300. *P. clintonii*(m).
Host belonging to family Acanthaceae.
Teliospore-wall uniformly thick. — 301. *P. ruelliae.*
Teliospore-wall strongly umbonate at apex.
Teliospore-pedicel concolorous.
Teliospores broadly ellipsoid, 1-celled. — *. *U. ruelliae.*
Teliospores ellipsoid, 2-celled. — *. *P. anisacanthi.*
Teliospore-pedicel with brown collar at insertion. — *. *P. tetramerii.*
Host belonging to family Rubiaceae (also nos. 165–66). — *. *P. bouvardiae*(d).
Host belonging to family Caprifoliaceae. — 302. *P. linkii*(m).
Host belonging to family Adoxaceae. (See correlated species under no. 250.)
Host belonging to family Ambrosiaceae (also nos. 170–71). — 303. *P. intermixta*(d).
Host belonging to family Carduaceae.
Of the tribe Vernonieae. — 304. *P. vernoniae.*
Of the tribe Eupatorieae(also no. 172).
Lower teliospore-pore at septum. — 305. *P. conoclinii.*
Lower teliospore-pore depressed.
Teliospore-wall smooth. — 306. *P. kuhniae.*
Teliospore-wall finely rugose. — 307. *P. subdecora.*
Of the tribe Astereae (also no. 176). — 308. *P. russa*(m).
Of the tribe Heliantheae (also nos. 177–80).
Teliospore-wall smooth.
Teliospores 2-celled.
Lower teliospore-pore at septum.
Teliospore-wall 2–2.5 μ thick.
Urediospore-wall thick, 2.5–3 μ. — 309. *P. helianthellae.*
Urediospore-wall thin, 1.5–2 μ. — *. *P. enceliae.*
Teliospore-wall 3–5 μ thick.
Teliospore-pedicel uniform. — *. *P. parthenii.*
Teliospore-pedicel inflated below. — *. *P. turgidipes.*
Lower teliospore-pore depressed.
Urediospore-wall thick, 1.5–3 μ. — *. *P. abrupta.*
Urediospore-wall thin, 1–1.5 μ. — *. *P. massalis.*
Teliospores 1-celled.
Urediospores small, 16–18 by 18–22 μ. — *. *U. columbianus.*
Urediospores large, 19–27 by 27–35 μ. — *. *U. bidenticola.*
Teliospore-wall verrucose.
Teliospores 2-celled, oblong-ellipsoid.
Teliospore-wall minutely verrucose. — 310. *P. balsamorhizae.*
Teliospore-wall conspicuously verrucose. — *. *P. triannulata*(d).
Teliospores 1-celled, globoid. — *. *U. martinii.*
Of the tribe Anthemideae (also no. 181). — 311. *P. absinthii.* *U. oblongisporus*(m).
Of the tribe Helenieae (also no. 182).
Urediospore-wall cinnamon-brown. — 312. *P. gaillardiae*(d?).
Urediospore-wall chestnut-brown. — 313. *P. eriophylli.*
Of the tribe Senecioneae (also * no. 182).
Teliospore-wall verrucose. — 314. *P. arnicalis.*
Teliospore-wall smooth.
Teliospore-wall chestnut-brown. — 315. *P. subcircinata*(d). *P. expansa*(m).
Teliospore-wall cinnamon-brown. — 316. *P. conglomerata*(m).
Of the tribe Cynareae.
Pore of lower teliospore-cell at or near septum.
Cuticle over urediospore-pores strongly inflated. — 317. *P. onopordi.*
Cuticle over urediospore-pores slightly inflated. — 318. *P. cnici.*
Pore of lower teliospore-cell depressed.
Urediospore-pores 3, rarely 4.
Teliospore-wall thin, 1.5–2.5 μ.

Urediospore-wall minutely echinulate. 319. *P. obtegens.*
Urediospore-wall prominently echinulate.
Teliospores striately verrucose or smooth. 320. *P. cirsii.*
Teliospores minutely and evenly verrucose. 321. *P. bardanae.*
Teliospore-wall thick, 2.5–3.5 μ.
Teliospores broadly ellipsoid. 322. *P. carthami.*
Teliospores irregularly oblong-ellipsoid. *. *P. irrequisita.*
Urediospore-pores 2. 323. *P. cyani*(d?).
Host belonging to family Cichoriaceae (also no. 183).
Teliospore-wall very finely verrucose.
Teliospore-wall dark chestnut- or chocolate-brown. *. *P. pinaropappi.*
Teliospore-wall chestnut-brown.
Urediospore-pores 2, sometimes 3.
Urediospore-wall thin, 1–1.5 μ. 324. *P. lapsanae.*
Urediospore-wall thicker, 1.5–2.5 μ.
Teliospores small, 21–32 μ long.
Teliospore-wall 1.5–2 μ thick. 325. *P. variabilis.*
Teliospore-wall 1–1.5 μ thick. 326. *P. inspirata.*
Teliospores larger, 26–42 μ long. 327. *P. hieracii.* *P. harknessii*(d). *P. h. major*(d).
Urediospore-pores 3 or 4. 328. *P. crepidis-montanae.*
Teliospore-wall cinnamon- or yellowish-brown.
Teliospore-wall 1.5–2.5 μ thick.
Urediospore-wall yellowish. 330. *P. orbicula.*
Urediospore-wall cinnamon-brown. 331. *P. minussensis.*
Teliospore-wall 1 μ thick. 332. *P. chondrillina.*
Teliospore-wall prominently conic-verrucose. 329. *P. suksdorfii*(m).

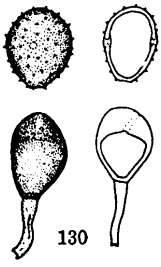
(§ EUPUCCINIA)

1. UROMYCES SPARGANII. Fig. 130.

(N. A. F. 7: 222, 745, 826.)

Uromyces sparganii C. & P.; Peck, Ann. Rep. N. Y. State Mus. **26:** 77. 1874.
Nigredo sparganii Arth., N. Am. Flora **7:** 222. 1912.

Pycnia and aecia unknown. Uredia amphigenous, scattered or sometimes grouped, pulverulent, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 15–18 by 18–24 μ; wall golden-brown, 1–1.5 μ thick, finely and sparsely echinulate, the pores 2 or 3, equatorial. Telia amphigenous, densely crowded in small groups, soon naked, compact, blackish; teliospores obovoid or pyriform, 15–19 by 20–27 μ, rounded or truncate above, narrowed below; wall cinnamon-brown, 1.5–2 μ thick at sides, 5–7 μ above; pedicel tinted, about length of spore or less.


130

ON SPARGANIACEAE: **Sparganium eurycarpum** Engelm., Ill., Iowa, Mich., Neb., N.Y., Ohio, Wis.; Ont., Queb. **Range:** Eastern Quebec to central Nebraska.

2. PUCCINIA SORGHI. Fig. 131.

(N. A. F. 7: 277, 773, 832.)

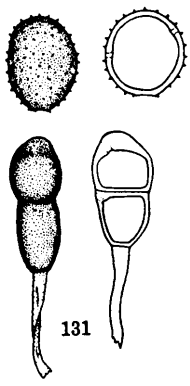
Puccinia sorghi Schw., Trans. Am. Phil. Soc. II. **4:** 295. 1832.
Puccinia maydis Bérenger, Atti Soc. Ital. **6:** 475, hyponym. 1845. Not *Uredo maydis* DC. 1815.

Puccinia zeae Bérenger, in Klotzsch, Herb. Viv. Myc. Suppl. *18*. 1851. Not *Uredo zeae* Schw. 1822.
(*Aecidium oxalidis* Thüm., Flora **59**: 425. 1876.)
Dicaeoma sorghi Ktze., Rev. Gen. **3**[3]: 470. 1898.

Pycnia amphigenous, few, inconspicuous. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 13–19 by 18–26 μ; wall pale-yellow, 1.5 μ thick, finely verrucose.

On Oxalidaceae: **Oxalis corniculata** L., Ind., S.D.—**O. cymosa** Small, Ind., Iowa, Neb.—**O. stricta** L., Ga., Iowa, Kans., Neb., N.D., S.D.—**O. violacea** L., Kans., Neb.

Uredia amphigenous, scattered, oblong or elongate, pulverulent, cinnamon-brown; urediospores ellipsoid or globoid, 23–29 by 26–32 μ; wall cinnamon-brown, 1.5–2 μ thick, finely and moderately echinulate, the pores 4, sometimes 3, approximately equatorial. Telia amphigenous, scattered or sometimes in large compact groups, oblong, soon naked, blackish-brown; teliospores oblong or ellipsoid, 16–23 by 29–45 μ, rounded or obtuse both above and below, slightly constricted at septum; wall dark chestnut-brown, 1–2 μ thick at sides, 5–7 μ above; pedicel colorless, except near the spore, once or twice length of spore.


131

On Poaceae (tribe *Maydeae*): **Euchlaena mexicana** Schrad., Iowa.—**Zea mays** L., most of the states and provinces.

Range: Throughout the United States and Canada, and wherever corn (maize) is cultivated.

Successful cultures were made in 1904 and 1905 by Arthur (Bot. Gaz. **38**: 64–87. 1904; Jour. Myc. **11**: 65. 1905; same **12**: 17. 1906), using both aeciospores and teliospores, and similarly in 1905 and 1906 in Russia by Tranzschel (Beitr. Biol. Ured. II. 15. 1906; same III, 15. 1909), in Austria by Hecke (Ann. Myc. **4**: 419. 1906), and in South Africa by Mary Pole Evans (Div. Bot. Union S. Africa, Sci. Bull. 2. 1923). Mabel A. Rice (Bull. Torrey Club **60**: 34. 1933) reports sowing teliospores on *Oxalis stricta*, a garden weed, and *O. repens*, a red-leaved greenhouse weed, and in 1925 Smith (Phytop. **16**: 69. 1925) obtained aecia on *O. corniculata*, *O. europaea* and *O. tropaeoloides*.

The results of cultures made by Kellerman (Jour. Myc. **11**: 27–30. 1905), in which uredia followed the sowing of telial material on *Zea mays*, were undoubtedly due to a few undetected urediospores occurring in the telial sori, and do not prove, as the author at first inferred, that the species "is able at times to suppress the aecidial stage."

In addition to the above, cultures were made by E. B. Mains which were not published. Teliospores from *Zea mays* infected *Oxalis corniculata* in 1916, 1924 and 1925, both in the greenhouse and in the open. The data are in the Arthur Herbarium.

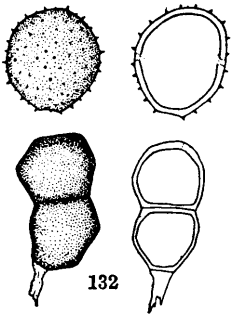
The identification of the several collections of *Oxalis* is rendered somewhat uncertain, as different systematists do not agree upon the diagnostic characters defining the species.

3. PUCCINIA POLYSORA. Fig. 132.

(N. A. F. 7: 279, 773, 832.)

Puccinia polysora Underw., Bull. Torrey Club **24**: 86. 1897.
Dicaeoma polysorum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Uredia amphigenous, oblong, usually dehiscent by a longitudinal slit, cinnamon-brown, urediospores globoid or ellipsoid, 24–29 by 27–34 μ; wall cinnamon-brown, 1.5–2 μ thick, finely and sparsely echinulate, the pores 5, rarely 4, equatorial. Telia amphigenous, linear, 0.5–1.5



132

mm. in length, long covered by epidermis, chocolate-brown; teliospores irregularly ellipsoid or obovoid, 18–26 by 29–40 μ, rounded or truncate above, narrowed below, moderately or not constricted at septum; wall chestnut-brown, 1.5 μ thick at sides, slightly thicker above; pedicel tinted, about one-fourth length of spore, or less.

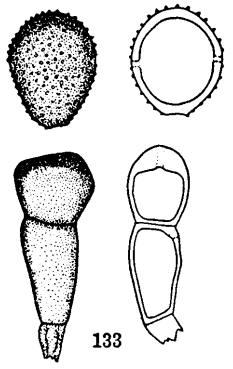
On Poaceae (tribe *Andropogoneae*): **Erianthus divaricatus** (L.)Hitchc., Fla.; (tribe *Maydeae*): **Tripsacum dactyloides** L.(*T. monostachyum* Willd.), Ala., Fla., N.J.—**T. latifolium** Hitchc., Va.—**T. laxum** Nash, Va. **Range:** East of the Alleghany Mountains from New Jersey to Florida; also in West Indies and Mexico.

4. PUCCINIA VIRGATA. Fig. 133.

(N. A. F. 7: 280, 773, 832.)

Caeoma (*Uredo*) *andropogi* Schw., Trans. Am. Phil. Soc. II. **4:** 290. 1832. Not *Puccinia andropogi* Schw., 1832.
Puccinia virgata E. & E., Proc. Acad. Phila. **1893:** 154. 1893.
Puccinia clavispora Ellis & Barth., Erythea **4:** 79. 1896.
Dicaeoma virgatum Ktze., Rev. Gen.**3**[3]: 471. 1898.

Pycnia and aecia unknown. Uredia amphigenous, soon naked, chestnut-brown, with numerous paraphyses, clavate or capitate, cinnamon- or chestnut-brown; urediospores obovoid or ellipsoid, 21–31 by 26–42 μ; wall chestnut-brown above, paler below, 2–3 μ thick, moderately verrucose, the pores 4, equatorial. Telia amphigenous, oblong or linear, 1–5 mm. long, soon naked, blackish-brown; teliospores oblong or oblong-clavate, 18–26 by 48–60 μ, rounded or truncate above, the lower cell often longer than the upper, slightly constricted at septum; wall chestnut-brown above, paler below, 1.5–2 μ thick at sides, 5–10 μ above; pedicel thick, short, concolorous, or darker than base of spore.



133

On Poaceae (tribe *Andropogoneae*): **Erianthus** sp., Ga.—**Sorghastrum nutans** (L.)Nash(*Andropogon n., Chrysopogon avenaceus* Benth.), Ala., Colo., Fla., Ga., Kans., Miss., Neb., N.C., Okla., Pa., S.C., Tenn., Tex. **Range:** Pennsylvania to Colorado, southward to Florida and Texas; also in Mexico and Brazil.

5. PUCCINIA ELLISIANA. Fig. 134.

(N. A. F. 7: 280, 773, 832.)

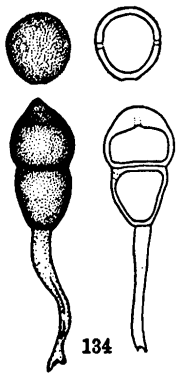
(*Aecidium mariae-wilsoni* Peck, Ann. Rep. N. Y. State Mus. **24:** 92. 1872.)
Puccinia ellisiana Thüm., Bull. Torrey Club **6:** 215. 1878.
Puccinia americana Lagerh., Tromsø Mus. Aarsh. **17:** 45. 1895.
Dicaeoma mariae-wilsoni A. & F., N. Am. Flora **7:** 280. 1920.

Pycnia epiphyllous, in small groups, inconspicuous. Aecia hypophyllous, in crowded groups, cupulate or short-cylindric, small; aeciospores globoid, small, 12–19 μ in diameter; wall light-yellow, 1–1.5 μ thick, minutely verrucose.

On Violaceae: **Viola eriocarpa** Schw.(*V. scabriuscula* Schw.), Wis.—**V. fimbriatula** J.E.Sm., Mass.—**V. lanceolata** L., Del., N.Y.—**V. nephrophylla**

Greene, Sask.—**V. nuttallii** Pursh, Colo., Kans., S.D., Wyo.—**V. palmata** L., Iowa.—**V. papilionacea** Pursh(*V. palmata cucullata* Gray), Ill., Ind., Iowa, Kans., Neb., N.Y., N.D., S.D.—**V. pedata** L., Ala., Conn., Iowa, Md., Wis.—**V. pedatifida** G.Don(*V. delphinifolia* Nutt.), Iowa, Kans., N.M.—**V. primulifolia** L., Md.—**V. rostrata** Pursh, N.Y., W.Va.—**V. sagittata** Ait., D.C., N.J., Va.—**V. septentrionalis** Greene, Me.—**V. sororia** Willd., W.Va.—**V. tricolor** L., Kans., Neb.

Uredia hypophyllous, cinnamon-brown, pulverulent; urediospores globoid, 18–21 by 19–23 μ; wall light cinnamon-brown, 2.5–3.5 μ thick, finely verrucose, the pores 3 or 4, equatorial. Telia hypophyllous, scattered, small, early naked, dark chocolate-brown; teliospores ellipsoid or obovoid, 18–23 by 35–46 μ, usually rounded above, narrowed or rounded below; wall chestnut-brown, 1.5–2.5 μ thick at sides, 5–10 μ above; pedicel light-yellow, once to once and a half length of spore.



134

On Poaceae (tribe *Andropogoneae*): **Andropogon glomeratus** (Walt.)B.S.P., N.J., N.C.—**A. provincialis** Lam. (*A. furcatus* Muhl.), Colo., Iowa., Kans., Mich., Miss., N.M., N.Y., N.D.—**A. scoparius** Michx.(*Schizachyrium s.* Nash), Colo., Conn., Ind., Iowa, Kans., Md., Mass., Miss., Mo., Neb., Nev., N.H., N.J., N.M., N.Y., N.D., Okla., S.D., W. Va., Wis.—**A. semiberbis** (Nees)Kunth(*S. s.*), Fla.—**A. virginicus** L., N.J., Tenn., Va.

Range: East of the Rocky Mountains from Maine to Saskatchewan, southward to Florida and New Mexico; also rare in West Indies and Mexico.

Successful cultures were made in 1912 by Arthur (Mycol. **7:** 230–231. 1915) by sowing teliospores on *Viola papilionacea* and *V. nuttallii.* Teliospores were used in 1926 by Mains (Mycol. **25:** 413. 1933) to infect *V. papilionacea,* and in 1927 to infect *V. nephrophylla, V. papilionacea, V. septentrionalis* and *V. sororia,* and others to some extent. Elaborate experiments made in 1913 and 1914 by Long (Jour. Agr. Res. **2:** 303–319. 1914), showing that this species could be grown on *Pentstemon* as well as on *Viola,* with morphologic changes, have not been successfully repeated by other investigators.

Uromyces andropogonis.

(N. A. F. **7:** 223, 745, 826.)

(*Caeoma* (*Aecidium*) *pedatatum* Schw., Trans. Am. Phil. Soc. II. **4:** 293. 1832.)
(*Caeoma* (*Aecidium*) *sagittatum* Schw., Trans. Am. Phil. Soc. II. **4:** 293. 1832.)
Uromyces andropogonis Tracy, Jour. Myc. **7:** 281. 1893.
Nigredo andropogonis Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.
Nigredo pedatata Arth., N. Am. Flora **7:** 223. 1912.

Pycnia and aecia as in *Puccinia ellisiana.*

On Violaceae: **Viola lanceolata** L., N.J.—**V. lovelliana** Brain., Tenn.—**V. papilionacea** Pursh(*V. palmata cucullata* Gray), N.C., Tenn., W.Va.—**V. pedata** L., Pa.—**V. primulifolia** L., D.C., Ga., Miss., Pa., W.Va.—**V. sagittata** L., Del., Pa., W.Va.—**V. striata** Ait., N.C.—**V. tricolor** L., Conn.

Uredia as in *P. ellisiana,* except the urediospores smaller, 13–17 by 16–19 μ, and the wall thinner, 2–2.5 μ thick. Telia as in *P. ellisiana,* except the teliospores one-celled, broadly ellipsoid, 13–16 by 19–29 μ, and the wall slightly thinner at sides.

On Poaceae (tribe *Andropogoneae*): **Andropogon glomeratus** (Walt.) B.S.P., Ala., Del., Fla., Md., Miss., N.J., Tenn.—**A. scoparius** Michx.(*Schizachyrium s.* Nash), N.J., N.C.—**A. ternarius** Michx., Fla., Tenn.—**A. virginicus** L., Ala., Ark., Del., Fla., Ind., Ky., La., Md., Miss., Mo., N.Y., N.C., Ohio, S.C., Tenn., Va., W.Va.

Range: Connecticut to Indiana southward to Florida and Louisiana.

Successful cultures were made in 1909 by Sheldon (Torreya **9:** 55. 1909), using teliospores from *Andropogon virginicus,* and repeated the same year by Arthur (Mycol. **2:** 228. 1910). Correlation of the one- and two-celled species was shown by Orton (Mycol. **4:** 199. 1912).

6. PUCCINIA ANDROPOGONIS. Fig. 135.

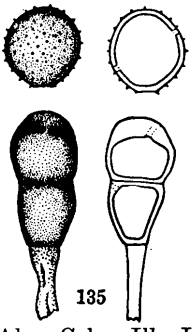
(N. A. F. 7: 281, 625, 626, 627, 773, 832.)

Puccinia andropogonis Schw., Trans. Am. Phil. Soc. II. **4:** 295. 1832.
Dicaeoma andropogonis Ktze., Rev. Gen. **3**[3]: 467. 1898.

Pycnia amphigenous, in groups. Aecia usually hypophyllous, cupulate or short-cylindric, small; aeciospores globoid or broadly ellipsoid, 15–24 by 16–30 μ; wall colorless, 1–2 μ thick, finely verrucose.

On hosts, listed under the several varieties.

Uredia chiefly hypophyllous, scattered, small, pulverulent, dark cinnamon-brown; urediospores globoid or broadly ellipsoid, 19–26 by 20–28 μ; wall bright cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores variable, 3–6, usually scattered, sometimes approximately equatorial. Telia chiefly hypophyllous, scattered, oblong or linear, small, early naked, pulvinate, blackish-brown; teliospores obovoid or ellipsoid, 15–21 by 29–48 μ, rounded or obtuse above, somewhat narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 5–9 μ and darker above; pedicel concolorous with base of spore, as long as spore.


135

On Poaceae (tribe *Andropogoneae*): **Andropogon glomeratus** (Walt.)B.S.P., Ga.—**A. hallii** Hack., Colo., Kans., Neb., Nev., N.D.—**A. provincialis** Lam.(*A. furcatus* Muhl.), Ala., Colo., Ill., Ind., Iowa, Kans., Minn., Miss., Mo., Neb., N.Y., N.D., Okla., S.D., Tex., W.Va., Wis.; Ont.—**A. scoparius** Michx.(*Schizachyrium s.* Nash.), Ala., Ariz., Ark., Colo., Del., Ga., Iowa, Ind., Kans., Mass., Mich., Minn., Miss., Mo., Neb., Nev., N.M., N.Y., N.D., Ohio, Okla., Pa., R.I., S.C., S.D., Tenn., Tex., Vt., Wis.—**A. ternarius** Michx., Ala., S.C., Tex.—**A. virginicus** L., Ala., Conn., Ill., N.C., N.Y., Okla., Pa., Tenn., Va.

Range: Along the southern border of Canada, southward in the United States to the Gulf of Mexico and Nevada to southern California; also in Mexico and Central America.

The species is separable by means of cultures, by slight differences in size of aeciospores, by the number and position of pores in the urediospores, and by the aecial hosts, into the following nine varieties:

(1). **Puccinia andropogonis pentstemonis** [Schw.] n. comb. (*Aecidium pentastemonis* Schw., *A. chelonis* Ger.). Urediospores usually with 3 or 4 pores,

approximately equatorial, or in part about the hilum; aeciospores 15–19 by 18–23 μ, the wall 1–1.5 μ thick; on SCROPHULARIACEAE: **Chelone glabra** L., Conn., Mass., N.J., N.Y.—**C. lyoni** Pursh, Tenn.—**Pentstemon acuminatus** Dougl., Sask.—**P. albidus** Nutt., Colo., Kans., S.D.—**P. alpinus** Torr., Colo., Wyo.—**P. ambiguus** Torr., Colo.—**P. angustifolius** Pursh(*P. coeruleus* Nutt.), Colo., Kans., Neb.—**P. australis** Small, Ala., Miss., N.C., S.C.—**P. canescens** Britt., Tenn., Va.—**P. digitalis** (Sweet)Nutt., Kans.—**P. eriantherus** Pursh, Sask.—**P. fruticosus** (Pursh)Greene, Wyo.—**P. glaber** Pursh, S.D.—**P. gracilis** Nutt., Iowa, S.D., Wis.—**P. grandiflorus** Nutt., Iowa, Kans., Neb., N.D., S.D.—**P. hirsutus** (L.)Willd.(*P. pubescens* Sol.), Ga., Ind., N.Y., Pa.—**P. laevigatus** Sol.(*P. pentstemon* Britt.), Ind., S.C., Va.—**P. newberryi** Gray, Calif.—**P. nitidus** Dougl., Mont.—**P. pallidus** Small, Ill., Mo.—**P. radicosus** Nels., S.D.—**P. secundiflorus** Benth., Colo.—**P. tenuiflorus** Pennell, Okla.—**P. torreyi** Benth., N.M.—**P. unilateralis** Rydb., Colo.—**P. virens** Pennell(*P. humilis* Gray, not Nutt.), Colo.—**P. virgatus** Gray, Ariz. **Range:** Massachusetts to Saskatchewan, southward to Georgia, New Mexico and California.

Successful cultures were made in 1899, 1903, 1906 and 1910 by Arthur (Bot. Gaz. **29:** 272–273. 1900; Jour. Myc. **10:** 11. 1904; same **13:** 197. 1907; Mycol. **4:** 17. 1912), in 1902 by Kellerman (Jour. Myc. **9:** 10. 1903), and in 1924 by Fraser (Mycol. **17:** 84. 1925), sowing teliospores on *Pentstemon* in each instance. Cultures were also made by Mains (Mycol. **25:** 412. 1933) with teliospores from Indiana and Wisconsin sown on *P. hirsutus* and from New York sown on *C. glabra.* The extensive experiments in 1913 and 1914 by Long (Jour. Agr. Res. **2:** 303–319. 1914), from which he drew the conclusion that *"Puccinia ellisiana* and *Puccinia andropogonis* are but different forms of the same species," have not been verified by other persons.

(2). **Puccinia andropogonis gerardiae** [Peck] n. comb. (*Aecidium gerardiae* Peck). Urediospores not examined; aeciospores 15–21 by 17–24 μ, the wall 1–2 μ thick; on SCROPHULARIACEAE: **Aureolaria flava** (L.)Farwell (*Gerardia f., G. quercifolia* Pursh), N.J., N.C.—**A. microcarpa** Pennell, Ala.—**A. virginica** (L.)Pennell(*G. v.*, B.S.P., *Dasystoma v.* Britt.), Conn., Mich., N.Y., N.C., Tenn.—**Seymeria macrophylla** Nutt.(*Afzelia m.* Ktze., *D. m.* Raf.), Neb. **Range:** Connecticut to Michigan southward to North Carolina, Alabama and Nebraska.

(3). **Puccinia andropogonis micropuncta** [E. & E.] n. comb. (*Aecidium micropunctum* E. & E.). Urediospores with 3 or 4 pores, approximately equatorial; aeciospores 18–21 by 21–24 μ, the wall 1–2 μ thick; on SCROPHULARIACEAE: **Castilleja coccinea** (L.)Spreng., Iowa.—**C. foliolosa** H.&A., Calif.—**C. integra** Gray, Colo.—**C. sessiliflora** Pursh, Colo., Iowa, Kans., Neb., S.D., Wis.—**C. sulphurea** Rydb., N.M. **Range:** A western form, occurring from Wisconsin to South Dakota, southwestward to New Mexico and southern California.

(4). **Puccinia andropogonis melampyri** n. nom. Urediospores not examined; aeciospores 16–19 by 19–24 μ, the wall 1.5–2.5 μ thick; on SCROPHULARIACEAE: **Linaria canadensis** (L.)Dumort, Wis.—**Melampyrum lineare** Lam., Conn., Del., Mass., N.J.; Ont. **Range:** Massachusetts and Delaware to Wisconsin.

An unsuccessful attempt was made by Davis (Trans. Wis. Acad. Sci. **24:** 297. 1929) to infect *Andropogon furcatus* with aeciospores from *Linaria canadensis.* The variety is delimited chiefly by morphologic characters.

(5). **Puccinia andropogonis polygalina** [Peck] n. comb. (*Aecidium polygalinum* Peck). Urediospores with 3 or 4 pores, approximately equatorial; aeciospores 15–20 by 18–26 μ, the wall 1 μ thick; on POLYGALACEAE: **Polygala senega** L., Iowa, Mich., Wis. **Range:** Michigan to Iowa.

Cultures were made in 1927 and 1928 by Davis (Trans. Wis. Acad. Sci. **24:** 283, 297. 1929), using teliospores from *Andropogon furcatus*, and in 1927 the aecia thus produced were used to obtain uredia and telia on *A. furcatus*. Cultures by Mains (Mycol. **25:** 412. 1933), made in 1920 record reciprocal infection of *A. scoparius* and *P. senega*.

(6). **Puccinia andropogonis pustulata** [Curt.] n. comb. (*Aecidium pustulatum* Curt., *A. hamiltoniae* Thüm., *Puccinia pustulata* Arth.). Urediospores usually with 5 or 6 pores, scattered; aeciospores small, 15–19 by 19–23 μ, the wall 1–1.5 μ thick; on SANTALACEAE: **Comandra pallida** A.DC., Colo., Iowa, Kans., Neb., N.D.—**C. umbellata** (L.)Nutt., Ill., Ind., Iowa, Kans., Mass., Mo., N.Y., Ohio, Wis.; Ont. **Range:** Massachusetts to North Dakota and eastern Colorado.

Cultures were made in 1903, 1905 and 1910 by Arthur (Jour. Myc. **10:** 17. 1904; same **12:** 16. 1906; Mycol. **4:** 17. 1912) using teliospores, and in each instance sowing on both *Comandra* and *Pentstemon* with infection on the former and none on the latter.

(7). **Puccinia andropogonis onobrychidis** [Burr.] n. comb. (*Aecidium onobrychidis* Burr., *A. amphigenum* E.&K., *A. daleae* Kellerm.&Sw., *A. lupini* Peck, *A. falcatae* Arth., *A. petalostemonis* Kellerm.&Carl., *A. fluxum* Arth.). Urediospores with 4–6 pores, scattered; aeciospores 18–27 by 21–29 μ, the wall 1–2 μ thick; on FABACEAE: **Amphicarpa comosa** (L.)Nieuw.&Lun. (*A. monoica* Ell., *Falcata c.* Ktze.), Iowa, N.D., Wis.—**Apios tuberosa** Moench(*Glycine apios* L.), Iowa, Neb.—**Baptisia australis** (L.)R.Br., Kans.—**B. leucophaea** Nutt.(*B. bracteata* Gray, not Ell.), Kans., Neb.—**Desmodium dillenii** Darl. (*Meibomia d.* Ktze.), Ala.—**D. grandiflorum** (Walt.)DC.(*D. acuminatum* DC., *M. g.* Ktze.), Minn., Wis.—**Lupinus argenteus** Pursh(*L. decumbens* Torr.), S.D., Wyo.—**L. perennis** L., Wis.; N.S.—**Parosela enneandra** (Nutt.)Britt. (*Dalea e.*), Kans., Neb.—**Petalostemon candidus** (Willd.)Michx., Kans., Neb. —**P. oligophyllus** (Torr.)Rydb., Neb.—**P. purpureus** (Vent.)Rydb.(*P. violaceus* Michx.), Kans., Neb.—**P. villosus** Nutt., Colo., Neb., N.D.—**Psoralea onobrychis** Nutt., Ill. **Range:** Wisconsin to North Dakota, southward to Kansas, one station in New York and one in Alabama.

Successful cultures were carried out in 1925 and 1926 by Davis (Trans. Wis. Acad. Sci. **22:** 184. 1926; same **24:** 272. 1929) with aeciospores from *Amphicarpa monoica* sown on *Andropogon furcatus*.

(8). **Puccinia andropogonis xanthoxyli** [Peck] n. comb. (*Aecidium xanthoxyli* Peck). Urediospores with 5 or 6 pores, scattered; aeciospores 15–23 by 18–26 μ, the wall 1–2 μ thick; on RUTACEAE: **Zanthoxylum americanum** Mill., Iowa, Kans., Mo., Neb., Wis.—**Z. clava-herculis** L.(*Fagara c.* Small), Ala., Tex. **Range:** Wisconsin to Nebraska, southward to Alabama and Texas.

Cultures were made in 1926 by Davis (Trans. Wis. Acad. Sci. **24:** 272. 1929), using aeciospores which produced uredia and telia on *Andropogon furcatus*.

(9). **Puccinia andropogonis oxalidis** n. nom. Urediospores broadly ellipsoid, 20–23 by 24–27 μ, the pores 3 or 4, usually with 2 near hilum and 2 above

the equator or with 1 near apex; aeciospores 17–20 by 19–24 μ, the wall 1 μ thick; on OXALIDACEAE: **Oxalis corniculata** L., Okla., Tex. **Range:** Only two localities known, not far apart, southern Oklahoma and northern Texas.

A successful culture was made in 1908 at Denton, Tex., by Long (Phytop. **2:** 164. 1912) using teliospores from *A. furcatus,* sown on *O. corniculata.* The culture was successfully repeated by Long with the same telial material at Washington, D. C., but not published, the data being in the Arthur Herbarium. These results were discredited at the time, as the present writer did not succeed in producing verifying cultures. Recently Mains (Mycol. **25:** 413. 1933) has decided that Long was correct, and upon reviewing the whole matter the writer makes the above disposition with considerable confidence.

Much remains to be done in order to ascertain the variation and limits of *Puccinia andropogonis.* It may be that the above nine varieties will be modified or rearranged by further cultural and morphologic studies. It is also possible that the number may be reduced, but even more likely that additions may be made. There is some evidence that *Aecidium chamaecristae* Arth. may belong to the series.

Puccinia pentstemonis.

(N. A. F. 7: 565.)

Puccinia pentstemonis Peck, Bull. Torrey Club **12:** 35. 1885.
Puccinia mexicana D. & H.; Holw., Bot. Gaz. **24:** 33. 1897.
Puccinia circinans E. & E., Bull. Torrey Club **27:** 61. 1900. Not Fckl., 1870, or Diet., 1897.
Puccinia toumeyi Syd.; Sacc., Syll. Fung. **16:** 299. 1902.
Micropuccinia pentstemonis A. & J., N. Am. Flora **7:** 565. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, sometimes amphigenous and caulicolous, gregarious, compact, blackish-brown, becoming cinereous by germination; teliospores as in *Puccinia andropogonis,* 18–26 by 32–48 μ.

ON SCROPHULARIACEAE: **Pentstemon azureus** Benth., Calif.—**P. bridgesii** Gray, Calif.—**P. deustus** Dougl., Calif., Wyo.—**P. diffusus** Dougl., Ore.—**P. linarioides** Gray, Ariz.—**P. roezli** Regel, Calif.—**P. spectabilis** Thurb., Ariz., Calif. **Range:** High plateaus from Wyoming to eastern Oregon, southward to Arizona and southern California; also in Mexico.

This microcyclic species is correlated with *Puccinia andropogonis pentstemonis,* as indicated by Dietel (Centr. Bakt. **48:** 493. 1918).

Puccinia seymeriae.

(N. A. F. 7: 565.)

Puccinia seymeriae Burr., Bot. Gaz. **9:** 189. 1884.
Puccinia gerardiae Syd., Ann. Myc. **1:** 18. 1903.
Micropuccinia seymeriae A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown. Aecia and uredia wanting. Telia and teliospores as in *Puccinia andropogonis,* the latter 16–20 by 26–38 μ.

ON SCROPHULARIACEAE: **Gerardia besseyana** Britt. (*G. tenuifolia macrophylla* Benth., *Agalinis b.* Britt.), Ill.—**Seymeria macrophylla** Nutt. (*Afzelia m.* Ktze., *Dasystoma m.* Raf.), Ill., Ind., Kans., Neb., Ohio. **Range:** Northern Ohio to eastern Kansas and Nebraska.

This microcyclic species is correlated with *Puccinia andropogonis gerardiae,* as pointed out by Travelbee (Proc. Ind. Acad. Sci. **1914:** 233. 1915).

Puccinia comandrae.

(N. A. F. 7: 553.)

Puccinia comandrae Peck, Bull. Torrey Club **11:** 49. 1884.
Micropuccinia comandrae A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown. Aecia and uredia wanting. Telia and teliospores as in *Puccinia andropogonis*, the latter 16–23 by 35–55 μ.

On Santalaceae: **Comandra pallida** A.DC., Colo., Mont., Nev., Utah, Wash.; Alta., Sask.—**C. umbellata** (L.)Nutt., Calif., Mich., Ore.; Pr.Ed.Id. **Range:** Regions along the boundary between the United States and Canada and southward to Colorado and California.

This microcyclic species is correlated with *Puccinia andropogonis pustulata* as pointed out by Travelbee (Proc. Ind. Acad. Sci. **1914:** 233. 1915).

Puccinia nesodes A. & H. (*Micropuccinia n.* A. & J.) with pycnia unknown; aecia and uredia wanting; telia and teliospores as in *Puccinia andropogonis*, the latter 14–19 by 26–40 μ; occurs on Scrophulariaceae: species of **Castilleja** and **Lamourouxia** in Central America; a microcyclic species correlated with *Puccinia andropogonis micropuncta.* (N. A. F. **7:** 566.)

7. PUCCINIA TRIPSACI. Fig. 136.

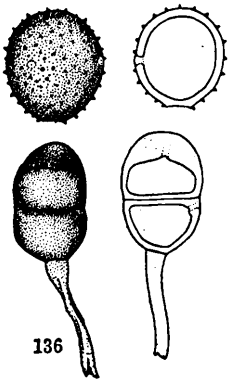
(N. A. F. 7: 279, 773, 832.)

(*Aecidium ceanothi* E. & K., Bull. Torrey Club **11:** 114. 1889.)
Puccinia tripsaci D. & H.; Holw., Bot. Gaz. **24:** 27. 1897.
Puccinia pattersoniae Syd., Monog. Ured. **1:** 820. 1904.
Dicaeoma tripsaci Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Puccinia ceanothi Arth., Mycol. **2:** 233. 1910.
Dicaeoma ceanothi A. & F., N. Am. Flora **7:** 279. 1920.

Pycnia epiphyllous, gregarious. Aecia hypophyllous, caulicolous and fructicolous, gregarious; aeciospores globoid or ellipsoid, 18–21 by 19–24 μ; wall colorless, 2–2.5 μ thick, inconspicuously verrucose.

On Rhamnaceae: **Ceanothus ovatus** Desf.(*C. ovalis* Bigel.), Wis.—**C. pubescens** (T.&G.)Rydb., Kans., Neb.

Uredia hypophyllous, linear, pulverulent, cinnamon-brown; urediospores globoid or broadly ellipsoid, 24–30 by 27–34 μ; wall bright cinnamon-brown, 2–3 μ thick, echinulate, the pores 3 or sometimes 4, approximately equatorial. Telia usually hypophyllous, oblong or linear, compact, blackish-brown; teliospores ellipsoid or obovoid, 18–23 by 35–50 μ, rounded or obtuse at each end, slightly constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides; 5–9 μ above; pedicel tinted, as long as spore or longer.


136

On Poaceae (tribe *Andropogoneae*): **Andropogon hallii** Hack., Kans., Neb., N.M., N.D.—**A. provincialis** Lam. (*A. furcatus* Muhl.), Colo., Kans., Minn., Neb., N.D., Okla., S.D.; (tribe *Maydeae*): **Tripsacum dactyloides** L.(*T. monostachyum* Willd.), Kans., Md., Miss., Neb., N.C., Tex.

Range: Maryland to North Dakota southward to Mississippi and New Mexico; also in Mexico.

Successful cultures were made in 1909 by Arthur (Mycol. **2:** 233. 1910) using teliospores from *Andropogon hallii*, sown on *Ceanothus americanus*, a species on which aecia have not been collected.

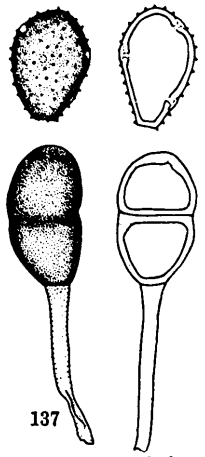
8. PUCCINIA PURPUREA. Fig. 137.

(N. A. F. 7: 284, 774, 833.)

Uredo sorghi Fckl.; Thüm., Bot. Zeit. **29:** 27. 1871. Not *Puccinia sorghi* Schw., 1832.
Puccinia purpurea Cooke, Grev. **5:** 15. 1876.

Dicaeoma purpureum Ktze., Rev. Gen. **3**[3]: 470. 1898.
Uredo andropogonis-hirti Maire, Bull. Soc. Myc. Fr. **21**: 162. 1905.
Puccinia sorghi-halepensis Speg., Anal. Mus. Nac. Buenos Aires **31**: 386. 1922.

Pycnia and aecia unknown. Uredia amphigenous, on purple spots, elliptic, chestnut-brown, with prominent peripheral, clavate or capitate paraphyses; urediospores ellipsoid or oblong, 23–31 by 29–40 μ; wall cinnamon- or dark chestnut-brown, 1.5–2 μ thick, closely verrucose-echinulate, the pores 5–10, scattered, often in zones. Telia amphigenous, oblong, 1–3 mm. long, dark chocolate-brown; teliospores ellipsoid or oblong, 23–32 by 40–55 μ, rounded or obtuse above, narrowed below, slightly or not constricted at septum; wall dark-brown, 2–3 μ thick at sides, 4–7 μ above; pedicel colorless, once to twice length of spore.


137

On Poaceae (tribe *Andropogoneae*): **Sorghum halepense** (L.) Pers. (*Holcus h.*, *Andropogon h.* Brot.), Ala., Calif., Fla., La., S.C., Tex.—**S. vulgare** Pers. (*S. dora* Griseb., *H. sorghum* L., *A. sorghum* Brot.), Calif., Fla., Mo., Okla., Tex. **Range**: South Carolina to Oklahoma and southern California; also in West Indies, Mexico and the warmer parts of the world.

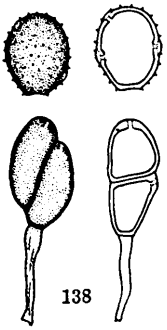
*. **Puccinia kaernbachii** (P. Henn.) Arth. (*Dicaeoma k.* A. & F.), with hypophyllous uredia, with abundant peripheral, capitate paraphyses, urediospores broadly ellipsoid, 18–24 by 22–32 μ, the wall chestnut-brown, 1–2 μ thick, finely echinulate, the pores 4 or sometimes 3, equatorial; teliospores oblong or elongate ellipsoid, 16–23 by 22–48 μ, rounded at each end, slightly constricted at septum, the wall chestnut-brown, lighter below, 1–3 μ thick at sides, 7–10 μ above, with concolorous pedicel, short, fragile; occurs on Poaceae (Tribe *Andropogoneae*): **Andropogon stolonifer** (Nash) Hitchc., in southern Florida and **Imperata hookeri** Rupr., in Grand Cañon of Colorado, Arizona; and on other species of hosts throughout the warmer regions of the world, usually found only in the uredial stage. (N. A. F. **7**: 283, 773, 833.)

9. PUCCINIA FLACCIDA. Fig. 138.

(N. A. F. 7: 292, 775, 833.)

Puccinia flaccida B. & Br., Jour. Linn. Soc. **14**: 91. 1873.
Puccinia abnormis P. Henn., Hedw. **35**: 243. 1896.
Dicaeoma flaccidum Ktze., Rev. Gen. **3**[3]: 468. 1898.

Pycnia and aecia unknown. Uredia amphigenous, oblong, sometimes forming lines, dark cinnamon-brown; urediospores ellipsoid, 18–26 by 23–31 μ; wall dark-brown, 1–2 μ thick, strongly echinulate, the pores 4–6, scattered. Telia amphigenous, small, chestnut-brown; teliospores terete, ellipsoid or oblong, 15–26 by 26–48 μ, usually narrowed above and below, slightly constricted at septum, which is usually oblique or nearly vertical; wall cinnamon-brown, paler than the urediospore-wall, 1–1.5 μ thick at sides, 2–4 μ above; pedicel colorless, as long as spore, fragile.


138

On Poaceae (tribe *Paniceae*): **Echinochloa crus-galli** (L.) Beauv. (*Panicum c.*), Ill., Kans., Mo., Neb., N.M., Okla., Wis. **Range**: Wisconsin to Nebraska, southward to New Mexico; also in Mexico, South America and southern India.

*. **Puccinia cameliae** (Mayor) Arth. (*Uredo c.*, *Dicaeoma c.* A. & F.), with amphigenous uredia, urediospores ellipsoid, 15–21 by 19–28 μ, the wall nearly colorless, 1 μ thick, finely echinulate, the pores 6–8, scattered, indistinct; teliospores oblong or cylindric, compacted, small, 10–16 by 32–39 μ, truncate or rounded at each end, slightly or not constricted at septum, the wall chestnut-brown, about 1 μ thick at sides,

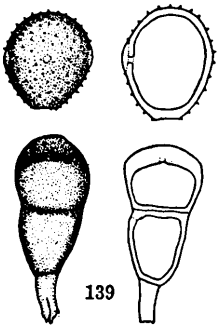
3–5 μ above, with very short or obsolete pedicel; occurs on POACEAE (tribe *Paniceae*): **Setaria macrostachya** H.B.K. (*Chaetochloa m.* Scribn. & Merr.) and **S. scheelei** (Steud.) Hitchc. (*C. polystachya* Scribn. & Merr.) both in Texas; also in West Indies. (N. A. F. **7:** 293, 775.)

10. PUCCINIA IMPOSITA. Fig. 139.

(N. A. F. 7: 290, 833.)

Uredo muhlenbergiae Diet.; Atk., Bull. Cornell Univ. **3:** 22. 1897. Not *Puccinia muhlenbergiae* A. & H., 1902.
Puccinia imposita Arth., Bull. Torrey Club **46:** 112. 1919.
Dicaeoma impositum A. & F., N. Am. Flora **7:** 290. 1920.

Pycnia and aecia unknown. Uredia amphigenous, elliptic, light chestnut-brown; urediospores globoid or broadly ellipsoid, 23–32 by 27–35 μ, wall cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 3 or 4, equatorial, distinct, covered with swollen, hyaline cuticle. Telia amphigenous, pulverulent, dark cinnamon- or chestnut-brown; teliospores oblong or clavate, 18–26 by 37–48 μ, rounded above, slightly narrowed below, usually not constricted at septum; wall dark chestnut-brown above, lighter below, 1.5–2.5 μ thick at sides, 6–8 μ above; pedicel colored, short.


139

ON POACEAE (tribe *Paniceae*): **Leptoloma cognatum** (Schult.) Chase (*Panicum c., P. autumnale* Bosc), Ala., Kans., N.M., Okla., Tex. **Range:** Kansas to central Alabama and New Mexico.

The first collection of this species was erroneously determined as on *Muhlenbergia,* hence the name bestowed by Dietel.

*. **Uromyces leptodermus** Syd. (*Nigredo l.* Arth.), with amphigenous, cinnamon-brown uredia, urediospores globoid or obovoid, 21–26 by 26–32 μ, the wall 1–2 μ thick, golden- or cinnamon-brown, echinulate, the pores 3, sometimes 4, equatorial; telia amphigenous, blackish-brown, teliospores globoid, 16–19 by 19–24 μ, wall uniformly 1–1.5 μ thick, chestnut-brown, smooth, pedicel colorless, short; occurs on POACEAE (tribe *Paniceae*): **Panicum barbinode** Trin., in southern Florida; also in Mexico, Central and South America, southern India and Japan. (N. A. F. **7:** 224, 746, 827.)

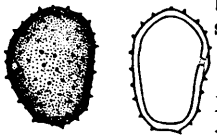
*. **Puccinia levis** (Sacc. & Bizz.) Magn. (*P. paspali* Tr. & Earle, *P. huberi* P. Henn., *Dicaeoma l.* A. & F.), with amphigenous uredia, chestnut-brown, urediospores globoid or broadly ellipsoid, 19–29 by 23–32 μ, the wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 2 or 3, sometimes 4, equatorial; teliospores globoid or oblong, 21–29 by 32–40 μ, rounded at each end, slightly or not constricted at septum, which is often oblique or nearly vertical, the wall chestnut-brown, 2.5–3.5 μ thick at sides, 7–12 μ above, with colorless pedicel, often inserted obliquely, fragile, short or even twice length of spore; occurs on POACEAE (tribe *Paniceae*): **Paspalum urvillei** Steud. (*P. larrañagai* Arech.), in southern border of Louisiana, Mississippi and Texas; also in Mexico, West Indies, Central and South America. (N. A. F. **7:** 286, 774, 833.)

11. PUCCINIA CENCHRI. Fig. 140.

(N. A. F. 7: 294, 775, 833.)

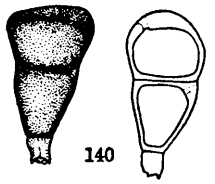
Puccinia cenchri D. & H.; Holw., Bot. Gaz. **24:** 28. 1897.
Dicaeoma cenchri Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Uredia amphigenous, or only epiphyllous, scattered, chestnut-brown; urediospores irregularly ellipsoid or oblong, 24–35 by 32–48 μ; wall cinnamon- or light chestnut-brown, 2–3 μ thick, prominently and sparsely echinulate, the pores usually 2, sometimes 3, equatorial, distinct. Telia hypophyllous, scattered, blackish-brown, long covered by epidermis; teliospores oblong or clavate, 18–27 by 40–58 μ, truncate or rounded above, narrowed below, slightly or not constricted at septum; wall cinnamon- or dark chestnut-



brown, about 1.5 μ thick at sides, 6–9 μ above; pedicel very short, colored.

ON POACEAE (tribe *Paniceae*): **Cenchrus echinatus** L., Fla.—**C. pauciflorus** Benth., Okla., Tex. **Range:** Florida to northern Oklahoma; also in Central America and West Indies.



140

*. **Puccinia paspalicola** (P. Henn.) n. comb. (*Uredo p.*, *Aecidium tubulosum* P. & G., *P. t.* Arth., *Dicaeoma t.* A. & F.), with pycnia and aecia on *Solanum elaeagnifolium* Cav., in Texas, *S. carolinense* L., in Iowa and on other species of *Solanum* in Mexico and West Indies; uredia amphigenous, sometimes with paraphyses, urediospores ellipsoid or obovoid, 15–27 by 20–32 μ, the wall nearly or quite colorless, 1–1.5 μ thick, closely echinulate, the pores 3 or 4, equatorial, usually distinct; teliospores elongate-obovoid or ellipsoid, 18–26 by 32–50 μ, rounded above, often narrowed below, the wall cinnamon- or chestnut-brown, 1–1.5 μ thick at sides, darker and 4–7 μ above, with slightly colored pedicel, one-half length of spore or less; occurs on POACEAE (tribe *Paniceae*): **Paspalum conjugatum** Berg., in southern Florida and **Syntherisma sanguinale** (L.) Dulac. (*Panicum s.*, *Digitaria s.* Scop.), in southern Texas; also in Mexico, West Indies, Central and South America, and southern Asia. (N. A. F. **7:** 288, 774, 833.)

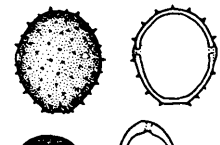
Puccinia claviformis Lagerh. (*Aecidium solanitum* Schw., hyponym, *Micropuccinia s.* A. & J.), in Central and South America, is correlated with the above species. Schweinitz mistook telia for aecia. It is not *Puccinia solani* Schw., as stated in N. Am. Flora **7:** 805. (N. A. F. **7:** 562, 805.)

12. PUCCINIA SUBSTRIATA. Fig. 141.

(N. A. F. 7: 289, 774, 833.)

Puccinia substriata Ellis & Barth., Erythea **5:** 47. 1897.
Dicaeoma substriatum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Uredia amphigenous, scattered, elliptic or oblong, cinnamon-brown; urediospores broadly ellipsoid, 19–30 by 24–35 μ; wall cinnamon-brown, 1.5–2.5 μ thick, sparsely and noticeably echinulate, the pores 3 or 4, equatorial, distinct. Telia amphigenous, scattered, oblong, pulverulent, chocolate-brown; teliospores oblong or ellipsoid, 15–24 by 29–48 μ, rounded or truncate above, slightly or not narrowed below, little if any constricted at septum; wall chestnut-brown, 1–2 μ thick at sides, 3–4 μ above; pedicel colorless except near the spore, about one-half length of spore.



141

ON POACEAE (tribe *Paniceae*): **Paspalum ciliatifolium** Michx., Fla., Tex.—**P. curtisianum** Steud., Fla.—**P. denticulatum** Trin., Tex.—**P. floridanum** Michx., Tex.—**P. setaceum** Michx., Kans., Neb.—**P. stramineum** Nash (*P. bushii* Nash), Neb., Okla. —**Setaria geniculata** (Lam.) Beauv. (*S. imberbis* R.&S., *Chaetochloa i.* Scribn., *C. g.* Millsp. & Chase), Fla. **Range:** Nebraska, southward to Florida and Texas; also in Mexico, Central America and West Indies.

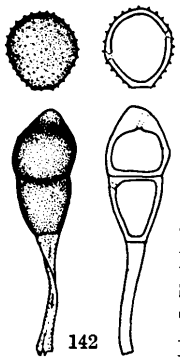
The morphologic and geographic limitations of this species are uncertain. With present knowledge the satisfactory determination of collections is difficult. The discovery of aecia would add important data. Like all the species in the tribe Paniceae, it is essentially a tropical form, and depends upon uredia rather than aecia for ready propagation.

13. PUCCINIA EMACULATA. Fig. 142.

(N. A. F. 7: 290, 774, 833.)

Puccinia emaculata Schw., Trans. Am. Phil. Soc. II. **4:** 295. 1832.
Dicaeoma emaculatum Ktze., Rev. Gen. **3³:** 468. 1898.

Pycnia and aecia unknown. Uredia epiphyllous, scattered, small, cinnamon-brown; urediospores broadly ellipsoid, 18–23 by 19–26 μ; wall cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 3, sometimes 4, approximately equatorial. Telia usually epiphyllous, scattered, oblong, chocolate-brown; teliospores ellipsoid or oblong, 16–23 by 29–48 μ, rounded or acute above, narrowed below, slightly or not constricted at septum; wall dark chestnut-brown, 1.5–2 μ thick at sides, 7–10 μ above; pedicel brown, one and a half times length of spore or less.


142

On Poaceae (tribe *Paniceae*): **Panicum capillare** L., Conn., Del., Ill., Ind., Iowa, Kans., Ky., Mass., Mich., Minn., Miss., Mo., Neb., N.H., N.J., N.Y., N.D., Ohio, Okla., Pa., R.I., S.D., Tenn., Va., W.Va., Wis.; Ont.—**P. commutatum** Schult., Tenn.—**P. condensatum** Nash, Tex.—**P. flexile** (Gatt.)Scribn., Ind.—**P. miliaceum** L., Ind.—**P. philadelphicum** Bernh., N.H. —**Paspalum stramineum** Nash(*P. bushii* Nash), Okla. **Range:** New Hampshire to North Dakota, southward to Mississippi and Texas.

In morphologic characters this species differs only slightly from *Puccinia panici*, the urediospores being a little smaller, and teliospores being somewhat darker colored with walls slightly thicker. The hosts for the two forms have a somewhat different aspect, but with unimportant differences in distribution. Such similarity has led to attempts in 1913 and 1914 by Arthur (Mycol. **7:** 65. 1915), to grow *P. emaculata* from *Panicum capillare* upon *Tithymalopsis corollata* (*Euphorbia c.*), the aecial host for *P. panici*, using teliosporic material both from Indiana and New Jersey, but with negative results.

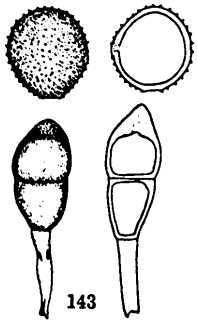
14. PUCCINIA PANICI. Fig. 143.

(N. A. F. 7: 291, 774, 833.)

(*Aecidium pammelii* Trel., Fungi Wis. 32. 1884; Trans. Wis. Acad. Sci. **6:** 136. 1885.)
Puccinia panici Diet., Erythea **3:** 80. 1895.
Dicaeoma pammelii Arth., Proc. Ind. Acad. Sci. **1903:** 149. 1904.
Puccinia pammelii Arth., Jour. Myc. **11:** 56. 1905.

Pycnia chiefly epiphyllous, in small groups. Aecia hypophyllous, gregarious, cupulate; aeciospores globoid or ellipsoid, 16–23 by 20–32 μ; wall nearly or quite colorless, 1.5–2 μ thick, minutely verrucose.

On Euphorbiaceae: **Dichrophyllum marginatum** (Pursh)K.&G.(*Euphorbia m., Lepadena m.* Nieuwl.), Colo., Kans., Neb., Okla., Tex.—**Tithymalopsis corollata** (L.)K.&G.(*Euphorbia c.*), Ala., Ill., Ind., Iowa, Minn., Mo., Neb., Wis.—**T. ipecacuanhae** (L.)Small(*E. i.*), N.J.—**Zygophyllidium hexagonum** (Nutt.) Small(*E. h.*), Neb.


143

Uredia epiphyllous, small, cinnamon-brown; urediospores broadly ellipsoid, 19–27 by 21–30 μ; wall cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 3 or 4, approximately equatorial, indistinct. Telia usually epiphyllous, small, often forming lines, dark chestnut-brown; teliospores ellipsoid or oblong, 16–24 by 27–45 μ, rounded or acute above, narrowed below, slightly or not constricted at septum; wall dark cinnamon- or chestnut-brown above, paler below, 1–1.5 μ thick at sides, 3–7 μ above; pedicel nearly or quite colorless, once to once and a half length of spore.

On Poaceae (tribe *Paniceae*): **Panicum amarum** Ell.,

Va.—**P. virgatum** L., Ala., Colo., Conn., Del., Ind., Iowa, Kans., Miss., Neb., N.J., N.Y., Ohio, Okla., Pa., S.D., Tex., W.Va., Wis.—**P. virgatum cubense** Griseb., N.J.

Range: Connecticut to South Dakota, southward to Alabama and Texas.

Successful cultures using teliospores sown on *Tithymalopsis corollata* were made in 1901 by Stuart (Proc. Ind. Acad. Sci. **1901:** 284. 1902), and in 1904 and 1905 by Arthur (Jour. Myc. **11:** 56. 1905; same **12:** 16. 1906). Attempts to grow the rust on *Dichrophyllum marginatum* with teliospores from Indiana, where that aecial host does not occur, were negative, but with teliospores from Nebraska, where *D. marginatum* is abundant and *T. corollata* is absent or rare, successful cultures were obtained in 1907 by Arthur (Jour. Myc. **14:** 16. 1908), indicating the presence of biologic races.

Uromyces graminicola.

(N. A. F. 7: 224, 745, 826.)

Uromyces graminicola Burr., Bot. Gaz. **9:** 188. 1884.
(*Aecidium crotonopsidis* Burr., Bot. Gaz. **9:** 190. 1884.)
Uromyces panici Tracy, Jour. Myc. **7:** 281. 1893.
(*Aecidium stillingiae* Tr. & Earle, Bull. Torrey Club **26:** 493. 1899.)
Nigredo graminicola Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia and aecia as in *Puccinia panici*.

On Euphorbiaceae: **Croton monanthogynus** Michx., Ill., Mo.—**Crotonopsis linearis** Michx., Ill.—**Sebastiana ligustrina** (Michx.)Muell.-Arg.(*Stillingia l.*), Miss.—**Stillingia angustifolia** (Torr.)Wats., Fla.—**S. sylvatica** L., Okla.

Uredia as in *Puccinia panici*, except the urediospores smaller, 15–19 by 18–23 μ, and the wall thicker, 2–2.5 μ thick. Telia as in *P. panici*, except the teliospores one-celled, 13–19 by 21–32 μ, the wall 1.5–2 μ thick at sides, 3–9 μ above.

On Poaceae (tribe *Paniceae*): **Panicum altum** Hitchc.&Chase, Fla.—**P. amarulum** Hitchc.&Chase, Fla., Va.—**P. depauperatum** Muhl., Mo.—**P. maximum** Jacq., Fla.—**P. virgatum** L., Conn., Del., Fla., Ill., Iowa, Kans., Miss., Neb., N.M., N.Y., N.C., Okla., S.D., Wis.

Range: Connecticut to South Dakota, southward to Florida and New Mexico; also in West Indies.

The correlation between the one- and two-celled species was first pointed out by Orton (Mycol. **4:** 202–203. 1912).

*. **Puccinia chaetochloae** Arth. (*Dicaeoma c.* A. & F.), with amphigenous uredia, urediospores broadly and angularly ellipsoid or ellipsoid-oblong, 21–29 by 29–45 μ, the wall cinnamon-brown, 1.5–2 μ thick, strongly and sparsely echinulate, the pores 3 or 4, approximately equatorial; teliospores broadly ellipsoid or oblong, 23–26 by 32–37 μ, rounded above, slightly or not narrowed below, usually somewhat constricted at septum, which is often oblique or nearly vertical, the wall chestnut-brown, 1.5 μ thick at sides, 2–4 μ above, the pedicel slightly colored, short; occurs on Poaceae (tribe *Paniceae*): **Setaria macrosperma** (Scribn.&.Merr.) Schum. (*Chaetochloa m.*), in southern Florida; also in the Greater Antilles. (N. A. F. **7:** 288.)

*. **Puccinia setariae** D. & H. (*Dicaeoma s.* Arth.), with mostly epiphyllous uredia, urediospores globoid or broadly ellipsoid, 26–29 by 30–34 μ, the wall golden-brown, about 3 μ thick, finely verrucose, the pores 6–8, scattered; teliospores broadly ellipsoid or obovoid, 26–34 by 39–48 μ, rounded or obtuse at each end, slightly or not constricted at septum, the wall dark chestnut-brown, 2.5–3 μ thick at sides, 7–13 μ above, with colorless pedicel, twice length of spore; occurs on Poaceae (tribe *Paniceae*): **Setaria geniculata** (Lam.) Beauv. (*S. imberbis* R.&S., *Chaetochloa i.* Scribn., *C. g.* Millsp. & Chase), in southern Louisiana; also in Mexico and South America. (N. A. F. **7:** 293.)

*. **Puccinia atra** D. & H. (*Dicaeoma a.* Arth.), with epiphyllous uredia, urediospores broadly ellipsoid or obovoid, 21–29 by 26–32 μ, the wall light cinnamon-

brown, 1.5–3.5 μ thick, minutely verrucose, the pores 4, occasionally 5 or 6, equatorial; teliospores broadly ellipsoid, 23–30 by 29–42 μ, rounded at each end, slightly constricted at septum, the wall chestnut-brown, 1.5–3 μ thick at sides, 5–7 μ above, with colorless pedicel once to twice length of spore; occurs on POACEAE (tribe *Paniceae*): **Leptoloma cognatum** (Schult.)Chase(*Panicum c.*, *P. autumnale* Bosc.), in Texas, **Panicum bulbosum sciaphillum** (Rupr.)Hitchc.&Chase, in Arizona and New Mexico, and **Valota saccharata** (Buckl.)Chase (*P. s.*), in New Mexico and Texas; also in West Indies, Mexico, Central and South America, and Hawaii. (N. A. F. **7:** 291, 292, 775, 833.)

15. UROMYCES HALSTEDII. Fig. 144.

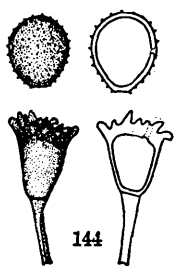
(N. A. F. 7: 226, 621, 747, 827.)

(*Aecidium trillii* Burr., Bot. Gaz. **9:** 190. 1884.)
Uromyces digitatus Halst., Jour. Myc. **3:** 138. 1887. Not Winter, 1886.
Uromyces halstedii De-T., in Sacc., Syll. Fung. **7:** 557. 1888.
Nigredo halstedii Arth., N. Am. Flora **7:** 226. 1912.

Pycnia amphigenous, gregarious. Aecia hypophyllous, in circular groups, cupulate; aeciospores globoid or broadly ellipsoid, 19–22 by 20–24 μ; wall colorless, 1 μ thick or less, finely and closely verrucose.

ON LILIACEAE: **Trillium erectum** L., N.Y.—**T. grandiflorum** (Michx.) Salisb., N.Y.—**T. recurvatum** Beck, Ill.—**T. undulatum** Willd., N.Y.

Uredia chiefly hypophyllous, scattered, cinnamon-brown, with few capitate paraphyses; urediospores ellipsoid or obovoid, 15–21 by 21–28 μ; wall cinnamon-brown, 1–1.5 μ thick, finely echinulate, the pores usually 3, sometimes 2 or 4, equatorial. Telia chiefly hypophyllous, oblong or linear, blackish-brown; teliospores obovoid or broadly cuneate, 13–24 by 18–30 μ; wall dark chestnut-brown, paler below, 1–1.5 μ thick at sides, much thicker above and bearing numerous digitate projections 3–8 μ long; pedicel brown, about as long as spore.


144

ON POACEAE (tribe *Oryzeae*): **Leersia oryzoides** (L.)Sw. (*Homalocenchrus o.* Poll.), Del., Pa., S.D., Tex., Wis.—**L. virginica** Willd. (*H. v.* Britt.), Ala., Iowa, La., Md., Wis.; (tribe *Agrostideae*): **Brachyelytrum erectum** (Schreb.)Beauv., N.Y.

Range: New York to South Dakota, southward to Alabama and Texas; also in Japan and (aecia) Kamchatka.

Successful cultures were carried out in 1926 and 1927 by Barrus (Mycol. **20:** 120–123. 1928), using aeciospores from *Trillium* and teliospores from *Brachyelytrum*. There are small morphologic differences between the *Leersia* and *Brachyelytrum* forms, which may indicate varieties.

16. PUCCINIA SESSILIS. Fig. 145.

(N. A. F. 7: 298, 775, 834.)

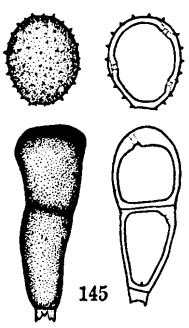
(*Aecidium majanthae* Schum., Enum. Pl. Saell. **2:** 224. 1803.)
(*Aecidium uvulariae* Schw., Schr. Nat. Ges. Leipzig **1:** 69. 1822.)
Puccinia sessilis Schneid.; Schroet., Abh. Schles. Ges. **48:** 19. 1870.
(*Aecidium iridis* Ger.; Peck., Ann. Rep. N. Y. State Mus. **24:** 93. 1872.)
Puccinia phalaridis Plowr., Jour. Linn. Soc. **24:** 88. 1888.
Puccinia majanthae A. & H., Bull. Lab. Nat. Hist. Univ. Iowa **5:** 188. 1901.
Dicaeoma majanthae Arth., Proc. Ind. Acad. Sci. **1903:** 149. 1904.

Pycnia amphigenous, in large groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 15–21 by 16–27 μ; wall nearly or quite colorless, 1–2 μ thick, finely verrucose.

ON CONVALLARIACEAE: **Maianthemum canadense** Desf.(*Unifolium c.* Greene), Minn., Wis.—**Polygonatum commutatum** (R.&S.)Dietr., Iowa, Wis.—

P. pubescens (Willd.)Pursh(*P. biflorum* Gray, not Ell.), Ala., Conn., Iowa, N.Y., Wis.—**Smilacina amplexicaulis** Nutt., Utah.—**S. racemosa** (L.)Desf. (*Vagnera r.* Morong), Iowa, N.Y., Pa.—**S. sessilifolia** Nutt.(*V. s.* Greene), Calif., Wash.—**S. stellata** (L.)Desf.(*V. s.* Morong), Ida., Neb., N.D.; B.C., Man., Ont.—**Uvularia grandiflora** Smith, Iowa, Mo., Wis.—**U. perfoliata** L., N.C.—**U. sessilifolia** L.(*Oakesia s.* Wats.), Del., Miss., N.Y., Wis.; on IRIDACEAE: **Iris versicolor** L., Ind., Iowa, Mass., Mich., Minn., Neb., N.Y., Wis.; Man., Queb.

Uredia amphigenous, scattered, oblong or linear, cinnamon-brown; urediospores ellipsoid, 19–26 by 24–34 μ; wall bright cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores about 8, scattered. Telia amphigenous, oblong or linear, often in lines, long covered by epidermis, grayish-black; teliospores oblong or oblong-clavate, 19–26 by 35–55 μ, rounded or truncate above, usually narrowed below, slightly or not constricted at septum; wall chestnut-brown, about 1.5 μ thick at sides, 3–5 μ above; pedicel brown, short, usually broken away.


145

ON POACEAE (tribe *Phalarideae*): **Phalaris angusta** Nees, Okla.—**P. arundinacea** L., Colo., Ind., Iowa, Mich., Mont., N.Y., Ore., S.D., Wis., Wyo.; Man., Ont.—**P. californica** H.&A., Calif.—**P. canariensis** L., Calif.—**P. minor** Retz., Calif.

Range: Southern Quebec to British Columbia, southward to Alabama, Colorado and southern California; also in Europe and Japan.

Much cultural work with the rust on *Phalaris arundinacea* has been done in Europe, resulting in the segregation of a number of races, including a race with aecia on *Allium*. The data have been brought together by Klebahn (Wirtsw. Rostp. 263–272. 1904) under the headings of seven biologic species. The first cultures in America were made in 1916 by Whetzel and Jackson, using teliospores from *Phalaris arundinacea* sown on *Iris versicolor*, and the work recorded and repeated in 1917 by Arthur (Mycol. **9**: 305–306. 1917). There are doubtless biologic races in America, but their detection remains for future investigators.

17. PUCCINIA INTERVENIENS. Fig. 146.

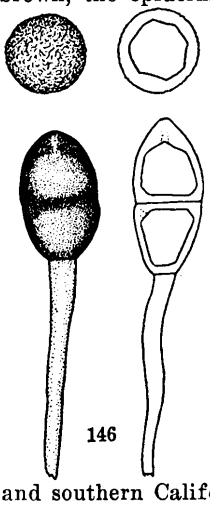
(N. A. F. 7: 299, 776, 797, 834.)

(*Aecidium modiolae* Thüm., Flora **63**: 31. 1880.)
(*Roestelia interveniens* Peck., Bull. Torrey Club **10**: 74. 1883.)
(*Aecidium malvastri* P. Henn., Hedw. **36**: 216. 1897.)
Puccinia interveniens [Peck] Bethel; Blasd., Univ. Calif. Pub. Bot. **7**: 119. 1919.
Dicaeoma interveniens A. & F., N. Am. Flora **7**: 299. 1920.
Allodus interveniens Arth. & Orton, N. Am. Flora **7**: 797. 1927.

Pycnia amphigenous, in small groups. Aecia hypophyllous and caulicolous, bag-shaped, opening by a small pore, the peridium lacerate and somewhat recurved almost to the base; aeciospores globoid or ellipsoid, 16–24 by 18–27 μ; wall colorless, 5–7 μ thick, finely striolate-verrucose.

ON MALVACEAE: **Callirhoë alceoides** (Michx.) Gray, Neb.—**C. digitata** Nutt., Tex.—**Phymosia rivularis** (Dougl.)Rydb.(*Sphaeralcea r.* Torr.), Ida., Wash.—**Sidalcea asprella** Greene, Calif.—**S. candida** Gray, Utah.—**S. malvaeflora** (Moc.&Sessé)Gray, Calif.—**S. neomexicana** Gray, Colo., Utah, Wyo.—**S. nervata** Nels., Ida.—**Sphaeralcea fasciculata** (Nutt.)Arth.(*Malvastrum f.* Greene, *M. thurberi* Gray), Calif.

Uredia wanting. Telia epiphyllous, large and prominent, dark chestnut-brown, the epidermis rupturing in shreds full length of the sorus, 5–20 mm.; teliospores in resting condition oblong or ellipsoid, 27–30 by 35–45 μ, rounded at each end, not constricted at septum, or in germinating condition oblong-fusiform, 20–24 by 48–67 μ, obtuse or acuminate above, rounded or obtuse below; wall in resting condition dark chestnut-brown, 2–3 μ thick at sides, darker and 4–10 μ above, or when in early germinating condition pale cinnamon-brown, 2–2.5 μ at sides, lighter and 6–18 μ above; pedicel colorless, stout, once to twice length of spore or more.


146

On Poaceae (tribe *Agrostideae*): **Stipa comata** Trin.& Rupr., Colo.—**S. lepida** Hitchc., Calif.—**S. lepida andersoni** (Vasey) Hitchc. (*S. eminens andersoni* Vasey), Calif.—**S. lettermani** Vasey, Colo.—**S. minor** (Vasey) Scribn., Colo., Utah.—**S. pulchra** Hitchc., Calif.—**S. speciosa** Trin.&Rupr., Ariz., Calif.

Range: Colorado to Washington, southward to Texas and southern California; also in Mexico and South America.

This species was for a time confused with *Puccinia burnettii* (as in the N. Am. Flora **7:** 299). Its correct identification was largely due to the unpublished outdoor cultures, begun in 1912, and the extensive field observations made by Bethel (Blasdale, Univ. Calif. Publ. Bot. **7:** 120. 1919), supplemented by observations in South America by Holway (Arthur, Proc. Am. Phil. Soc. **64:** 204. 1925). Cultures have been published by Mains (Mycol. **25:** 411. 1933) using teliospores from *Stipa pulchra* and *Stipa* sp., both infecting *Sidalcea candida*. Aeciospores from the latter infected *Stipa pulchra* and *Oryzopsis miliacea*. There is a close relationship with *Puccinia graminella*, an autoecious species, especially evidenced by the peculiar striolate-verrucose markings of the aeciospores. These markings are also found on the spores of the allied microcyclic form, *Endophyllum tuberculatum*, an evident offshoot of the aecial part of the species.

Puccinia graminella.

(N. A. F. 7: 454, 797.)

(*Aecidium graminellum* Speg., An. Soc. Ci. Argent. **12:** 77. 1881.)
Puccinia graminella [Speg.] D. & H.; Diet., Erythea **3:** 80. 1895.
Allodus graminella Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia unknown. Aecia epiphyllous, scattered or in lines along the veins, cylindric or somewhat flattened; aeciospores globoid, 16–25 μ in diameter; wall colorless, 3–4 μ thick, finely striolate-verrucose. Uredia wanting. Telia epiphyllous, scattered, in lines along the veins or crowded about the aecia, dark chestnut-brown; teliospores and pedicel as in *Puccinia interveniens*.

On Poaceae (tribe *Agrostideae*): **Stipa lepida** Hitchc., Calif.—**S. lepida andersoni** (Vasey) Hitchc. (*S. eminens andersoni* Vasey), Calif. **Range:** Central California; also in South America.

This autoecious species has been collected at only one station in North America. Collections were made by W. C. Blasdale during April, May and June, 1894, on the hill back of the campus of Stanford University, but the rust has not been seen since, although search has often been made for it. The species is closely correlated with *P. interveniens*, but with the peridial cells somewhat more elongated, and the early germinating form of the teliospores less abundant. It appears to be a common species along the western coast of South America.

Only one other autoecious rust is known on Poaceae. This is the South American *Puccinia digna* (Arthur, Proc. Am. Phil. Soc. **64:** 198. 1925), occurring on species of *Stipa* and the closely related *Nasella*, in Argentina and the western coast of South America. Besides the aecia and telia, which closely resemble those of *P. graminella*,

uredia with paraphyses are abundantly formed. This group of correlated species is worthy of careful study. The correlation of this species and the following microcyclic species was recorded in the N. Am. Flora **7:** 543, 701.

Puccinia sherardiana.

(N. A. F. 7: 543, 544, 803, 847.)

Puccinia sherardiana Körn., Hedw. **16:** 19. 1877.
Puccinia malvastri Peck, Bull. Torrey Club **12:** 35. 1885.
Puccinia sphaeralceae E. & E., Am. Nat. **31:** 428. 1897.
Puccinia sidalceae Holw., N. Am. Ured. **1:** 67. 1907.
Micropuccinia sherardiana A. &. J.; Arth., Bull. Torrey Club **48:** 41. 1921.
Micropuccinia sidalceae A. & J., N. Am. Flora **7:** 544. 1922.

Pycnia amphigenous, few, surrounded by telia, or wanting. Aecia and uredia wanting. Telia hypophyllous and caulicolous, compact, blackish-brown, becoming cinereous by germination; teliospores as in *Puccinia interveniens* but with wall sometimes finely verrucose.

On Malvaceae: **Althaea rosea** (L.)Cav., Calif.—**Sidalcea glaucescens** Greene, Calif.—**S. malvaeflora** (Moc.&Sessé)Gray, Calif.—**S. oregana** (Nutt.) Gray, Calif., Colo., Ore., Wash.—**S. spicata** Greene, Calif., Ore.—**S. virgata** Howell, Ore.—**Sphaeralcea ambigua** Gray, Nev.—**S. angustifolia** (Cav.)G. Don, N.M., Tex.—**S. arcuata** (Greene)Arth.(*Malvastrum a.* B.L.Rob.), Calif.—**S. arenaria** W.&S., N.M., Tex.—**S. arizonica** Heller, Utah.—**S. coccinea** (Nutt.)Rydb.(*M. c.* Gray), Colo., Kans., Mont., Neb., N.M., N.D., Okla., S.D., Tex., Wyo.; Alta., Sask.—**S. cuspidata** (Gray)Britt., Ariz., Colo.—**S. dissecta** (Nutt.)Rydb.(*M. d.* Nels.), Colo., Utah.—**S. elata** (E. G. Baker)Rydb.(*M. e.* Nels.), Colo., N.M., Utah.—**S. fasciculata** (Nutt.)Arth.(*M. f.* Greene, *M. thurberi* Gray), Calif.—**S. fendleri** Gray, Ariz., N.M.—**S. fremontii** (Torr.) Jepson (*M. f.*), Calif.—**S. incana** Torr., N.M.—**S. lobata** Woot., N.M., Tex.—**S. marginata** York, Ariz., Colo., N.M., Utah.—**S. munroana** (Dougl.)Spach (*M. m.* Gray), Ida., Utah, Wash.—**S. subrhomboidea** Rydb., Utah. **Range:** North Dakota to Alberta, southward to Texas and southern California; also in Mexico, South America and Asia.

The same variation from ellipsoid to fusiform teliospores occurs in this microcyclic species as in the two preceding correlated species, but not so marked, as this is a leptoform and all the spores germinate with readiness.

Endophyllum tuberculatum.

(N. A. F. 7: 701, 814.)

Aecidium tuberculatum E. & K., Jour. Myc. **4:** 26. 1888.
Endophyllum tuberculatum (E. & K.) A. & F., Bull. Torrey Club **42:** 58. 1915.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia aecidioid, hypophyllous and caulicolous, systemic from a perennial mycelium, large, orange-yellow when fresh, fading to pale-yellow, opening by a small pore, the colorless peridium becoming lacerate, evanescent; teliospores catenulate, globoid or rarely oblong, 16–26 by 18–30 μ, one-celled or sometimes two-celled; wall pale-yellow, 1–2 μ thick, closely striolate-verrucose.

On Malvaceae: **Althaea rosea** (L.)Cav., Colo., Kans., Neb., Okla.—**Callirhoë involucrata** (T.&G.)Gray, Kans., Neb., Okla.—**Sidalcea candida** Gray, Colo.—**S. neomexicana** Gray, Colo., Wyo. **Range:** Plains from Wyoming to Oklahoma.

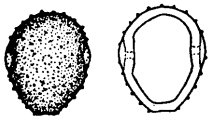
The teliosporic method of germination with a promycelium was first demonstrated in 1914 by Arthur & Fromme (Bull. Torrey Club **42:** 56. 1915). The morphologic similarity of the spores, even in the surface markings, to the aeciospores of *Puccinia interveniens,* together with the hosts and geographic distribution, leaves no doubt of the very close relationship to that rust. It indicates, furthermore, that the evolution has assumed the aecial form of the species rather than that of the telial.

18. PUCCINIA BURNETTII. Fig. 147.

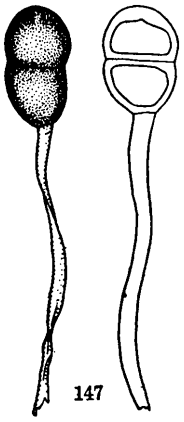
(N. A. F. 7: 299, 776.)

(*Aecidium eurotiae* E. & E., Jour. Myc. **6:** 119. 1891.)
Puccinia burnettii Griff., Bull. Torrey Club **29:** 298. 1902.
Dicaeoma burnettii Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Dicaeoma eurotiae A. & F., N. Am. Flora **7:** 776. 1926.

Pycnia hypophyllous, scattered, conspicuous. Aecia hypophyllous, scattered over all or most of the leaf-surface, cylindric; aeciospores globoid or ellipsoid, 16–19 by 19–24 μ; wall colorless, 1–1.5 μ thick, finely verrucose.



On Chenopodiaceae: **Eurotia lanata** (Pursh)Moq., Colo., Mont., N.M., Wash., Wyo.



147

Uredia not seen, probably not formed; urediospores in telial sori ellipsoid, 20–27 by 26–32 μ; wall golden-yellow, about 3 μ thick, finely verrucose-echinulate, the pores 4, equatorial. Telia epiphyllous, large, fusiform, 3–10 mm. long, blackish or chocolate-brown; teliospores ellipsoid, 23–27 by 35–42 μ, rounded at each end, slightly or not constricted at septum; wall chestnut-brown, 2–3 μ thick at sides, 4–6 μ above; pedicel colorless, two or three times length of spore.

On Poaceae (tribe *Agrostideae*): **Oryzopsis hymenoides** (R.&S.)Ricker(*O. cuspidata* Benth.), Colo., Mont., Nev., Wyo.

Range: Wyoming to southeastern Washington, southward to New Mexico and Nevada; also in western Europe.

Field observations in 1921 and 1923 enabled Bethel fully to establish the aecial and telial connection of this species. Record in Arthur Herbarium, but never published.

Puccinia eurotiae.

(N. A. F. 7: 525.)

Puccinia eurotiae Griff., Bull. Torrey Club **34:** 210. 1907.
Micropuccinia eurotiae A. & J., N. Am. Flora **7:** 525. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, in groups, pulvinate, early naked, chocolate-brown; teliospores ellipsoid, 23–26 by 32–40 μ, rounded at each end, slightly or not constricted at septum, the two cells readily falling apart by splitting of septum; wall cinnamon- or chestnut-brown, 2–3.5 μ thick at sides, 5–6 μ above, with a pale subcuticular layer extending through the septum, best seen in lactic acid; pedicel colorless, two to three times length of spore.

On Chenopodiaceae: **Eurotia lanata** (Pursh)Moq., Nev., Utah. **Range:** Known only from adjacent regions in Nevada and Utah.

The correlation of this microcylic species with *P. burnettii* was recorded in the N. Am. Flora **7:** 525. 1922.

19. PUCCINIA VILFAE. Fig. 148.

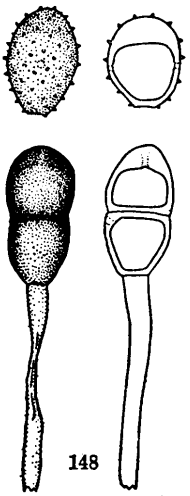
(N. A. F. 7: 303, 777, 834.)

(*Aecidium verbenicolum* E. & K., Bull. Torrey Club **11:** 114. 1884.)
Puccinia sydowiana Diet., Hedw. **36:** 299. 1897. Not Zopf, 1879.
Puccinia vilfae A. & H., Bull. Iowa Lab. Nat. Hist. **4:** 388. 1898.
Puccinia verbenicola Arth., Bot. Gaz. **35:** 16. 1903.
Dicaeoma verbenicola Arth., Proc. Ind. Acad. Sci. **1903:** 151. 1904.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores angularly globoid or oblong, 18–23 by 23–31 μ; wall colorless, 1–1.5 μ thick at sides, 4–12 μ above, inconspicuously verrucose.

On Verbenaceae: **Verbena angustifolia** Michx., Kans., Mo.—**V. bracteosa** Michx., Neb.—**V. canadensis** (L.)Britt., Okla.—**V. hastata** L., Ind., Kans., S.D.—**V. stricta** Vent., Ill., Ind., Kans., Neb., Okla.—**V. urticifolia** L., Kans., Neb., Okla.

Uredia epiphyllous, yellowish; urediospores obovoid or ellipsoid, 21–27 by 26–35 μ; wall colorless, 1.5–2 μ thick at sides, 5–10 μ above, sparsely and conspicuously verrucose-echinulate, the pores 6–8, approximately equatorial, indistinct. Telia epiphyllous, compact, blackish-brown; teliospores ellipsoid or oblong, 18–28 by 37–53 μ, rounded or somewhat obtuse at each end, slightly constricted at septum; wall chestnut-brown above, paler below, 1.5–2 μ thick at sides, 5–9 μ above; pedicel colorless, stout, twice length of spore.



148

On Poaceae (tribe *Agrostideae*): **Sporobolus asper** (Michx.)Kunth(*S. longifolius* Wood), Ala., Ill., Ind., Iowa, Kans., Miss., Mo., Neb., Okla., S.D., Tenn., Wis.—**S. drummondii** (Trin.)Vasey, Kans.—**S. neglectus** Nash, Neb.

Range: Wisconsin to South Dakota, southward to Alabama and Oklahoma.

Successful cultures were made in 1899, 1902, 1904 and 1905 by Arthur (Bot. Gaz. **29:** 274. 1900; same **35:** 16. 1903; Jour. Myc. **11:** 56. 1905; same **12:** 16. 1906), using both aeciospores and teliospores. The remarkable similarity between the aeciospores and urediospores gave the first indication of their relationship.

20. PUCCINIA SPOROBOLI. Fig. 149.

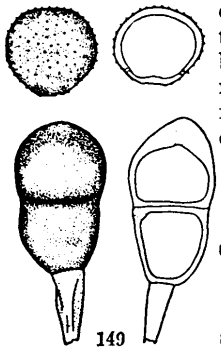
(N. A. F. 7: 303, 777.)

Puccinia sporoboli Arth., Bull. Iowa Agr. Coll. Dep. Bot. **1884:** 159. 1884.
Dicaeoma sporoboli Ktze., Rev. Gen. **3³:** 470. 1898.

Pycnia epiphyllous, inconspicuous. Aecia hypophyllous, in groups, cupulate; aeciospores angularly globoid or ellipsoid, 16–18 by 21–26 μ; wall pale-yellow, 1 μ thick, finely verrucose, appearing almost smooth when wet.

On Liliaceae: **Allium** sp., proved by cultures, not collected in the field.—**Lilium umbellatum** Pursh, Neb., N.D.

Uredia amphigenous, oval or oblong; urediospores flattened-globoid, 25–29 μ broad by 23–27 μ long; wall dark cinnamon-brown, 0.5–2 μ thick, finely



149

echinulate, the pores 3, sometimes 4 or 6, basal, mostly near the hilum. Telia amphigenous, oblong or linear, blackish-brown; teliospores oblong or ellipsoid, 15–29 by 27–55 μ, rounded above, rounded or narrowed below; wall dark chestnut-brown, 1.5 μ thick at sides, 10 μ above; pedicel light cinnamon-brown, as long as spore.

On Poaceae (tribe *Agrostideae*): **Sporobolus asper** (Michx.)Kunth(*S. longifolius* Wood), N.D.—**S. heterolepis** Gray, Iowa, N.D.

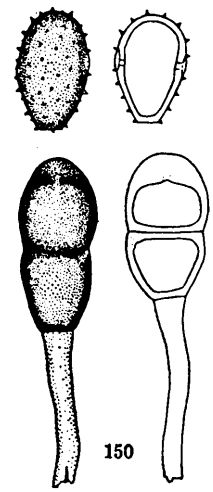
Range: Locally on prairies from southern North Dakota, southward to central Iowa and Nebraska.

Successful cultures following suggestions by Brenckle were made in 1917 by Arthur (Mycol. **9**: 307. 1917), using teliospores from *Sporobolus heterolepis*.

21. PUCCINIA SIMULANS. Fig. 150.

(N. A. F. 7: 304, 777, 834.)

Uromyces simulans Peck, Bot. Gaz. **4**: 127. 1879.
Puccinia cryptandri Ellis & Barth., Erythea **5**: 47. 1897.
Dicaeoma simulans A. & F., N. Am. Flora **7**: 304. 1920.
Puccinia simulans (Peck) Barth., N. Am. Ured. *32*. 1922.



150

Pycnia and aecia unknown. Uredia epiphyllous and caulicolous, oblong-linear, dark cinnamon-brown; uredio-spores narrowly ellipsoid or obovoid, 19–25 by 20–40 μ; wall cinnamon-brown, 2 μ thick, strongly and coarsely echinulate, the pores 4, rarely 3 or 5, equatorial. Telia epiphyllous, oblong, blackish-brown; teliospores ellipsoid or oblong, 24–32 by 40–50 μ, rounded or obtuse above, rounded below, slightly constricted at septum; wall dark chestnut-brown, 1.5–3 μ thick at sides, 4–9 μ above; pedicel colorless, twice length of spore.

On Poaceae (tribe *Agrostideae*): **Sporobolus contractus** Hitchc.(*S. strictus* Merr., not Franchet), Colo., N.M.—**S. cryptandrus** (Torr.)Gray, Ariz., Colo., Kans., Mont., Neb., N.M., Okla., S.D., Tex., Wyo.—**S. wrightii** Munro, Ariz.; (tribe *Festuceae*): **Tridens strictus** (Nutt.)Nash, Tex. **Range:** Plains from South Dakota and Montana, southward to Texas and Arizona.

Uromyces sporoboli.

(N. A. F. 7: 227, 747, 827.)

(*Aecidium alliicola* Wint., in Rab.-Wint., Fungi Eur. *3317*. 1885.)
Uromyces sporoboli E. & E., Proc. Acad. Sci. Phila. **1893**: 155. 1893.
Nigredo sporoboli Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Nigredo alliicola Arth., N. Am. Flora **7**: 747. 1926.

Pycnia amphigenous and caulicolous, scattered among the aecia. Aecia amphigenous and caulicolous, cupulate or short-cylindric, the margin erose; aeciospores angularly oblong or broadly ellipsoid, 18–23 by 24–30 μ; wall colorless, 1–2 μ thick, finely verrucose, appearing smooth when wet.

On Liliaceae: **Allium canadense** L., Mo., Neb.—**A. mutabile** Michx., Kans. —**A. textile** Nels.&Macbr. (*A. reticulatum* Fraser, not Presl ex G.Don), Kans., Neb., S.D.—**A. stellatum** Ker, Kans.

Uredia largely functioning as amphispores, hypophyllous, scattered, oblong or linear, cinnamon-brown; urediospores broadly or narrowly ellipsoid, 26–31 by 42–45 μ; wall pale cinnamon-brown, 1.5–2 μ thick, coarsely echinulate, the pores 4, equatorial, distinct. Telia hypophyllous, scattered, oblong or linear, blackish-brown; teliospores obovate or globoid, 19–23 by 25–43 μ, rounded or obtuse above, usually narrowed below; wall dark chestnut-brown, 1.5–2.5 μ thick at sides, 6–9 μ above; pedicel nearly colorless, once to twice length of spore or more.

On Poaceae (tribe *Agrostideae*): **Sporobolus asper** (Michx.)Kunth(*S. longifolius* Wood), Kans., S.D.—**S. cryptandrus** (Torr.)Gray, S.D.—**S. neglectus** Nash, Iowa, Kans., Neb., S.D.—**S. vaginaeflorus** (Torr.) Wood, Kans.

Range: South Dakota to Missouri.

Successful reciprocal cultures were conducted in 1916 by Arthur (Mycol. **9**: 301. 1917) by using teliospores from *Sporobolus vaginaeflorus* and aeciospores from *Allium stellatum*.

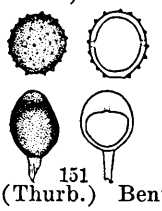
The correlation between *Puccinia simulans*, whose aecia are unknown, and *Uromyces sporoboli* was pointed out in 1917 by the writer (Mycol. **9**: 308. 1917), at which time it was thought that *P. sporoboli* might also be another variety of the same species, but not enough data are yet available to prove or disprove the correctness of this assumption.

22. UROMYCES MINIMUS. Fig. 151.

(N. A. F. 7: 226, 747.)

Uromyces minimus J. J. Davis, Bot. Gaz. **19**: 415. 1894.
Nigredo minima Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Uredia hypophyllous, scattered, cinnamon-brown; urediospores globoid, 13–20 by 15–22 μ; wall cinnamon-brown, 1.5–2 μ thick, strongly verrucose-echinulate, the pores 2–4, equatorial. Telia hypophyllous, dark chocolate-brown; teliospores globoid or obovoid, 12–19 by 14–23 μ; wall dark chestnut-brown, 1–1.5 μ thick at sides, 5–9 μ above; pedicel slightly colored, about length of spore.


151

On Poaceae (tribe *Agrostideae*): **Muhlenbergia comata** (Thurb.) Benth., Ore.—**M. racemosa** (Michx.)B.S.P.(*M. glomerata* Trin.), Ore.—**M. torreyi** (Kunth)Hitchc.(*M. umbrosa* Scribn., *M. sylvatica* Torr.), Wis.

Range: Southeastern Wisconsin and northern Oregon.

*. **Uromyces ignobilis** (Syd.) Arth. (*Uredo i.*, *Nigredo i.* Arth., *Uromyces major* Arth.), with amphigenous uredia, cinnamon-brown, urediospores broadly ellipsoid, 19–23 by 21–26 μ, the wall bright cinnamon-brown, 2–2.5 μ thick, strongly echinulate, the pores 4, equatorial; teliospores broadly ellipsoid or globoid, 19–23 by 23–27 μ, the wall chestnut-brown, 2–2.5 μ thick at sides, 5–9 μ above, with nearly colorless pedicel, once or twice length of spore; occurs on Poaceae (tribe *Agrostideae*): **Muhlenbergia reverchonii** Vasey, in central Texas; also in Mexico, Central and South America, West Indies and India. (N. A. F. **7**: 225, 746.)

23. PUCCINIA PYGMAEA. Fig. 152.

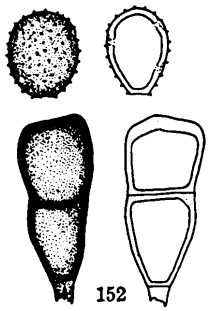
(N. A. F. 7: 311, 778, 814.)

Puccinia pygmaea Erikss., Fungi. Paras. Scand. *449*. 1895.
Puccinia milii Erikss., Fungi. Paras. Scand. *450*. 1895.
Dicaeoma pygmaeum A. & F., N. Am. Flora **7**: 311. 1920.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 16–21 by 19–24 μ; wall 1.5 μ thick, colorless, finely verrucose.

On Berberidaceae: **Berberis** sp., in Europe, not reported from America.

Uredia chiefly epiphyllous, pale cinnamon-brown; with numerous, capitate, straight, nearly colorless paraphyses, the pedicel slender; urediospores broadly ellipsoid, 19–29 by 21–35 μ; wall cinnamon-brown, 1.5 μ thick, finely echinulate, the pores usually 8, scattered, indistinct. Telia hypophyllous, compact, long covered by epidermis; teliospores clavate or cylindric, 12–21 by 29–51 μ, truncate above, narrowed below, slightly or not constricted at septum; wall chestnut-brown, 1 μ thick at sides, 3–5 μ above; pedicel dark chestnut-brown, very short.


152

On Poaceae (tribe *Agrostideae*): **Arctagrostis arundinacea** (Trin.) Beal, Alas.—**Calamagrostis aleutica** Bong., Alas., Ore.—**C. canadensis** (Michx.) Beauv., Mich., Wis.—**Milium effusum** L., Wis.—**Oryzopsis asperifolia** Michx., Wis.; Ont.; (tribe *Festuceae*): **Melica subulata** (Griseb.) Scribn., Calif.

Range: Southern Ontario to northern Wisconsin, and from western Alaska to central California; also in northern Europe.

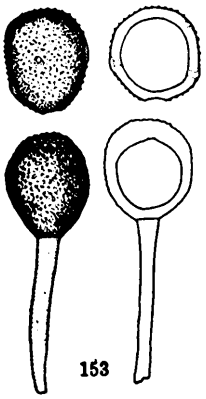
Successful cultures were made in 1930 by Tranzschel (Compt. Rend. Acad. Sci. U. S. S. R. **1931:** 46. 1931) by sowing teliospores on *Berberis vulgaris* and *B. amurensis*.

24. UROMYCES ARISTIDAE. Fig. 153.

(N. A. F. 7: 747.)

Uromyces aristidae E. & E., Jour. Myc. **3:** 56. 1887.
Puccinia ? scribneriana Arth., Bull. Torrey Club **46:** 109. 1919.
Nigredo aristidae Arth., N. Am. Flora **7:** 747. 1926.

Pycnia and aecia unknown. Uredia epiphyllous, intercostal, chestnut-brown, with numerous capitate paraphyses; urediospores globoid or ellipsoid, 23–29 by 27–35 μ; wall dark cinnamon-brown, 3–3.5 μ thick, strongly verrucose-echinulate, the pores 6–8, scattered. Telia epiphyllous, blackish-brown; teliospores globoid or broadly obovoid, 18–26 by 23–26 μ, rounded above and usually below; wall chestnut-brown, 2–3 μ thick at sides, 5–7 μ above, at first smooth, becoming tesselate or even tuberculate above; pedicel colorless, thrice length of spore or more.


153

On Poaceae (tribe *Agrostideae*): **Aristida arizonica** Vasey, N.M. **Range:** Northern New Mexico.

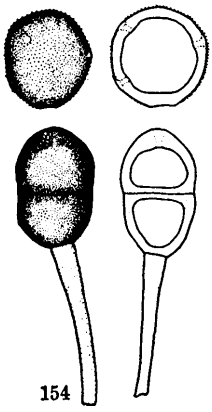
This highly characteristic species has only been reported from the mountainous region about Santa Fé and Las Vegas, N. M. The publication of Arizona for the type locality was an error.

25. PUCCINIA EPICAMPIS. Fig. 154.

(N. A. F. 7: 308, 778.)

Puccinia epicampis Arth., Bull. Torrey Club **28:** 662. 1901.

Pycnia and aecia unknown. Uredia amphigenous; urediospores globoid or oblong, 22–26 by 25–30 μ; wall cinnamon-brown, 2–3 μ thick, finely echinulate, the pores 6–8, scattered. Telia amphigenous, dark chocolate-brown; teliospores ellipsoid or oblong, 22–26 by 30–40 μ, rounded at each end, slightly or not constricted at septum; wall dark chestnut-brown, 2–3 μ thick at sides, 5–10 μ above; pedicel colored near the spore, twice to thrice length of spore.



154

On Poaceae (tribe *Aristideae*): **Epicampes rigens** Benth., Calif., N.M. **Range**: Northern New Mexico to southern California.

This semitropical rust was made synonymous with *Puccinia hibisciata* in the North American Flora, but a more careful study shows it to be distinct.

*. **Uromyces epicampis** D. & H. (*Nigredo e.* Arth.), correlated with *Puccinia epicampis* (as indicated in the N. Am. Flora **7:** 778. 1926), has one-celled teliospores, 20–26 by 26–35 μ; occurs on Poaceae (tribe *Aristideae*): **Epicampes rigens** Benth., in southern Arizona; also in Mexico and Central and South America. (N. A. F. **7:** 229, 750, 827.)

26. PUCCINIA MICRANTHA. Fig. 155.

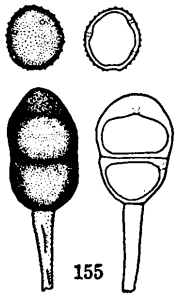
(N. A. F. 7: 302, 776, 834.)

Puccinia micrantha Griff., Bull. Torrey Club **29:** 299. 1902.
Dicaeoma micranthum A. & F., N. Am. Flora **7:** 302. 1920.

Pycnia chiefly epiphyllous, gregarious. Aecia chiefly hypophyllous, in groups, cylindric, the margin erose; aeciospores globoid, 15–18 by 16–25 μ; wall colorless, 1.5–2 μ thick, finely verrucose.

On Grossulariaceae: **Grossularia inermis** (Rydb.)Cov.&Britt.(*Ribes i.*, *R. vallicola* Greene), Colo.—**G. leptantha** (Gray)Cov.&Britt.(*R. l.*), Colo., Utah. —**G. missouriensis** (Nutt.)Cov.&Britt.(*R. m.*, *R. gracile* Pursh, not Michx.), S.D.—**Ribes aureum** Pursh(*Chrysobotrya a.* Rydb.), Neb., Wyo.

Uredia epiphyllous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 15–19 by 18–22 μ; wall light cinnamon-brown, 1.5 μ thick, finely echinulate, the pores 6–8, scattered. Telia epiphyllous, dark chocolate-brown; teliospores obovoid or oblong-ellipsoid, 19–23 by 34–40 μ, rounded or narrowed both above and below, slightly constricted at septum; wall chestnut-brown, 1–1.5 μ thick at sides, 6–9 μ above; pedicel nearly colorless, as long as spore.



155

On Poaceae (tribe *Agrostideae*): **Oryzopsis micrantha** (Trin.&Rupr.)Thurb., Colo., Mont., Neb., S.D.

Range: South Dakota and central Montana, southward to Colorado and Utah.

Numerous observations and open-air cultures made by Bethel in 1919 and 1921, but not published, fully established the aecial and telial connection. Cultures made in 1921 by Mains (Mycol. **25:** 411. 1933), using teliospores supplied by Bethel on *Oryzopsis micrantha*, gave infection on *Ribes aureum*.

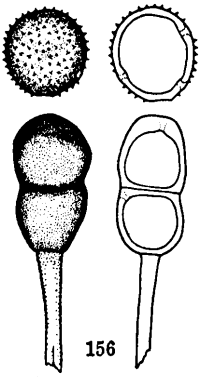
27. PUCCINIA SCABER. Fig. 156.

(N. A. F. 7: 302, 776, 814, 834.)

Uromyces scaber E. & E., Jour. Myc. **6:** 119. 1891.
Puccinia substerilis E. & E., Bull. Torrey Club **22:** 58. 1895.

Uredo luxurians E. & E., N. Am. Fungi *3583*. 1898.
Dicaeoma scaber Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Puccinia scaber (E. & E.) Barth., N. Am. Ured. *2560*. 1922.

Pycnia and aecia unknown. Uredia of typical sort rarely seen, cinnamon-brown; urediospores globoid or broadly ellipsoid, 18–23 by 21–27 μ, wall pale cinnamon-brown, 1.5–2 μ thick, closely and strongly echinulate, the pores 4–6, scattered; amphisporic uredia common, much darker, the spores 19–26 by 26–35 μ; the wall 2.5–3 μ thick, often thicker above; with a semi-persistent pedicel. Telia usually associated with amphisori; teliospores oblong or ellipsoid, 16–24 by 30–45 μ, rounded or truncate above, rounded or narrowed below, noticeably constricted at septum; wall cinnamon-brown, 1.5 μ thick at sides, 3–7 μ and darker above; pedicel nearly colorless, as long as spore or longer.


156

On Poaceae (tribe *Agrostideae*): **Oryzopsis hymenoides** (R.&S.)Ricker(*O. cuspidata* Benth.), Calif., Colo., Mont., Nev., N.M., Utah.—**Stipa lettermani** Vasey, Colo., N.M., Utah.—**S. minor** (Vasey)Scribn., Colo.—**S. nelsonii** Scribn., Colo.—**S. scribneri** Vasey, Colo., N.M.—**S. vaseyi** Scribn.(*S. robusta* Scribn.), Colo., N.M., S.D.—**S. viridula** Trin., Colo., Mont., N.M., N.D., S.D., Wyo.; Alta., Man. **Range:** Dry plains and mountains, Manitoba to Alberta, southward to New Mexico and southern California.

Many cultures were attempted with both teliospores and amphispores, but success was attained only with the latter, taken from *Stipa viridula* in 1905, 1907 and 1909, by Arthur (Jour. Myc. **12:** 24. 1906; **14:** 20. 1908, erroneously reported as *P. cryptandri*; Mycol. **2:** 228. 1910). In each case amphispores were shown on *S. viridula* and ordinary urediospores only obtained.

28. PUCCINIA STIPAE. Fig. 157.

(N. A. F. 7: 300, 776, 814, 834.)

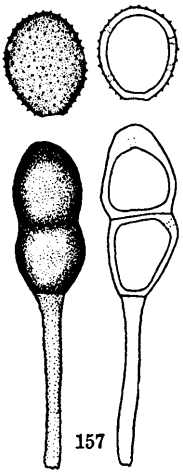
(*Aecidium bigeloviae* Peck, Bot. Gaz. **3:** 35. 1878.)
Puccinia stipae Arth., Bull. Iowa Agric. Coll. Dep. Bot. **1884:** 160. 1884.
Dicaeoma stipae Ktze., Rev. Gen. **3³:** 470. 1898.
(*Aecidium lygodesmiae* Shear; E. & E., Fungi Columb. *1476*. 1901.)
(*Aecidium grindeliae* Griff., Bull. Torrey Club **29:** 299. 1902. Not Syd., 1901.)

Pycnia amphigenous, grouped. Aecia amphigenous, in gall-like groups, the peridium opening by a central pore, evanescent; aeciospores globoid, 21–26 by 22–29 μ; wall cinnamon-brown, 1.5–2 μ thick, rarely thicker, finely verrucose, the pores 6–8, scattered, indistinct.

On Carduaceae (tribe *Astereae*): **Aster amethystinus** Nutt., Neb.—**A. exiguus**(Fern.)Rydb., Neb., N.D.—**A. multiflorus** Ait., Iowa, Kans., Neb., S.D.—**A. porteri** Gray, Colo.—**Chrysopsis villosa** (Pursh)Nutt., Ariz., Colo., Mont., Neb., Wyo.—**Chrysothamnus graveolens** (Nutt.)Greene(*C. nauseosus* Britt.), Colo., Wash.—**C. pulcherrimus** Nels., Colo.—**C. pumilus** Nutt.(*Bigelovia douglasii pumila* Gray), Mont., Wyo.—**C. serrulatus** (Torr.)Rydb., Colo.—**C. viscidiflorus** (Hook.)Nutt.(*B. douglasii* Gray), Colo.—**Erigeron flagellaris** Gray, Colo.—**E. pumilus** Nutt., Wyo.—**Grindelia squarrosa** (Pursh)Dunal, Colo., Neb., N.D., S.D.—**Gutierrezia sarothrae** (Pursh)Britt.&Rusby(*G. euthamiae* T.&G.), Colo., Mont., Neb., Tex.—**Sideranthus grindelioides** (Nutt.)Rydb. (*Aplopappus nuttallii* T.&G.), Colo.—**Solidago concinna** Nels., Colo.—**S. elongata** Nutt., Mont.—**S. glaberrima** Martens, Colo., Neb., N.D.; Alta.—**S. mollis**

Bartl., Mont., Neb., N.D., S.D.; Alta.—**S. rigida** L., Neb., N.D.—**S. serotina** Ait.(*S. pitcheri* Nutt.), N.M.—**Townsendia grandiflora** Nutt., Colo.; (tribe *Helenieae*): **Hymenopappus arenosus** Heller, Colo.—**Tetraneuris arizonica** Greene, Ariz., Colo.; (tribe *Senecioneae*): **Senecio densus** Greene, Colo.—**S. integerrimus** Nutt., Colo.—**S. oblanceolatus** Rydb., Colo.—**S. perplexus** Nels. (*S. dispar* Nels.), Colo., Wyo.—**S. pudicus** Greene, Colo.—**S. riddellii** T.&G., Neb.—**S. salicinus** Rydb., Colo.—**S. spartioides** T.&G., Colo.; on CICHORIACEAE: **Agoseris arizonica** Greene(*A. leptocarpa* Osterh.), Colo.—**A. laciniata** (Nutt.) Greene, Colo.—**Crepis acuminata** Nutt., Mont.—**C. glauca** (Nutt.)T.&G., Utah. —**Lygodesmia juncea** (Pursh)D.Don, Colo., Mont., Neb., S.D.; Sask.

Uredia chiefly epiphyllous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 18–23 by 21–26 μ; wall pale cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 6–8, scattered. Telia epiphyllous, chocolate-brown; teliospores ellipsoid or oblong, 18–25 by 35–64 μ, rounded or somewhat narrowed at each end, noticeably constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 5–10 μ above; pedicel light cinnamon-brown, twice to thrice length of spore.



157

ON POACEAE (tribe *Agrostideae*): **Oryzopsis hymenoides** (R.&S.)Ricker(*O. cuspidata* Benth.), Ariz., Colo.—**Stipa arida** Jones, Ariz.—**S. californica** Merr.&Davy, Calif. —**S. comata** Trin.&Rupr., Ariz., Colo., Mont., Neb., Ore., N.D., S.D., Utah, Wyo.; Alta., Man.—**S. lepida andersoni** (Vasey)Hitchc.(*S. eminens andersoni* Vasey), Calif.—**S. minor** (Vasey)Scribn., Calif.—**S. neo-mexicana** (Thurb.) Vasey, Colo.—**S. pulchra** Hitchc., Calif.—**S. spartea** Trin., Colo., Iowa, Minn., Neb., N.D., S.D., Wis.—**S. tweedyi** Scribn.(*S. comata intermedia* Scribn.&Vasey, Alta.; (tribe *Aveneae*): **Koeleria cristata** (L.)Pers., Colo.

Range: Manitoba to Alberta, southward to Texas and southern California.

Successful cultures were made in 1904, 1910 and 1912 by Arthur (Jour. Myc. **11:** 63. 1905; Mycol. **4:** 19. 1912; same **7:** 72. 1915), using teliospores from *Koeleria* and *Stipa spartea*, sown on *Aster, Grindelia, Gutierrezia, Senecio* and *Solidago*. A similar culture in 1919 was made by Davis (Trans. Wis. Acad. Sci. **20:** 422. 1922) by sowing teliospores from *Stipa spartea* on *Aster multiflorus*.

Puccinia grindeliae.

(N. A. F. 7: 576, 806, 848.)

Puccinia grindeliae Peck, Bot. Gaz. **4:** 127. 1879.
Puccinia lygodesmiae E. & E., Proc. Acad. Sci. Phila. **1893:** 154. 1893.
Puccinia xylorrhizae Arth., Bull. Torrey Club **28:** 662. 1901.
Micropuccinia grindeliae A. & J., Bull. Torrey Club **48:** 41. 1921.

Pycnia occur occasionally on certain hosts, particularly on *Xylorrhiza*. Aecia and uredia wanting. Telia amphigenous or caulicolous, in groups on small gall-like swellings, at first opening by a pore, simulating the aecia of *Puccinia stipae;* teliospores as in *P. stipae*, but usually more robust.

ON CARDUACEAE (tribe *Astereae*): **Chrysoma laricifolia** (Gray)Greene, Ariz.—**Chrysopsis bakeri** Greene, Colo., Utah.—**C. berlandieri** Greene, Okla.

—**C. fastigiata** Greene, Calif.—**C. imbricata** Nels., Colo.—**C. resinolens** Nels., Colo., Wyo.—**C. villosa** (Pursh)Nutt., Colo.—**Chrysothamnus bigelovii** (Gray) Greene, Colo.—**C. bloomeri** (Gray)Greene, Calif.—**C. elegans** Greene, Colo.—**C. frigidus** Greene, Wyo.—**C. glaucus** Nels., Wyo.—**C. graveolens** (Nutt.) Greene (*C. nauseosus* Britt.), Colo., Mont., Nev.—**C. lanceolatus** Nutt., Colo.—**C. linifolius** Greene, Utah.—**C. marianus** Rydb., Utah.—**C. plattensis** Greene, Colo., Mont.—**C. puberulus** (Eaton)Greene, Utah.—**C. pulcherrimus** Nels., Utah.—**C. pumilus** Nutt.(*Bigelovia douglasii pumila* Gray), Colo., Utah.—**C. viscidiflorus** (Hook.)Nutt.(*B. douglasii* Gray), Utah.—**Erigeron arenarioides** Gray(*Aster a.* Gray), Utah.—**E. caespitosus** Nutt., Wyo.—**E. eatonii** Gray, Wyo.— **E. filifolius** (Hook.)Nutt., Nev.—**E. macranthus** Nutt., Colo., Utah, Wyo.—**E. microlonchus** Greene, Wyo.—**E. salsuginosus** Gray, Utah.—**Eucephalus glaucus** Nutt.(*A. g.* T.&G.), Colo., Wyo.—**Grindelia aphanactis** Rydb., Colo., N.M.—**G. cuneifolia** Nutt., Calif.—**G. erecta** Nels., Colo.—**G. fastigiata** Greene, Colo.—**G. inornata** Greene, Colo.—**G. perennis** Nels., Colo.—**G. robusta** Nutt., Calif.—**G. squarrosa** (Pursh)Dunal, Colo., Kans., Mont., Neb., N.M., Tex., Wyo.; Alta., Sask.—**G. subalpina** Greene, Colo., N.M.—**G. texana** Scheele, Colo., Tex.—**Gutierrezia californica** (DC.)T.&G., Calif.—**G. diversifolia** Greene, Ariz., Wyo.—**G. filifolia** Greene, Utah.—**G. glomerella** Greene, N.M., Utah.—**G. juncea** Greene, Ariz., N.M., Wyo.—**G. longifolia** Greene, Ariz.—**G. sarothrae** (Pursh)Britt.&Rusby(*G. euthamiae* T.&G.), Ariz., Colo., Mont., Nev., N.D., S.D., Utah., Wyo.—**G. tenuis** Greene, Ariz., N.M.—**Hazardia squarrosa** (H.&A.)Greene(*Aplopappus s.*), Calif.—**Isocoma heterophylla** (Gray)Greene, N.M.—**Machaeranthera canescens** (Pursh)Gray, Nev.—**M. tanacetifolia** (H.B.K.)Nees, Colo., Kans.—**Petradoria pumila** (Nutt.)Greene(*Solidago p.* T.&G.), Utah.—**Prionopsis ciliata** Nutt., Kans.—**Pyrrocoma vaseyi** (Parry) Rydb., Colo.—**Sideranthus annuus** Rydb., Colo.—**S. australis** (Greene)Rydb., Ariz., Colo.—**S. gracilis** (Nutt.)Rydb., Ariz.—**S. grindelioides** (Nutt.)Rydb. (*Aplopappus nuttallii* T.&G.), Mont., Wyo.—**S. spinulosus** (Pursh)Sweet, Colo., Kans., Mont., Neb., N.M., Tex.; Sask.—**Solidago californica** Nutt., Calif.—**S. missouriensis** Nutt., Wash.—**S. mollis** Bartl., S.D.—**S. nana** Nutt., Colo.—**S. nemoralis** Ait., Ill., Iowa, Minn., Neb.—**S. oreophila** Rydb., Colo., Wyo.—**S. pulcherrima** Nels., Colo., Utah, Wyo.—**S. rigidiuscula** (T.&G.)Porter, Neb.—**S. trinervata** Greene, N.M., Utah.—**Stenotus acaulis** Nutt., Wyo.—**S. latifolius** Nels., Utah.—**Xylorrhiza glabriuscula** Nutt., Wyo.—**X. parryi** (Gray)Greene, Wyo.; (tribe *Helenieae*): **Hymenopappus scabiosaeus** L'Her.(*H. carolinensis* Porter), Okla.—**Psilostrophe cooperi** (Gray)Greene, Ariz.—**P. tagetine** (Nutt.) Greene, Ariz.—**Tetraneuris acaulis** (Pursh)Greene, Mont., Utah, Wyo.—**T. argentea** (Gray)Greene, N.M.—**T. arizonica** Greene, Colo.—**T. fastigiata** Greene, Kans.—**T. leptoclada** (Gray)Greene, Colo., Utah.—**T. simplex** Nels., N.D.—**T. torreyana** (Nutt.)Greene, Colo., Wyo.; (tribe *Senecioneae*): **Tetradymia canescens** DC., Nev., Utah.—**T. glabrata** Gray, Calif., Nev.—**T. nuttallii** T.&G., Utah.—**T. spinosa** H.&A., Nev., Wyo.; on CICHORIACEAE: **Lygodesmia juncea** (Pursh)D.Don, Colo., Kans., Neb., Nev., N.D., S.D.; Man. **Range:** Manitoba to Washington, southward to Texas and southern California.

The correlation of this microcyclic species with *Puccinia stipae*, first indicated by Travelbee (Proc. Ind. Acad. Sci. **1914:** 233. 1915), is not only shown in the correspondence of the teliospores and the aecial hosts, but very strikingly by the reaction

of the host in forming gall-like swellings of similar appearance for the aecial and the microcyclic sori. Many additional synonyms both for the rust and the hosts may be found in the North American Flora.

29. PUCCINIA SCHEDONNARDI. Fig. 158.

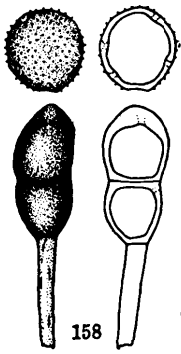
(N. A. F. 7: 308, 778, 834.)

(*Caeoma* (*Aecidium*) *hibisciatum* Schw., Trans. Amer. Phil. Soc. II. **4**: 293. 1832.)
Puccinia schedonnardi Kellerm. & Sw., Jour. Myc. **4**: 95. 1888.
(*Aecidium gossypii* E. & E., Erythea **5**: 6. 1897.)
Puccinia muhlenbergiae A. & H., Bull. Lab. Nat. Hist. Univ. Iowa **5**: 317. 1902.
Puccinia hibisciata Kellerm., Jour. Myc. **9**: 110. 1903.
Dicaeoma hibisciatum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, grouped. Aecia hypophyllous, surrounding pycnia, cupulate; aeciospores globoid or broadly ellipsoid, 15–21 by 16–26 μ; wall colorless, 1–3 μ thick, finely verrucose, often appearing smooth.

On Malvaceae: **Althaea rosea** (L.)Cav., Kans., Neb.—**Callirhoë alceoides** (Michx.)Gray, Kans., Neb.—**C. digitata** Nutt., Okla.—**C. involucrata** (T.&G.) Gray, Colo., Kans., Neb., Okla.—**Gossypium barbadense** L., Ariz.—**G. hirsutum** L., Ariz., Tex.—**Hibiscus lasiocarpus** Cav., Ill.—**H. militaris** Cav., Ill., Neb., Pa.—**H. moscheutos** L., Ala., Ill., Mo., N.C., Ohio.—**Napaea dioica** L., Ind., Ill., Iowa, Wis.—**Sida hederacea** (Dougl.)Torr.(*Disella h.* Greene), N.M.—**Sidalcea candida** Gray, Colo.—**Sphaeralcea ambigua** Gray, Ariz.—**S. coccinea** (Nutt.)Rydb.(*Malvastrum c.* Gray), Colo., Kans., Mont., Neb., N.D.—**S. fasciculata** (Nutt.)Greene(*M. f.* Greene, *M. thurberi* Gray), Calif.—**S. fendleri** Gray, Ariz.—**S. grossulariaefolia** (H.&A.)Rydb., Ariz.—**S. lobata** Woot., N.M.

Uredia amphigenous, light cinnamon-brown; urediospores globoid or broadly ellipsoid, 18–26 by 19–30 μ; wall light cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 6–8, scattered. Telia amphigenous, dark chocolate-brown; teliospores broadly ellipsoid or oblong, 15–24 by 27–45 μ, rounded or somewhat narrowed at each end, slightly or not constricted at septum, which is occasionally oblique; wall dark chestnut-brown, 1.5–2 μ thick at sides, 3–7 μ above; pedicel light cinnamon-brown, once to thrice length of spore; mesospores occasionally present.


158

On Poaceae (tribe *Agrostideae*): **Limnodea arkansana** (Nutt.)Dewey, Tex.—**Muhlenbergia cuspidata** (Torr.)Rydb. (*Sporobolus c.* Wood), Iowa, Neb., N.D., S.D.—**M. filiformis** (Thurb.)Rydb., N.M.—**M. gracillima** Torr., Colo.—**M. mexicana** (L.)Trin., Ill., Ind., Iowa, Kans., Ky., Md., Neb., N.Y., Ohio, Okla., Pa., Tenn., Va., W.Va., Wis.—**M. parviglumis** Vasey, Tex.—**M. porteri** Scribn., Ariz.—**M. racemosa** (Michx.)B.S.P.(*M. glomerata* Trin.), Ind., Kans., Mo., Neb., N.D., S.D., Utah.—**M. repens** (Presl) Hitchc.(*S. r.*), Ariz., N.M., Tex.—**M. schreberi** Gmel.(*M. diffusa* Willd.), Ark., Del., Ill., Ind., Iowa, Kans., Mo., Ky., Neb., N.J., N.Y., N.C., Ohio, Okla., Pa., S.C., Tenn., W.Va.—**M. sobolifera** (Muhl.)Trin., Ind.—**M. squarrosa** (Trin.) Rydb., Ariz., Mont., N.M., Utah.—**M. tenuiflora** (Willd.)B.S.P., Ind.—**M. torreyi** (Kunth)Hitchc.(*M. umbrosa* Scribn., *M. sylvatica* Torr.), Va., Wis.—**M. trifida** Hack., Colo., N.M., Utah.—**Sporobolus airoides** Torr., N.D., S.D., Wyo.—**S. asperifolius** (Nees&Meyen)Thurb., Calif., Colo., Kans., Mont., Neb., N.M., N.D., Tex., Utah, Wyo.—**S. auriculatus** Vasey, Tex.—**S. buckleyi** Vasey,

Tex.; (tribe *Chlorideae*): **Schedonnardus paniculatus** (Nutt.)Trel.(*S. texanus* Steud.), Colo., Kans., Neb., S.D.; (tribe *Festuceae*): **Melica mutica** Walt. (*M. diffusa* Pursh), Ind.—**M. porteri** Scribn., Colo.—**Monanthochloë littoralis** Engelm., Tex.—**Triplasis purpurea** (Walt.)Chapm.(*Triodia p.* Hack.), Kans., Okla., Tex.

Range: Nearly throughout the United States, except the northern Pacific slope, but more abundant southward; also in Mexico.

The first successful cultures were instituted in 1903 by Kellerman (Jour. Myc. **9:** 109, 232. 1903), using teliospores from *Muhlenbergia mexicana,* sown on *Hibiscus moscheutos* and *H. militaris.* Successful cultures were obtained in 1908, 1909 and 1910 by Arthur (Mycol. **1:** 251. 1909; same **2:** 226. 1910; same **4:** 18. 1912), using teliospores from *M. mexicana* and *M. racemosa,* sown on *Callirhoë involucrata,* but without results on *Althaea, Hibiscus, Napaea* or *Sidalcea.* Similar work in 1914 (Mycol. **7:** 81–82. 1915) with telial material from *Sporobolus asperifolius* gave results on *Sphaeralcea incana* and *S. lobata,* but not on *Callirhoë* or *Hibiscus.* Again in 1916 (Mycol. **9:** 299–300. 1917) success was obtained with material from two strikingly similar grasses as seen in the field, *Muhlenbergia gracillima* and *Schedonnardus paniculatus,* both sown on *Malvastrum coccineum.* The aecia obtained by Kellerman were large and orange-yellow, while those secured by Arthur were smaller and colorless (white). Both kinds of aecia have been gathered in the field, sometimes on the same plants, or even on the same leaf, but not in the same group of sori. The different appearance of the aecia, and the selection of hosts in cultures indicate physiologic races, but no morphologic distinctions have been detected.

Puccinia heterospora.

(N. A. F. 7: 544, 803, 847.)

Puccinia heterospora B. & C., Jour. Linn. Soc. **10:** 356. 1868.
Uromyces pulcherrimus B. & C., Grev. **3:** 56. 1874.
Micropuccinia heterospora A. & J., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, usually in groups, blackish-brown, central sori sometimes cinereous from germination; teliospores as in *Puccinia schedonnardi,* but more variable and the mesospores more numerous, often with no two-celled spores present.

On Malvaceae: **Abutilon theophrasti** Medic.(*A. abutilon* Rusby, *A. avicennae* Gaertn.), D.C., Kans., Mo., Neb.—**A. holosericeum** Scheele, Tex.—**A. incanum** (Link)Sweet, Ariz., Tex.—**A. parvulum** Gray, Ariz.—**A. texense** T.& G., Tex.—**Althaea rosea** (L.)Cav., Kans., Tex.—**Gayoides crispum** (L.)Small, Fla.—**G. imberbe** (Griseb.)Small, Fla.—**Malva sylvestris** L., Kans.—**Malvastrum coromandelianum** (L.)Garcke, Tex.—**Sida hastata** St.Hil., Tex.—**S. physocalyx** Gray, Ariz., Tex.—**S. spinosa** L., Ga., Ill., Ind., Ky., La., Miss.—**S. texana** (T.&G.)Small, Tex.—**Wissadula amplissima** (L.)R.E.Fries, Tex.—**W. periplocifolia** (L.)Thwaites, Tex. **Range:** District of Columbia to Nebraska and Nevada, southward to the United States boundary; also in Mexico, Central and South America, West Indies and throughout the warmer part of the world.

The undoubted correlation of this microcyclic species (recorded in the N. Am. Flora **7:** 544. 1922) with *Puccinia schedonnardi* probably does not comprise all the named forms now usually considered independent species. The whole complex is essentially tropical, and many known synonyms are consequently omitted. Cultures were made in 1896 by Carleton (Bull. Bur. Plant Industry **63:** 26. 1904), using teliospores from *Abutilon theophrasti,* sown on the same host, and producing teliospores again.

30. PUCCINIA AMPHIGENA. Fig. 159.

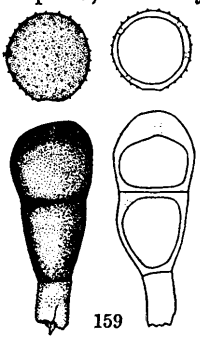
(N. A. F. 7: 310, 778, 835.)

Puccinia amphigena Diet., Hedw. **34:** 291. 1895.
Dicaeoma amphigenum Ktze., Rev. Gen. **3³:** 467. 1898.

Pycnia amphigenous. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or oblong, 16–23 by 19–26 μ; wall nearly colorless, 1–1.5 μ thick, finely verrucose.

On Liliaceae: **Leucocrinum montanum** Nutt., Colo.; on Smilaceae: **Smilax bona-nox** L., Okla.—**S. herbacea** L. (*Nemexia h.* Small), Kans., N.D.; Man. —**S. hispida** Muhl., Kans., Neb.

Uredia amphigenous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 18–23 by 21–26 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores about 8, scattered. Telia amphigenous, blackish-brown; teliospores oblong or oblong-clavate, 18–32 by 30–56 μ, rounded or less often truncate or attenuate above, usually narrowed below, only slightly constricted at septum; wall dark chestnut-brown, 1–1.5 μ thick at sides, 7–10 μ above; pedicel pale cinnamon-brown, once length of spore or less.


159

On Poaceae (tribe *Agrostideae*): **Calamovilfa gigantea** (Nutt.) Scribn.&Merr., Colo.—**C. longifolia** (Hook.) Hack., Colo., Ill., Kans., Mich., Mont., Neb., N.D., Okla., S.D., Wyo.; Alta., Man., Ont.

Range: Plains and prairies from eastern shore of Lake Huron to Alberta, southward to Oklahoma.

Successful cultures were made in 1902, 1903, 1905, 1907, 1909 and 1910 by Arthur (Bot. Gaz. **35:** 20. 1903; Jour. Myc. **10:** 11. 1904; same **12:** 16. 1906; same **14:** 15. 1908; Mycol. **2:** 225. 1910; same **4:** 18. 1912), with teliospores sown on *Smilax hispida* and once on *S. herbacea.* Garden cultures on *Leucocrinum* were made in 1916 by Bethel, but were not published.

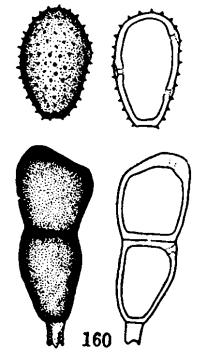
31. PUCCINIA CONSPICUA. Fig. 160.

(N. A. F. 7: 642.)

(*Aecidium conspicuum* Arth., Bull. Torrey Club **45:** 153. 1918.)
Puccinia conspicua [Arth.] Mains, Mycol. **25:** 408. 1933.

Pycnia amphigenous, in groups. Aecia amphigenous, crowded in large groups, cupulate or short cylindric; aeciospores globoid, 18–23 by 19–26 μ; wall colorless, 1 μ thick, finely verrucose.

On Carduaceae (tribe *Helenieae*): **Dugaldea hoopesii** (Gray) Rydb. (*Helenium h.*), Ariz., Colo., N.M.


160

Uredia amphigenous, brownish-yellow; urediospores oblong, 14–19 by 24–38 μ; wall pale-yellow, 1.5–2.5 μ thick, echinulate, the pores 4–6, scattered, obscure. Telia amphigenous, tardily naked, chestnut-brown; teliospores irregularly ellipsoid or clavate, 20–28 by 28–40 μ; wall yellowish-brown, 1 μ thick at sides, irregularly rounded or truncate and 5 μ thick above; pedicel very short.

On Poaceae (tribe *Aveneae*): **Koeleria cristata** (L.) Pers., Colo.

Range: Central Colorado to Arizona and New Mexico.

Cultures were made by Mains (Mycol. **25:** 408. 1933) using aeciospores sown on *Koeleria cristata.*

32. PUCCINIA LIATRIDIS. Fig. 161.

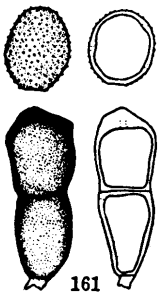
(N. A. F. 7: 326, 780, 836.)

(*Aecidium compositarum liatridis* Webber, Ann. Rep. Neb. Board Agric. **1889**: 210. 1890.)
(*Aecidium liatridis* Ellis & And., Bot. Gaz. **16**: 47. 1891.)
Puccinia liatridis [Webber] Bethel; Arth., Mycol. **9**: 301. 1917.
Dicaeoma liatridis A. & F., N. Am. Flora **7**: 326. 1920.

Pycnia amphigenous, in groups. Aecia amphigenous, cupulate; aeciospores globoid or ellipsoid, 16–24 by 19–29 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Carduaceae (tribe *Eupatorieae*): **Liatris aspera** (Michx.) Greene (*L. scariosa* Auth., not Willd.), Kans., N.D., Wis.—**L. punctata** Hook., Colo., Neb., N.D., Wyo., Sask.—**L. spicata** Willd., Neb.—**L. squarrosa** (L.) Willd., Neb.

Uredia epiphyllous, orange-yellow, rarely with a few hyphoid paraphyses; urediospores ellipsoid, 18–23 by 23–30 μ; wall pale-yellow or brownish, 1.5–2 μ thick, finely echinulate, the pores 6–8, scattered, usually indistinct. Telia hypophyllous, blackish-brown, long covered by epidermis, surrounded by subepidermal paraphyses; teliospores irregularly oblong or clavate-oblong, 16–29 by 42–55 μ, truncate or obtuse above, narrowed below, slightly or not constricted at septum; wall dark chestnut-brown, paler below, 1–2 μ thick at sides, 5–7 μ above; pedicel tinted, very short. Mesospores occasional.


161

On Poaceae (tribe *Aveneae*): **Koeleria cristata** (L.) Pers., Colo., N.M., N.D., S.D., Wis.; (tribe *Agrostideae*): **Agrostis exarata** Trin., Colo.—**A. hyemalis** (Walt.) B.S.P. (*A. scabra* Willd.), Colo., N.M.

Range: On plains and foothills from northwestern Wisconsin to North Dakota and Saskatchewan, southward to southern New Mexico.

Successful cultures were made in 1916 by Arthur (Mycol. **9**: 301. 1917) by sowing teliospores from *Koeleria cristata* on *Liatris punctata*. Earlier cultures made by Bethel in the open were not published.

33. PUCCINIA EATONIAE. Fig. 162.

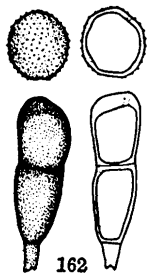
(N. A. F. 7: 324, 624, 780, 835.)

(*Aecidium ranunculi* Schw., Schr. Nat. Ges. Leipzig **1**: 67. 1822. Not Schum., 1803.)
(*Aecidium myosotidis* Burr., Bot. Gaz. **9**: 189. 1884.)
Puccinia eatoniae Arth., Jour. Myc. **10**: 18. 1904.
Dicaeoma eatoniae Arth., Proc. Ind. Acad. Sci. **1903**: 148. 1904.
(*Aecidium indecisum* Arth., Bull. Torrey Club **47**: 474. 1920.)
Dicaeoma myosotidis A. & F., N. Am. Flora **7**: 780. 1926.

Pycnia hypophyllous, scattered over large areas. Aecia hypophyllous, systemic, cupulate; aeciospores globoid or ellipsoid, 12–20 by 15–25 μ; wall nearly or quite colorless, 1.5 μ thick, finely verrucose.

On hosts, listed under the varieties.

Uredia chiefly epiphyllous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 12–18 by 19–24 μ; wall golden-yellow, 1–1.5 μ thick, finely echinulate, the pores 6–8, scattered. Telia chiefly hypophyllous and caulicolous, long covered by epidermis, blackish-brown, with brownish subepidermal paraph-



162

yses; teliospores clavate-oblong or cylindric, 13–22 by 25–50 μ, truncate or rounded above, narrowed below, slightly or not constricted at septum; wall light cinnamon-brown, about 1 μ thick at sides, 3–6 μ and darker above; pedicel short, colored.

On Poaceae (tribe *Aveneae*): **Sphenopholis nitida** (Spreng.)Scribn.(*Eatonia dudleyi* Vasey, *E. n.* Nash), Del., Miss., S.C., Va.—**S. obtusata** (Michx.)Scribn.(*E. o.* Gray), Fla., Iowa, Kans., Miss., Neb., N.D., Okla., S.D., Wis.; Sask.—**S. obtusata lobata** (Trin.)Scribn., Utah.—**S. pallens** (Spreng.) Scribn.(*E. pennsylvanica* Gray), Del., Ind., Iowa., Neb., N.Y., N.D., Ohio, S.D., Tenn., W.Va.; Ont.

Range: Northern New York and Ontario to Saskatchewan, southward to northern Florida and Oklahoma, and in central California.

The species is separable by means of cultures, size of aeciospores, and aecial hosts into two varieties:

(1). **Puccinia eatoniae ranunculi** Mains. Aeciospores 12–17 by 15–24 μ; on Ranunculaceae: **Ranunculus abortivus** L., Conn., Del., Ill., Ind., Iowa, Mich., Miss., Mo., N.Y., N.C., N.D., Ohio, Pa., S.C., S.D., W.Va., Wis.; Ont.—**R. bolanderi** Greene, Calif.—**R. californicus** Benth., Calif.—**R. calthaeflorus** Greene, Colo.—**R. lobbii** Gray, Calif.—**R. micranthus** Nutt., W.Va. **Range**: New York to North Dakota, southward to South Carolina and Missouri, and in California.

Cultures were carried out in 1903 by Arthur (Jour. Myc. **10:** 18. 1904), using aeciospores from *Ranunculus abortivus* sown on *Sphenopholis pallens* (*Eatonia pennsylvanica*), and in 1920 by Mains (Mycol. **24:** 208. 1932) using teliospores from *S. pallens* on *R. abortivus*, and sowing aeciospores thus obtained in the following spring on *S. pallens* and *S. obtusata* with infection only on the former. Urediospores from the latter culture were sown on *S. pallens* and *S. obtusata* with infection only on *S. pallens*.

(2.) **Puccinia eatoniae myosotidis** Mains. Aeciospores 15–20 by 18–25 μ; on Boraginaceae: **Myosotis virginica** (L.)B.S.P., Ill., Ind., Mo., Wis. **Range**: Wisconsin, southward to eastern Missouri.

This variety appears to have slightly larger teliospores as well as aeciospores than the preceding, and the walls of both aeciospores and urediospores are slightly thicker. These and other features may indicate that *Myosotis* supplies more available nutriment than *Ranunculus*. Cultures were successfully made in 1921 by Mains (Mycol. **24:** 210. 1932) by placing aeciospores on *S. obtusata*, the resulting urediospores being used to infect both *S. obtusata* and *S. pallens*. Teliospores from *S. obtusata* were sown in 1920 on *Myosotis virginica*, resulting in production of aecia the following spring, and the aeciospores were then (1921) successfully used on *S. obtusata*.

34. PUCCINIA MONOICA. Fig. 163.

(N. A. F. 7: 312, 778, 835.)

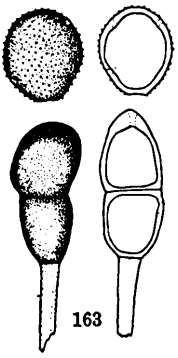
(*Aecidium parryi* Peck, Amer. Nat. **8:** 215. 1874.)
(*Aecidium monoicum* Peck, Bot. Gaz. **4:** 230. 1879.)
Puccinia monoica [Peck] Arth., Mycol. **4:** 61. 1912.
Dicaeoma monoicum A. & F., N. Am. Flora **7:** 312. 1920.
Dicaeoma parryi Arth., N. Am. Flora **7:** 778. 1926.

Pycnia amphigenous, scattered over large areas. Aecia hypophyllous, systemic, cupulate; aeciospores globoid or ellipsoid, 15–24 by 17–30 μ; wall colorless, 1.5–2.5 μ thick, finely verrucose.

On Brassicaceae (*Cruciferae*): **Arabis bolanderi** Wats., Calif.—**A. brachycarpa** (T.&G.)Britt., Alta.—**A. canescens** Nutt., Colo.—**A. connexa**

Greene, Colo.—**A. crandallii** B.L.Rob., Colo.— **A. cusickii** Wats., Wash.—**A. drummondii** Gray, Colo., N.M., Utah; Alta.—**A. exilis** Nels., Mont.—**A. fendleri** (Wats.)Greene, Colo., N.M.—**A. lignifera** Nels., Colo.—**A. lyallii** Wats., Mont.—**A. lyrata** L., Wis.; Ont.—**A. nuttallii** B.L.Rob., B.C.—**A. ovata** (Pursh)Poir., Colo., Nev.—**A. platysperma** Gray, Calif.—**A. retrofracta** Grah. (*A. holboellii* Am.auth.), Calif., Colo., Mont., Utah, Wash.; B.C.—**A. selbyi** Rydb., Colo.—**A. whitedii** Piper, Wash.—**Draba** sp., N.M.—**Phoenocaulis cheiranthoides** Nutt.(*Arabis menziesii* Hook.), Nev.—**P. pedicellata** (Nels.)Heller (*A. p.*), Nev.—**Schoenocrambe linifolia** (Nutt.)Greene(*Sisymbrium l.*), Colo., Mont., Utah, Wyo.—**S. pinnata** Greene, Colo.—**Smelowskia calycina** (Desv.)C. A.Mey., Colo., Wyo.—**Sophia incisa** (Engelm.)Greene(*Sisymbrium i.*), N.M.—**S. leptostylis** Rydb., Utah.—**S. pinnata** (Walt.)Howell(*Sisymbrium canescens* Nutt.), Colo.—**Thelypodium linearifolium** Wats., Ariz.

Uredia chiefly epiphyllous, dark cinnamon-brown; urediospores ellipsoid or obovoid, 19–27 by 24–31 μ; wall cinnamon-brown, 2 μ thick, finely echinulate, the pores 6–8, scattered. Telia chiefly epiphyllous, chestnut-brown, cinereous by germination; teliospores ellipsoid or clavate-oblong, 14–24 by 34–55 μ, rounded or sometimes acute at both ends, slightly constricted at septum; wall cinnamon- or chestnut-brown, 1–1.5 μ thick at sides, 5–10 μ above; pedicel nearly or quite colorless, once to twice length of spore.



163

On Poaceae (tribe *Aveneae*): **Koeleria cristata** (L.) Pers., Calif., Colo., N.M., Wyo.—**Trisetum spicatum** (L.) Richter(*T. subspicatum* Beauv.), Colo., Utah; (tribe *Agrostideae*): **Stipa elmeri** Piper&Brodie, Nev.—**S. occidentalis** Thurb., Calif.

Range: Montana to British Columbia, southward to New Mexico and central California, and in Wisconsin and western Ontario.

In 1911 cultures were made by sowing aeciospores on *Trisetum spicatum* and *T. majus*, and from teliospores so obtained sowing was made on *Arabis* in the rosette stage, which produced an abnormal development of the host without reaching the pycnial stage until the following spring. In 1912 further successful sowings were made on *Koeleria cristata*. These cultures were all by Arthur (Mycol. **4**: 59–61. 1912; same **7**: 75. 1915). Both the suggestion and the material for the cultures came from Bethel, who made observations in Colorado. Cultures in 1920 by Mains (Mycol. **25**: 407. 1933) using teliospores from *Stipa* sp. gave pycnia and aecia on *Arabis* sp. the following spring; and in 1921 aeciospores from *Arabis* sp. gave infection on *Koeleria cristata*.

Puccinia consimilis.

(N. A. F. 7: 459, 798.)

Puccinia consimilis E. & E., Jour. Myc. **6**: 120. 1891.
Allodus consimilis Orton, Mem. N. Y. Bot. Gard. **6**: 187. 1916.

Pycnia chiefly hypophyllous, scattered over large areas. Aecia as in *Puccinia monoica*, systemic. Uredia wanting. Telia hypophyllous, arising from around or within the aecia, pulvinate, dark chestnut-brown; teliospores as in *P. monoica*.

On Brassicaceae (*Cruciferae*): **Schoenocrambe linifolia** (Nutt.)Greene (*Sisymbrium l.*), Mont.—**Smelowskia americana** Rydb.(*S. calycina* Am.auth.),

Utah. **Range**: Known only from the vicinity of Helena, in western Montana, and in the Uinta Mountains in northeastern Utah.

This correlated species is well developed and without intergrading forms with *P. monoica*, so far as present evidence goes. The correlation was recorded in the N. Am. Flora **7**: 533. 1922. The systemic aecia show affiliation with the microcyclic form, *P. holboellii*.

Puccinia holboellii.

(N. A. F. 7: 532, 802, 846.)

Aecidium holboellii Hornem., Fl. Dan. **37**: 11. 1840.
Puccinia holboellii (Hornem.) Rostr., Medd. Grønland **3**: 534. 1888.
Micropuccinia holboellii A. & J.; Arth., Bull.Torrey Club **48**: 41. 1921.

Pycnia amphigenous, preceding or among the telia. Aecia and uredia wanting. Telia chiefly hypophyllous, simulating the habit of aecia of *Puccinia monoica*, systemic, cinereous by germination; teliospores as in *P. monoica*, but usually more robust.

On Brassicaceae (*Cruciferae*): **Arabis ambigua** DC., Alas.—**A. arcuata** Gray, Calif.—**A. breweri** Wats., Calif.—**A. canescens** Nutt., Nev.—**A. crandallii** B.L.Rob., Colo.—**A. divaricarpa** Nels., Ida., Utah; Alta.—**A. drummondii** Gray, Mont.; B. C.—**A. exilis** Nels., Colo., Mont.—**A. furcata** Wats., Wash.—**A. holboellii** Hornem., Alas.; Greenl.—**A. lignipes** Nels., Alta.—**A. lyallii** Wats., Mont., Wash.; B.C.—**A. lyallii occidentalis** Wats., Alas.—**A. microphylla** Nutt., Calif., Ida., Utah.—**A. oreophylla** Rydb., Wyo.—**A. pendulocarpa** Nels., Wyo.—**A. perennans** Wats., Calif.—**A. retrofracta** Grah.(*A. holboellii* Am.auth.), Ore., Utah.—**Draba spectabilis** Greene, Colo., Utah.—**Erysimum pallasii** (Pursh)Fern.(*Cheiranthus pygmaeus* Adams), Grinnell Land (Lat. 81°41′)—**Schoenocrambe linifolia** (Nutt.)Greene(*Sisymbrium l.*), Mont., Utah, Wyo.—**S. pinnata** Greene, Colo.—**Smelowskia fremontii** Wats., Nev. **Range**: Alberta to southwestern Alaska, southward to Colorado and southern California, and from Greenland to Grinnell Land.

The correlation of this species with *Puccinia monoica* was pointed out by Travelbee (Proc. Ind. Acad. Sci. **1914**: 233. 1915). The general resemblance of this microcyclic species to the early stages of the cupulate aecia in *P. monoica*, as well as its disposition on the host, is striking. This resemblance led Hornemann to describe the species, although possessing only telia, under the genus *Aecidium*. Both the microcyclic and macrocyclic species infect the host in autumn, and show pycnia the following spring. *P. holboellii* has about the same geographic range as the aecia of *P. monoica*. The collective species is remarkable in possessing independent heteroecious, autoecious, and microcyclic conditions, which can be considered to be either separate species or else varieties of one polymorphic species.

35. PUCCINIA KOELERIAE. Fig. 164.

(N. A. F. 7: 325, 780, 836.)

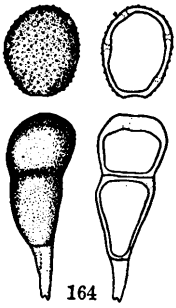
Puccinia koeleriae Arth., Mycol. **1**: 247. 1909.
Dicaeoma koeleriae A. & F., N. Am. Flora **7**: 325. 1920.

Pycnia chiefly epiphyllous, in groups. Aecia hypophyllous, in crowded groups, short-cupulate; aeciospores globoid, 16–23 by 18–26 μ (or on *Berberis fendleri* 19–26 by 23–29 μ); wall colorless, 1–2 μ thick, finely verrucose.

On Berberidaceae: **Berberis fendleri** Gray, Colo.—**Mahonia aquifolium** (Pursh)Nutt.(*M. diversifolia* Sweet, *Berberis a.*, *Odostemon nutkanus* Rydb.),

Ida., Ore., Wash.; B.C.—**M. repens** (Lindl.)Don(*B. r., O. aquifolium* Rydb.), Colo., Ida., Mont., N.M., S.D., Wyo.; B.C.

Uredia amphigenous, cinnamon-brown, with numerous long capitate paraphyses; urediospores ellipsoid, 19–26 by 23–32 μ; wall cinnamon-brown, 1–1.5 μ thick, finely verrucose-echinulate, the pores 8–10, scattered. Telia hypophyllous, long covered by epidermis, with a thin layer of subepidermal paraphyses; teliospores clavate or oblong-clavate, 13–21 by 45–64 μ, obtuse or truncate above, narrowed below, slightly or not constricted at septum; wall chestnut-brown, paler below, 1 μ thick at sides, 3–5 μ above; pedicel colored, short.


164

On Poaceae (tribe *Aveneae*): **Koeleria cristata** (L.) Pers., Colo., Mont., N.M., N.D., Ore., S.D., Utah.

Range: Western North Dakota to British Columbia, southward to northwestern New Mexico (alt. 8200 ft.) and Utah.

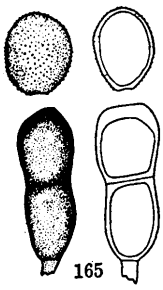
Successful cultures were conducted in 1908 by Arthur (Mycol. **1**: 246–248. 1909), after a suggestion by Bethel, using teliospores sown on *Mahonia repens*. In 1921 Mains (Mycol. **25**: 409. 1933) infected *Berberis fendleri* with teliospores from *Koeleria cristata*, and the following spring used these aeciospores to infect *K. cristata* and *Trisetum sesquiflorum*. Aeciospores from both *B. fendleri* and *M. repens* also infected *K. cristata*. The tall upright species of *Mahonia* is here called *M. aquifolium* and the trailing species *M. repens*, while in the N. Am. Flora (**7**: 155) *M. aquifolium* is applied to the trailing species.

36. PUCCINIA POAE-SUDETICAE. Fig. 165.

(N. A. F. 7: 327 in part, 780, 836.)

Uredo poae-sudeticae Westend., Bull. Acad. Belg. II. **9**: 650. 1869.
Puccinia poarum Auths., not Nielson, 1877.
Uredo boutelouae Arth., Bull. Iowa Agric. Coll. Dep. Bot. **1884**: 164. 1884.
Uredo anthoxanthina Bubák, Ann. Myc. **3**: 223. 1905.
Puccinia poae-sudeticae (Westend.) Jørstad, Mag. Naturv. **70**: 325. 1932.

Pycnia and aecia unknown. Uredia chiefly epiphyllous, orange-yellow, with numerous peripheral paraphyses, variously bent and incurved, mostly capitate with narrow neck and linear-clavate pedicel; urediospores globoid or ellipsoid, 18–24 by 21–29 μ; wall nearly colorless, 1.5–2 μ thick, finely verrucose-echinulate, the pores about 8, scattered, often obscure. Telia hypophyllous, long covered by epidermis, with subepidermal paraphyses; teliospores oblong or clavate, 18–25 by 39–55 μ, obtuse or rounded above, somewhat narrowed below, slightly or not constricted at septum; wall chestnut-brown, 1.5 μ thick at sides, 3–6 μ above; pedicel tinted, short.


165

On Poaceae (tribe *Agrostideae*): **Alopecurus alpinus** L. (*A. occidentalis* Scribn.), Colo.—**A. aristulatus** Michx., Ind., Neb., Utah.—**Phleum alpinum** L., Colo.; (tribe *Aveneae*): **Trisetum spicatum** (L.)Richter(*T. subspicatum* Beauv.), Calif.; (tribe *Festuceae*): **Catabrosa aquatica** (L.)Beauv.(*Aira a.*), Ind., Utah, Wyo.—**Festuca elatior** L., Ore.—**Poa alpina** L., Colo., Mont., Wyo.—**P. ampla** Merr., Ore.—**P. annua** L., Calif., Del., N.Y., Ore.; Alta.—**P. arachnifera** Torr., Tenn.—**P. arida** Vasey(*P. pratericola* Rydb.), Neb.—**P. bigelovii** Vasey&Scribn., N.M.—

P. compressa L., Colo., N.D., Pa., Wash.—**P. crocata** Michx., Mont.; Alta.—**P. interior** Rydb., Colo., Ida.; Alta.—**P. longipedunculata** Scribn., Utah.—**P. lucida** Vasey, Wyo.—**P. macrantha** Vasey, Ore.—**P. nemoralis** L., Alta.—**P. palustris** L.(*P. serotina* Ehrh.), Colo., Ida., Mont., N.Y., Ore., W.Va., Wis.; Alta.—**P. pratensiformis** Rydb., Colo., Wyo.—**P. pratensis** L., 26 states recorded in N. Am. Flora, and Alas., Ill., Tenn., Wyo.; Alta., Man., Ont., Queb.—**P. reflexa** Vasey&Scribn., Ida., Utah.—**P. trivialis** L., Wash.—**P. vaseyochloa** Scribn., Wash.—**P. wheeleri** Vasey, Wyo.; (tribe *Phalarideae*): **Anthoxanthum odoratum** L., Me.; N.S. **Range:** Almost throughout the United States and Canada in the uredial form, the telia being rare; also in Mexico, Central and South America, Europe, Japan and New Zealand.

The characters of this species were first pointed out by Jørstad (*l. c.*), separating it from *Puccinia poarum*, which has no uredial paraphyses, or else very inconspicuous ones. Telia are sparingly produced. They have been found in Indiana, Wyoming and Saskatchewan, and also in Central and South America, all on species of *Poa*.

(1). **Puccinia poae-sudeticae airae** (Lagerh.) n. comb. (*Uredo a.*, *Puccinia a.* Cruch.&May., *P. deschampsiae* Arth.), differs from the typical form in having somewhat larger urediospores, 18–26 by 24–32 μ, and with paraphyses less bent and more nearly linear-clavate throughout; on POACEAE (tribe *Aveneae*): **Deschampsia caespitosa** (L.)Beauv.(*Aira c.*), Colo.; Alta. **Range:** Central Colorado and mountains of western Alberta; also in Europe.

Teliospores occur in collections from three localities in Colorado.

37. PUCCINIA MONTANENSIS. Fig. 166.

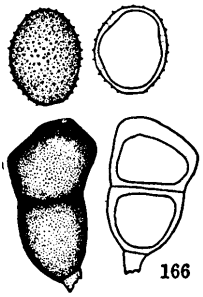
(N. A. F. 7: 330, 781, 836.)

Puccinia montanensis Ellis, Jour. Myc. **7**: 274. 1893.
Dicaeoma montanense Ktze., Rev. Gen. **3³**: 469. 1898.
(*Aecidium fendleri* Tr. & Earle, in Greene, Pl. Baker. **1**: 17. 1901.)

Pycnia chiefly epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores ellipsoid or globoid, 18–23 by 20–30 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

ON BERBERIDACEAE: **Berberis fendleri** Gray, Colo., N.M.

Uredia chiefly epiphyllous, elliptic, forming long lines, cinnamon-brown, with numerous clavate paraphyses; urediospores ellipsoid, 19–26 by 21–32 μ; wall pale cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 8–10, scattered. Telia chiefly hypophyllous, oblong or linear, often forming long lines, long covered by epidermis, with dark subepidermal paraphyses; teliospores irregularly oblong, 18–34 by 35–64 μ, truncate or angularly rounded above, narrowed below, slightly constricted at septum; wall cinnamon- or chestnut-brown, 1.5–2.5 μ thick at sides, 3–7 μ and darker above; pedicel colored, very short.



166

ON POACEAE (tribe *Festuceae*): **Melica imperfecta** Trin., Calif.; (tribe *Hordeae*): **Agropyron albicans** Scribn. &Sm., Alta.—**A. caninum** (L.)Beauv., Alta.—**A. dasystachyum** (Hook.)Scribn., Alta.—**A. palmeri** (Scribn.&Sm.)Rydb., Colo.—**A. pseudorepens** Scribn.&Sm., Colo.—**A. repens** (L.)Beauv., Sask.—**A. smithii**

Rydb.(*A. occidentale* Scribn.), Colo., Neb., N.D., S.D.; Alta., Man.—**A. tenerum** Vasey, Colo., Iowa, Kans., Mont., N.M., N.D., S.D., Utah; Alta.—**Elymus canadensis** L.(*E. robustus* Scribn.&Sm.), Colo., Ind., Iowa, Kans., Minn., Mo., Mont., Neb., N.M., N.D., S.D., Utah, Wis.; Alta., Man.—**E. curvatus** Piper, Man.—**E. glaucus** Buckl., Colo., Neb., Utah.—**E. macounii** Vasey, Colo.—**E. striatus** Willd., Iowa, Neb., N.D.—**E. virginicus** L., Colo., Ky., Neb., S.D., W.Va.—**Hordeum jubatum** L., Colo., Utah; Alta.—**Hystrix patula** Moench(*H. hystrix* Millsp.), Iowa.—**Sitanion hystrix** (Nutt.)J.G.Sm.(*S. elymoides* Raf.), Colo.

Range: Manitoba to British Columbia, southward to western West Virginia and southern California; also in western South America.

Successful cultures were conducted in 1919 with aeciospores sown on *Hordeum* and *Hystrix*, and in 1920 with teliospores from two species of *Agropyron*, all by Mains (Mycol. **13:** 316–318. 1921), who also reported similar aecial cultures by Bethel. The species has somewhat the habit of *Puccinia glumarum* in its tendency to produce lines of sori on golden-yellow or pale stripes.

38. PUCCINIA CORONATA. Fig. 167.

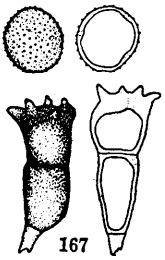
(N. A. F. 7: 313, 778, 835.)

(*Aecidium rhamni* Pers.; in J. F. Gmel., Syst. Nat. **2:** 1472. 1791.)
Puccinia coronata Cda., Ic. Fung. **1:** 6. 1837.
Puccinia lolii Niels., Ugeskr. Landm. **1875**[1]**:** 549. 1875.
Puccinia rhamni Wettst., Verh. Zool.-Bot. Ges. Wien **35:** 545. 1886.
Puccinia coronifera Kleb., Zeits. Pflanzenkr. **4:** 135. 1894.
Dicaeoma rhamni Ktze., Rev. Gen. **3**[3]**:** 470. 1898.
Puccinia beckmanniae McA., Rusts Austr. 116. 1906.

Pycnia epiphyllous, in groups. Aecia hypophyllous and caulicolous, grouped on more or less hypertrophied spots, cupulate; aeciospores globoid or broadly ellipsoid, 15–19 by 16–24 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Rhamnaceae: **Berchemia scandens** (Hill)Trel., Ala., La., Miss., S.C. —**Rhamnus alnifolia** L'Her., Ida., Ind., Iowa, Mich., Mont., N.Y., N.D., Vt., Wash., Wis.; Man., Ont., Sask.—**R. caroliniana** Walt., Ind.—**R. cathartica** L., Conn., Iowa, Mass., N.H., N.Y., N.D., S.D., Vt., Wis.; Ont., Sask.—**R. lanceolata** Pursh, Ind., Iowa, Mo., Neb.—**R. purshiana** DC., Ida., Mich., Mont., Ore., Wash.; B.C.—**R. smithii** Greene, Colo.; on Elaeagnaceae: **Elaeagnus commutata** Bernh.(*E. argentata* Pursh), Mont., N.D.; Alta., Sask.—**Shepherdia canadensis** (L.)Nutt.(*Lepargyraea c.* Greene), Alas., Colo., Ida., Mont., N.M., Ore., S.D., Utah, Wash., Wyo.; Alta., Sask., Yukon.

Uredia amphigenous, brownish-yellow, sometimes with few colorless paraphyses; urediospores globoid or broadly ellipsoid, 16–20 by 18–24 μ; wall pale-yellow, 1–1.5 μ thick, finely echinulate, the pores 6–8, scattered, indistinct. Telia amphigenous, long covered by the epidermis, occasionally with few subepidermal paraphyses; teliospores clavate-oblong, 13–19 by 30–67 μ, with 3–10 digitate projections above, narrowed below, slightly or not constricted at septum; wall chestnut-brown above, paler below, 1–1.5 μ thick at sides, 7–15 μ above, including projections; pedicel tinted, very short.


167

On Poaceae (tribe *Aveneae*): **Avena barbata** Brot., Calif.

—**A. fatua** L., Calif., Iowa, S.D.—**A. sativa** L., wherever oats are grown.—**Deschampsia caespitosa** (L.)Beauv.(*Aira c.*), Wyo.; Alta., Sask.—**Holcus lanatus** L.(*Notholcus l.* Nash), Calif., Conn., Mass., Miss., N.Y., N.C., Ore., Pa., Tenn., Va., Wash., W.Va.; B.C.—**Trisetum cernuum** (Kunth)Trin., Wash.; (tribe *Paniceae*): **Paspalum setaceum** Michx., Tenn.; (tribe *Phalarideae*): **Hierochloa odorata** (L.)Wahl.(*Torresia o.* Hitchc.), N.Y.; (tribe *Chlorideae*): **Beckmannia erucaeformis** (L.)Host, Colo., Iowa, S.D.; Alta., Sask.; (tribe *Agrostideae*): **Agrostis alba** L., Ore.—**A. diegoensis** Vasey, Ore.—**A. exarata** Trin., Calif., Ore., Wash.; B.C.—**A. longiligula** Hitchc., Calif., Ore.—**A. palustris** Huds., Ore.—**A. thurberiana** Hitchc., B.C.—**Alopecurus aristulatus** Michx., Ind.—**Ammophila arenaria** (L.)Link, Mass., N.H.—**Calamagrostis aleutica** Bong., Wash.—**C. canadensis** (Michx.)Beauv., Colo., Ida., Ind., Iowa, Mich., Minn., Mont., Neb., N.H., N.Y., Ore., Wash., Wis.; B.C., Man., N.S., Sask.—**C. elongata** (Kearney)Rydb., Sask.—**C. hyperborea** Lange, N.D., Ore.—**C. koelerioides** Vasey, Calif.—**C. montanensis** Scribn., Sask.—**C. neglecta** (Ehrh.)Gaertn., Calif.—**C. purpurascens** R.Br., Colo.—**C. rubescens** Buckl., Alta.—**C. scopulorum** Jones, Utah.—**Cinna arundinacea** L., Ind., Iowa, Md., Wis.—**C. latifolia** (Trev.)Griseb., Ida., Mont., Wash.—**Polypogon monspeliensis** (L.)Desf., Calif.; (tribe *Hordeae*): **Agropyron repens** (L.)Beauv., Vt.—**A. smithii** Rydb.(*A. occidentale* Scribn.), Sask.—**A. tenerum** Vasey, Sask.—**Elymus canadensis** L.(*E. robustus* Scribn.&Sm.), Sask.—**E. innovatus** Beal, S.D.; Alta.—**Lolium multiflorum** Lam., Calif., Ore., Wash.—**L. perenne** L., Ariz., Calif., Ore., Pa., S.C., Utah, Wash.; (tribe *Festuceae*): **Arundo donax** L., Calif.—**Bromus ciliatus** L., N.Y.; Sask.—**B. polyanthus** Scribn., Colo.—**B. porteri** (Coult.)Nash, Colo.—**B. pumpellianus** Scribn., Colo.; Alta.—**B. richardsonii** Link, Colo.—**Festuca elatior** L., Conn., Kans., Ky., Me., Mass., Mo., Neb., N.Y., Ore., Pa., Vt., Va., W.Va.—**Fluminia festucacea** (Willd.) Hitchc.(*Scolochloa f.* Link), N.D., S.D.; Man., Sask.—**Glyceria elata** Hitchc., Ore.—**G. grandis** Wats.(*Panicularia g.* Nash), N.D.—**G. nervata** (Willd.)Trin. (*P. n.* Ktze.), Ida.—**G. pauciflora** Presl.(*P. p.* Ktze.), Ore., Wash.—**Lamarckia aurea** (L.)Moench.(*Achyrodes a.* Ktze.), Calif.—**Melica purpurascens** (Torr.) Hitchc., Wis.—**Poa arachnifera** Torr., Ala.—**P. compressa** L., Kans., Mo., Pa.

Range: Nearly throughout the United States and southern Canada; also in Mexico, West Indies, South America, and in the more temperate parts of the Eastern Hemisphere.

The first successful culture was made in 1865 by de Bary (Monatsber. Preuss. Akad. Wiss. Berlin **1865:** 211. 1866), using detached leaves of *Rhamnus.* This was followed by Nielsen (in 1877), Cornu, Gad, Plowright, Klebahn and Ericksson, and their results are summarized by Klebahn in his Wirtswechselnde Rostpilze of 1904. Based upon the information thus obtained Klebahn divided the crown rust into two species: *P. coronata* (emend.) and *P. coronifera.* The two species were further divided into ten form-species, five for each.

Cultures in America were conducted in 1904, 1910 and 1916 by Arthur (Jour. Myc. **11:** 58. 1905; Mycol. **4:** 18. 1912; same **9:** 299. 1917), using aeciospores from *Rhamnus cathartica, R. caroliniana* and *R. lanceolata* sown on *Avena sativa,* teliospores from *Calamagrostis canadensis,* sown on *R. alnifolia,* and from *Agrostis* sp., sown on *R. purshiana.* Successful cultures also were made in 1916 by Jackson (Brooklyn Bot. Gard. Mem. **1:** 267. 1918), using teliospores from *Agrostis exarata,* sown on *R. purshiana.* Cultures were made in 1919 by Melhus, Dietz & Willey (Res. Bull. Iowa Exp. Sta. 72. 1922), with teliospores from *Festuca elatior* sown on *Rhamnus alnifolia, R. californica, R. cathartica, R. lanceolata,* with only pycnia formed on *R. frangula* and *R. purshiana.* Same experimenters secured positive infection in 1919, 1920 and 1921 with teliospores from *Avena sativa* and *Calamagrostis canadensis* on the same four species of *Rhamnus* and on *R. smithii,* and from the second

host on *R. crocea*, with partial results as in the previous instance, and also on *R. caroliniana*. Extensive cultures were made in 1919–1924 by Dietz (Jour. Agr. Res. **33**: 953–970. 1926), using teliospores from *Avena sativa, Calamagrostis canadensis* and *Festuca elatior* sown on 16 species of *Rhamnus* with similar results to those of Melhus, Dietz & Willey, and on *Berchemia scandens* and *Leparguraea canadensis*. Cultures were also made in 1924 by Fraser (Mycol. **17**: 82. 1925), using aeciospores from *Rhamnus alnifolia*, sown on *Calamagrostis canadensis* and *Scolochloa festucacea*, with weak infection on *Bromus* and *Avena*. In the same year aeciospores from *R. cathartica* were sown on *Avena sativa* and *A. fatua*, with weak infection on *Bromus, Festuca* and *Alopecurus*.

Reciprocal cultures were made by Bethel (see Fraser, Mycol. **17**: 79. 1925) in his garden using *Elaeagnus* and *Lepargyraea* and *Bromus, Agropyron* and *Trisetum*. In 1924 Fraser (Mycol. **17**: 79–81. 1925) conducted reciprocal cultures with *Elaeagnus commutata* and *Calamagrostis inexpansa*, and aslo used aeciospores from *Lepargyraea canadensis* on three species of *Bromus*, with weak infection on four other grass genera, but none on *Avena, Elymus* or *Scolochloa*.

For convenience of study the following form-species or races, largely based on the result of cultures with urediospores, may be recognized: *P. c. agropyri* Erikss., *P. c. agrostis* Erikss., *P. c. alopecuri* Erikss., *P. c. avenae* Erikss., *P. c. calamagrostis* Erikss., *P. c. festucae* Erikss., *P. c. glyceriae* Erikss., *P. c. holci* Kleb., *P. c. lolii* Erikss., and *P. c. phalaridis* Kleb. There are doubtless other races that could bear names to advantage.

More recent cultures than those reported above were made in 1925–7 by Fraser & Ledingham (Sci. Agric. **13**: 312–323. 1933), but not reported in detail. The cultures with some morphologic study led to the establishment of the four following varieties, occurring in the prairie provinces of Canada:

(1). *Puccinia coronata avenae* F. & L., apparently includes the race *P. c. avenae* Erikss., by using aeciospores from *Rhamnus cathartica*, infected *Avena fatua, Achyrodes aureum* and four cultivated species of *Avena*, but not other species of *Avena* or other genera; pycnia large, numerous, average diameter 124 μ.

(2). *Puccinia coronata calamagrostis* F. & L., probably includes the race *P. c. calamagrostis* Erikss., by using aeciospores from *Rhamnus alnifolia*, infected *Calamagrostis canadensis, C. elongata* and *Scolochloa festucacea;* pycnia small, average diameter 103 μ.

(3). *Puccinia coronata bromi* F. & L., by using aeciospores from *Shepherdia canadensis*, infected *Bromus ciliatus, B. latiglumis* and *B. pumpellianus;* pycnia few, small, average diameter 108 μ.

(4). *Puccinia coronata elaeagni* F. & L., by using aeciospores from *Elaeagnus commutata*, infected *Calamagrostis montanensis* (reported as *C. inexpansa*); pycnia rare or wanting.

Puccinia mesnieriana.

(N. A. F. 7: 541.)

Puccinia mesnieriana Thüm., Myc. Univ. *834*. 1877.
Puccinia digitata Ellis & Hark., Bull. Calif. Acad. **1**: 27. 1884.
Micropuccinia mesnieriana A. & J., Bull. Torrey Club **48**: 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, compact, brownish-black; teliospores as in *Puccinia coronata*, but somewhat thicker at sides, and pedicel generally longer.

On Rhamnaceae: **Rhamnus californica** Eschsch., Calif.—**R. crocea** Nutt., Calif.—**R. crocea illicifolia** (Kellogg)Greene, Calif. **Range**: Southern California; also in southern Europe and western Asia.

The correlation with *Puccinia coronata* was first pointed out by Dietel (Beitr. Morph. Biol. Ured.; inaug. diss. p. 25. 1887).

39. PUCCINIA FESTUCAE.

(N. A. F. 7: 315, 779.)

(*Aecidium periclymeni* Schum., Enum. Pl. Saell. **2**: 225. 1803.)
Uredo festucae DC., Fl. Fr. **6**: 82. 1815.
Puccinia festucae (DC.) Plowr., Gard. Chron. III. **8**: 42, 139. 1890.
Dicaeoma periclymeni A. & F., N. Am. Flora **7**: 315. 1920.

Pycnia amphigenous, in groups. Aecia hypophyllous, cupulate; aeciospores globoid or oblong, 17–23 by 19–29 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Caprifoliaceae: **Lonicera coerulea** L., N.B.—**L. prolifera** (Kirchner) Rehder (*L. sullivantii* Gray), Iowa.

Uredia hypophyllous, yellow; urediospores broadly ellipsoid, 19–23 by 20–26 μ; wall pale-yellow, 1–1.5 μ thick, finely echinulate, the pores 5–7, scattered, distinct. Telia hypophyllous, soon naked, chestnut-brown; teliospores narrowly oblong or cylindric, 13–19 by 45–58 μ, with 2–5 erect projections above, 10–25 μ long, narrowed below, slightly constricted at septum; wall chestnut-brown above, paler below, 1 μ thick at sides, much thicker above; pedicel pale chestnut-brown, short.

On Poaceae (tribe *Festuceae*): **Festuca ovina** L., and similar species in Europe, not yet found in America.

Range: Island of Grand Manan, New Brunswick, and one locality in northeastern Iowa; also in Europe and Japan.

The aecial and telial connection was demonstrated in 1890 by Plowright (Gard. Chron. III. **8:** 42. 1890), with reciprocal cultures, and later confirmed by Klebahn (1893 and 1894) and Ed. Fischer (1893). The species is very closely related to *P. coronata,* and could be treated as a variety of that species. As the presence of the species in America is based upon scanty aecial collections from two widely separated localities, some doubt may reasonably be entertained as to the assignment of the American material.

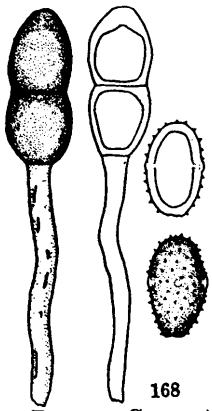
40. PUCCINIA PHRAGMITIS. Fig. 168.

(N. A. F. 7: 322, 780.)

(*Aecidium rubellum* Pers., in Gmel., Syst. Nat. **2:** 1473. 1791.)
Uredo phragmitis Schum., Enum. Pl. Saell. **2:** 231. 1803.
Puccinia arundinacea Hedw. f.; Poir., in Lam. Encyc. **8:** 250. 1808.
Puccinia phragmitis (Schum.) Körn., Hedw. **15:** 179. 1876.
Puccinia trailii Plowr., Brit. Ured. 176. 1889.
Dicaeoma rubellum A. & F., N. Am. Flora **7:** 322. 1920.

Pycnia amphigenous, in groups. Aecia hypophyllous, surrounding the pycnia, cupulate, colorless; aeciospores globoid or oblong, 15–19 by 18–23 μ; wall colorless, 2–4 μ thick, finely verrucose.

On Polygonaceae: **Rheum rhaponticum** L., Neb.—**Rumex altissimus** Wood, Neb.—**R. britannica** L. (*R. orbiculatus* Gray), Neb.—**R. mexicanus** Meisn. (*R. salicifolius* Hook., not Weinm.), N.D.; Man.—**R. venosus** Pursh, Neb., Okla.


168

Uredia amphigenous, cinnamon-brown; urediospores oblong-ellipsoid or obovoid, 18–21 by 29–34 μ; wall cinnamon-brown, 3–4 μ thick, prominently echinulate, the pores 4, equatorial. Telia amphigenous, chocolate-brown; teliospores oblong, 16–21 by 45–64 μ, rounded or narrowed at each end, somewhat constricted at septum; wall cinnamon-brown 2–3 μ thick at sides, 4–7 μ and paler above; pedicel tinted, two to four times length of spore.

On Poaceae (tribe *Festuceae*): **Phragmites communis** Trin. (*P. phragmites* Karst.), Colo., Conn., Del., Ill., Iowa, Kans., Mich., Minn., Neb., N.Y., N.D., Ohio, Wis.; Man.

Range: Connecticut to Manitoba, southward to Delaware and Oklahoma; also in South America, Europe, Africa and Japan.

The first successful cultures were made in 1875 by Winter (Hedw. **14:** 114. 1875), sowing teliospores on *Rumex.* Further cultures were made by Winter, Stahl, Schroeter,

Rostrup, Plowright, Klebahn and Fischer (Klebahn, Wirtsw. Rostp. 283–285. 1904). Cultures with American material were made in 1907, 1909 and 1911 by Arthur (Jour. Myc. **14:** 15. 1908; Mycol. **2:** 225. 1910; same **4:** 54. 1912), by sowing teliospores on *Rumex crispus*, and in 1918 by Fraser (Mycol. **11:** 130. 1919), by sowing teliospores on *Rumex occidentalis*.

Puccinia ornata

(N. A. F. 7: 525, 802.)

Puccinia ornata A. & H.; Arth., Bull. Geol. Nat. Hist. Surv. Minn. **3:** 30. 1887.
Micropuccinia ornata A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia more pulvinate than in *Puccinia phragmitis*, and becoming cinereous by germination, otherwise the same, as also the teliospores, the latter 16–24 by 35–48 μ.

On Polygonaceae: **Rumex britannica** L.(*R. orbiculatus* Gray), Me., Minn., N.H., N.Y., Wis.; Sask.—**R.** sp., Alta., Man. **Range:** Near the international boundary from Maine to Alberta; also in northern and eastern part of European Russia.

The correlation of this species with the preceding species was noted by Dietel (E. & P., Nat. Pfl. **1**1**: 69. 1897).

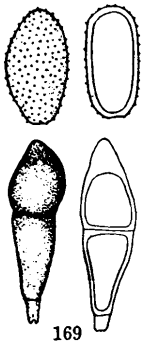
41. PUCCINIA MAGNUSIANA. Fig. 169.

(N. A. F. 7: 323.)

Puccinia magnusiana Körn., Hedw. **15:** 179. 1876.
Dicaeoma magnusianum Ktze., Rev. Gen. **3**3**:** 469. 1898.
Puccinia simillima Arth., Bot. Gaz. **34:** 17. 1902.

Pycnia epiphyllous, in groups. Aecia hypophyllous and caulicolous, cupulate, at first bright-orange; aeciospores globoid, 21–23 by 23–26 μ; wall light-yellow, 1–1.5 μ thick, finely verrucose.

On Ranunculaceae: **Anemone canadensis** L.(*A. pennsylvanica* L.), Iowa, Kans., Neb., N.Y., N.D., S.D., Wis.; Sask.



169

Uredia amphigenous, light-yellow, with large cinnamon-brown paraphyses; urediospores oblong-clavate, 18–19 by 26–42 μ; wall light-yellow, 1.5–2 μ thick, finely echinulate, the pores 6–8, scattered, indistinct. Telia amphigenous, blackish-brown, without subepidermal paraphyses; teliospores oblong or cylindric, 15–20 by 32–55 μ, narrowed at both ends, slightly constricted at septum; wall dark cinnamon- or chestnut-brown, lighter below, 1–1.5 μ thick at sides, 4–16 μ above; pedicel colorless, rarely as long as spore.

On Poaceae (tribe *Festuceae*): **Phragmites communis** Trin.(*P. phragmites* Karst.), Iowa, Neb., N.Y., N.D., S.D., Wis.; Man.

Range: Western New York to Saskatchewan, southward to Nebraska; also in Europe, Africa and Japan.

The first cultures were made in 1882 by Cornu, and afterward by Plowright, Ed. Fischer and Klebahn (Klebahn, Wirtsw. Rostp. 285–286. 1904), producing aecia on *Ranunculus repens* and *R. bulbosus*. Cultures with American material were made in 1902 and 1907 by Arthur (Bot. Gaz. **35:** 20. 1903; Jour. Myc. **14:** 15. 1908), using teliospores sown on *Anemone canadensis*. Sowings at the same time on *A. cylindrica*, *A. virginiana* and *Ranunculus septentrionalis* gave negative results. The aeciospores are morphologically identical with those of *Uromyces dactylidis*, but otherwise the two species appear to be distinct.

Puccinia anemones-virginianae.

(N. A. F. 7: 528, 846.)

Puccinia anemones-virginianae Schw., Schr. Nat. Ges. Leipzig **1:** 72. 1822.
Micropuccinia anemones-virginianae A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, compact, blackish-brown, often cinereous from germination; teliospores as in *Puccinia magnusiana*, but somewhat more slender, with lower cell longer and upper cell 5–10 μ thick above, and pedicel slightly colored.

On Ranunculaceae: **Anemone canadensis** L.(*A. pennsylvanica* L.), Mich., N.Y.; Man., Sask.—**A. cylindrica** Gray, Conn., Iowa, Mich., Minn., Neb., N.Y., N.D., S.D., Wis.—**A. riparia** Fern., Me., Vt.—**A. virginiana** L., Conn., Del., Ind., Iowa, Kans., Minn., Mo., N.J., N.Y., N.C., N.D., Ohio, Pa., Tenn., Vt., Va., Wis.; Ont., Queb. **Range:** Maine to Saskatchewan, southward to North Carolina and Kansas.

The correlation of this species with *Puccinia magnusiana* was reported by Travelbee (Proc. Ind. Acad. Sci. **1914:** 233. 1915).

42. PUCCINIA LUXURIOSA. Fig. 170.

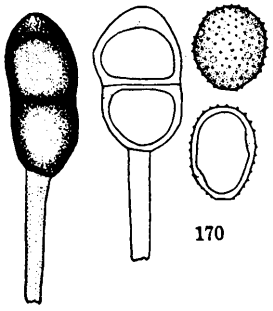
(N. A. F. 7: 305.)

Puccinia tosta luxurians Arth., Bull. Torrey Club **29:** 229. 1902. Not *P. luxurians* Diet. & Neg., 1897.
Puccinia luxuriosa Syd., Monog. Ured. **1:** 812. 1904.
Dicaeoma luxuriosum A. & F., N. Am. Flora **7:** 305. 1920.

Pycnia amphigenous, in groups. Aecia amphigenous, short-cylindric; aeciospores broadly ellipsoid or oblong, 18–23 by 22–32 μ; wall colorless, 1–2 μ thick, rarely more, finely verrucose.

On Chenopodiaceae: **Sarcobatus vermiculatus** (Hook.)Torr., Colo., Nev., N.M.

Uredia chiefly epiphyllous, cinnamon-brown; urediospores ellipsoid or oblong, 19–24 by 26–32 μ; wall pale cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 6–8, scattered. Telia chiefly epiphyllous, blackish-brown; teliospores broadly ellipsoid or oblong, 18–28 by 40–61 μ, rounded or narrowed at each end, somewhat constricted at septum; wall dark chestnut-brown, 1.5–2 μ thick at sides, 5–12 μ above; pedicel tinted, once to twice length of spore.



170

On Poaceae (tribe *Agrostideae*): **Sporobolus airoides** Torr., Ariz., Calif., Colo., Ida., Mont., Neb., Nev., N.M., Okla., Ore.

Range: Alkaline soil in mountainous regions from Montana to Oregon, southward to Oklahoma, New Mexico and Nevada.

Cultures were made in 1916 by Bethel (Phytop. **7:** 93. 1917), using both aeciospores and teliospores. The species is similar to *Puccinia aristidae*, but is morphologically distinct.

43. PUCCINIA ARISTIDAE. Fig. 171.

(N. A. F. 7: 305, 777, 834.)

(*Aecidium biforme* Peck; Parry, Amer. Nat. **9:** 351. 1875.)
(*Aecidium sarcobati* Peck, Bot. Gaz. **6:** 240. 1881.)

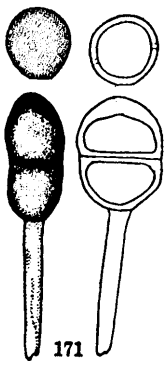
Puccinia buchloës Schof. (an error); Webber, Ann. Rep. Neb. Board Agric. **1889:** 68. 1890.
Puccinia aristidae Tracy, Jour. Myc. **7:** 281. 1893.
Puccinia subnitens Diet., Erythea **3:** 81. 1895.
Dicaeoma sarcobati Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, cylindric; aeciospores globoid, 13–21 by 15–23 μ; wall colorless, 1–3 μ thick, or less on fleshy-leaved hosts, finely verrucose.

On Scheuchzeriaceae: **Triglochin maritima** L., Calif., Colo., Nev.; Alta. —**T. striata** R.&P., Nev.; on Polygonaceae: **Eriogonum trichopodum** Torr., Ariz.—**Polygonum aviculare** L., Colo., Del., Neb., N.D.—**P. erectum** L., Colo. —**Rumex hymenosepalus** Torr., Ariz.; on Chenopodiaceae: **Atriplex hastata** L., Del., Me., N.Y.—**A. rosea** L., Colo., N.M., Nev., Utah.—**A. wolfii** Wats., Colo.—**Beta vulgaris** L., Colo., Utah.—**Blitum capitatum** L., Colo.—**Chenopodium album** L., Ariz., Colo., Mont., Neb., N.M., N.D.; Alta.—**C. fremontii** Wats., N. M.—**C. hybridum** L., Colo., Neb.—**C. incanum** (Wats.)Heller, Ariz.— **C. leptophyllum** Nutt., Ariz., Neb.—**C. murale** L., Ariz., Utah.—**C. pratericola** Rydb., Colo., Neb., N.M., Utah.—**C. rubrum** L., Ariz., Colo., N.M.—**C. salinum** Standl., Colo., Mont.—**Kochia scoparia** (L.)Schrad., Colo., Neb.—**Monolepis nuttalliana** (Schult.)Engelm., Colo., Mont., Nev., N.D.—**Nitrophila occidentalis** (Nutt.)Wats., Nev.—**Salsola pestifer** Nels., Ariz., Colo., Neb., N.M.— **Sarcobatus vermiculatus** (Hook.)Torr., Calif., Ida., Mont., Neb., Nev., Ore., Utah, Wash., Wyo.—**Spinacea oleracea** L., Ariz., Wash.; Alta.—**Suaeda depressa** (Pursh)Wats.(*Dondia d. Britt.*), Colo.—**S. torreyana** Wats.(*Dondia t.* Wats.), Calif.—**Suckleya suckleyana** (Torr.)Rydb., Colo.; on Amaranthaceae: **Amaranthus** sp., Colo.; on Allioniaceae: **Abronia fragrans** Nutt., Colo.—**A. umbellata** Lam., Calif.—**Allionia comata** Small, Ariz., N.M.— **Quamoclidion multiflorum** Torr., Ariz.—**Tripterocalyx micranthus** (Torr.) Hook.(*Abronia m.*), Colo.; on Tetragoniaceae: **Sesuvium verrucosum** Raf. (not *S. sessile* Pers.), Tex.; on Caryophyllaceae: **Saponaria vaccaria** L. (*Vaccaria vulgaris* Host), Colo.—**Silene antirrhina** L., Ariz.—**Spergularia macrotheca** (Hornem.)Heynh.(*Tissa m.* Britt.), Calif.—**Stellaria media** L. (*Alsine m.* Cyrill), Colo.; on Fumariaceae: **Corydalis micrantha** (Engelm.) Gray(*Capnoides m.* Britt.), Neb.—**C. montana** Engelm.(*C. m.* Britt.), Kans., Neb.; on Brassicaceae (*Cruciferae*): **Brassica juncea** (L.)Cosson, Colo.— **Capsella bursa-pastoris** (L.)Medic.(*Bursa b.* Britt.), Colo., Neb., Nev.— **Camelina microcarpa** Andrz., Colo., Utah.—**Cheirinia aspera** (Nutt.)Rydb. (*Erysimum a.* DC.), N.D.—**C. repanda** (L.)Link(*E. r.*), Utah.—**Draba cuneifolia** Nutt., Ariz.—**D. lutea** Gilib., Alta.—**Hutchinsia procumbens** (L.)Dev., Utah.—**Lepidium alyssoides** Gray, Colo.—**L. densiflorum** Schrad.(*L. apetalum* Gray), Colo., Mont., Neb., N.D., Utah.—**L. lasiocarpum** Nutt., Ariz.—**L. montanum** Nutt., Utah.—**L. perfoliatum** L., Nev., Utah.—**L. ramosum** Nels., Utah. —**L. simile** Heller, Utah.—**Lesquerella gordoni** (Gray)Wats., Ariz.—**Radicula nasturtium-aquaticum** (L.)Britt.&Rendle(*Sisymbrium n.*), Ariz.—**R. sinuata** (Nutt.)Greene, Colo., Neb.—**Raphanus sativus** L., Ariz.—**Sisymbrium altissimum** L.(*Nota a.* Britt.), Colo.—**Sophia andrenarum** Cockerell, N.M.—**S. incisa** (Engelm.)Greene(*Sisymbrium i.*), Colo.—**S. intermedia** Rydb., Colo., Neb., Utah.—**Stanleya pinnata** (Pursh)Britt., Colo.—**Thelypodium laciniatum** Endl.,

Calif.—**T. sagittatum** (Nutt.)Endl., Nev.; on CAPPARIDACEAE: **Cleome lutea** Hook.(*Peritoma l.* Raf.), Ariz.—**C. serrulata** Pursh(*P. s.* DC.), Ariz., Colo., Mont., Neb., N.M.—**C. sonorae** Gray(*P. s.* Rydb.), Colo.—**Cleomella monstrosae** Payson, Colo.—**C. parviflora** Gray, Nev.—**Isomeris arborea** Nutt., Calif.; on TROPAEOLACEAE: **Tropaeolum majus** L., Utah; on LOASACEAE: **Mentzelia albicaulis** Dougl.(*Acrolasia a.* Rydb.), Nev.—**M. congesta** Nutt. (*A. c.* Rydb.), Nev.—**M. pumila** Nutt.(*Nuttallia p.* Greene), Colo.—**M. rusbyi** Woot.(*N. r.* Rydb.), Colo.; on ONAGRACEAE: **Chylismia scapoidea** Nutt.(*Oenothera s.* Nutt.), Nev.—**Sphaerostigma chamaenerioides** (Gray)Small, Ariz.; on PRIMULACEAE: **Glaux maritima** L., Sask.; on GENTIANACEAE: **Centaurium calycosum** (Buckl.)Fern., N.M.; on POLEMONIACEAE: **Gilia inconspicua** (J.E. Sm.)Dougl., Ariz., Colo.—**G. leptomeria** Gray, Colo.—**G. longiflora** (Torr.)G. Don, Colo.—**Linanthus bigelovii** (Gray)Greene(*Gilia b.*), Ariz.; on HYDROPHYLLACEAE: **Phacelia crenulata** Torr., Ariz.; on BORAGINACEAE: **Amsinckia menziesii** (Lehm.)Nels.&Macbr.(*A. intermedia* Gray), Nev.—**Cryptantha barbigera** (Gray)Greene, Ariz.—**C. pterocarya** (Torr.)Greene, Ariz.—**Heliotropium xeraphilum** Cockerell(*H. spathulatum* Rydb.), Ariz., Calif., N.M., Tex., Utah.—**Lappula coerulescens** Rydb., Utah.—**L. heterosperma** Greene, Ariz.—**L. occidentalis** (Wats.)Greene, Ariz., Colo.—**Pectocarya linearis** (R.&P.) DC., Ariz.; on VERBENACEAE: **Verbena ciliata** Benth., Ariz.; on SOLANACEAE: **Chamaesaracha coronopus** (Dunal)Gray, N.M.—**Datura meteloides** DC., Ariz. —**Nicotiana trigonophylla** Dunal, Ariz.—**Petunia parviflora** Juss., Ariz.—**Physalis lobata** Torr.(*Quincula l.* Raf.), Colo.; on PLANTAGINACEAE: **Plantago eriopoda** Torr., Sask.; on LOBELIACEAE: **Nemocladus ramosissimus** Nutt., Ariz.

Uredia epiphyllous, dark cinnamon-brown; urediospores globoid or broadly ellipsoid, 18–24 by 19–30 μ; wall light cinnamon-brown, 2–3 μ thick, finely verrucose, the pores 4–6, approximately equatorial. Telia chiefly epiphyllous, dark chocolate-brown; teliospores broadly ellipsoid or obovoid-oblong, 18–28 by 27–45 μ, rounded or narrowed both above and below, somewhat constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 6–12 μ above; pedicel colorless except next to spore, about twice length of spore. Mesospores common.


171

ON POACEAE (tribe *Agrostideae*): **Aristida adscensionis** L.(*A. bromoides* H.B.K.), Calif., N.M.; (tribe *Festuceae*): **Distichlis spicata** (L.)Greene(*D. maritima* Raf.), Ariz., Calif., Colo., Del., Ida., Kans., Me., Mont., Neb., Nev., N.M., N.C., Okla., Ore., S.D., Tex., Utah, Wash., Wyo.; Alta., Sask. —**Scleropogon brevifolius** Phil., N.M.; (tribe *Zoysieae*): **Hilaria jamesii** (Torr.)Benth.(*Pleuraphis j.*), Ariz., N.M.—**H. mutica** (Buckl.)Benth.(*P. m.*), N.M.—**H. rigida** (Thurb.)Benth.(*P. r.*), Nev.

Range: Abundant on alkaline soil from North Dakota to Alberta, southward to Oklahoma and Arizona, and sparingly on the Atlantic coast from Maine to Delaware and on the Pacific coast from Washington to southern California; also in Mexico, South America, Asia and Africa.

One name antedates the one chosen for this species, that of *P. buchloës*, which was founded on an error in the determination of the host. For this reason and because it is little known it is consigned to synonymy.

Probably no other species possesses such a great number of distantly related aecial hosts, 24 families already being known, and about a hundred host-species. The discovery of these is to be credited in large part to Ellsworth Bethel, who also made many cultures in his garden (Phytop. **7:** 92–94. 1917). Successful cultures were made in 1902 by Arthur (Bot. Gaz. **35:** 19. 1903), using teliospores from *Distichlis spicata* from Nebraska sown on *Chenopodium album,* and in 1904 by Tranzschel (Beitr. Biol. Ured. I. 11–13. 1905), using teliospores from *Aristida pennata,* obtained in central Asia, sown on *Heliotropium europaeum,* and again in the same year by Arthur (Mycol. **1:** 234–236. 1908), using teliospores from *Distichlis spicata,* collected in Delaware, Nebraska and Nevada, and producing aecia on *Chenopodium album, Atriplex hastata* and *Sarcobatus vermiculatus,* in which indications of geographic differences were found. Cultures were also made in 1920 and 1921 by Fraser (Mycol. **14:** 229. 1922), using teliospores from *Distichlis* sown on *Glaux maritima,* and again in 1921 on *Plantago eriopoda,* and both results later confirmed (Mycol. **17:** 83. 1925). The species should receive extended study.

Uromyces peckianus.

(N. A. F. 7: 225, 230, 746, 751, 827.)

Uromyces peckianus Farl., Proc. Amer. Acad. **18:** 78. 1883.
(*Aecidium plantaginis* Burr., Bull. Ill. Lab. Nat. Hist. **2:** 232. 1885. Not Ces. 1858.)
(*Aecidium oldenlandianum* Ellis & Tr., Jour. Myc. **7:** 43. 1891.)
Nigredo peckiana Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Uromyces seditiosus Kern, Torreya **11:** 212. 1911.
Nigredo seditiosa Arth., N. Am. Flora **7:** 225. 1912.

Pycnia and aecia as in *Puccinia aristidae.*

On Chenopodiaceae: **Atriplex patula** L., N.S.—**Chenopodium album** L., N.S.—**Salicornia herbacea** L., N.S.—**S. pacifica** Standl.(*S. ambigua* Michx.), Calif., Wash.; B.C.—**Suaeda maritima** (L.)Dumort(*Dondia m.* Druce), N.S.; on Plantaginaceae: **Plantago aristata** Michx., Ind., Mo., Neb., Tex., Wis.—**P. eriopoda** Torr., Mont., Neb., N.D., Wash., Wyo.; Alta.—**P. heterophylla** Nutt., Okla.—**P. purshii** R.&S., Neb., Okla., Tex.—**P. rhodosperma** Dec., Tex.—**P. rugelii** Dec., Mo.—**P. tweedyi** Gray, Mont., Wyo.—**P. virginica** L., Ala., Ill., Miss., Mo., Okla., S.C., Tex.; on Rubiaceae: **Houstonia minima** Beck, Tex.—**H. minor** (Michx.)Britt.(*H. patens* Ell.), Ala., Tex.—**H. purpurea** L., Miss.

Uredia and telia as in *Puccinia aristidae,* except the teliospores are one-celled, 15–21 by 23–39 μ, occasionally a few with two cells.

On Poaceae (tribe *Agrostideae*): **Aristida basiramea** Engelm., Kans., Neb., Okla., Tex.—**A. curtissii** (Gray)Nash, Okla.—**A. desmantha** Trin.&Rupr., Okla.—**A. dichotoma** Michx., Ala., Ark., Kans., Ky., Tex.—**A. longispica** Poir.(*A. gracilis* Ell.), Ark., Ind., N.J.—**A. longiseta** Steud., Colo.—**A. micrantha** (Vasey)Nash, Tex.—**A. oligantha** Michx., Kans., Ill., La., Mo., Neb., Okla., Tenn., Tex.—**A. purpurascens** Poir., Ala., Ky., N.J., Tex., Va.—**A. purpurea** Nutt., Mo., Neb.—**A. ramosissima** Engelm., Ind.—**A. tuberculosa** Nutt., N.Y., Wis.; (tribe *Festuceae*): **Distichlis spicata** (L.)Greene(*D. maritima* Raf.), Calif., Conn., Fla., Mass., N.J., N.Y., Wash.; B.C., N.S.

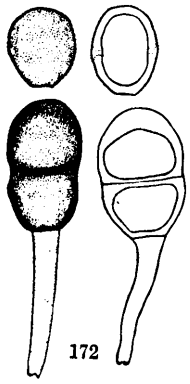
Range: On the plains from Montana to Alberta, southeastward to Alabama and Texas, on the Atlantic coast from Nova Scotia to Florida and on the Pacific coast from British Columbia to southern California, mostly in alkaline or arid soil.

Successful cultures were made in 1902 and 1917 by Arthur (Bot. Gaz. **35:** 17. 1903; Mycol. **9:** 307. 1917), by using teliospores from *Aristida basiramea* and *A. oligantha* sown on *Plantago aristata, P. lanceolata* and *P. rugelii*; also in 1910 by

Fraser (Mycol. **3**: 72–74. 1911; same **4**: 179. 1912.), sowing teliospores from *Distichlis spicata* on *Atriplex patula* and *Chenopodium album*, and essentially like cultures in 1911 by Arthur (Mycol. **4**: 55. 1912). Correlation between the one- and two-celled species on *Distichlis* was pointed out by Orton (Mycol. **4**: 198. 1912). Evidences of strongly marked racial characters have been obtained, partly geographic and partly dependent on hosts, but a general statement awaits further study.

44. PUCCINIA REDFIELDIAE. Fig. 172.

(N. A. F. 7: 324.)


172

Puccinia redfieldiae Tracy, Jour. Myc. **7**: 281. 1893.
Dicaeoma redfieldiae Ktze., Rev. Gen. **3**[3]: 470. 1898.

Pycnia and aecia unknown. Uredia amphigenous, oblong or linear, cinnamon-brown; urediospores ellipsoid, 18–24 by 24–29 μ; wall cinnamon-brown, 2.5–3.5 μ thick, finely verrucose, the pores 4, equatorial. Telia amphigenous, oblong or linear, compact, chocolate-brown; teliospores ellipsoid, 21–26 by 33–48 μ, rounded at both ends or obtuse above, sightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 5–8 μ above; pedicel nearly or quite colorless, once or twice length of spore.

On Poaceae (tribe *Festuceae*): **Redfieldia flexuosa** (Thurb.) Vasey, Kans., Neb., N.D. **Range**: Western sandhill region from North Dakota to Kansas.

45. PUCCINIA WINDSORIAE. Fig. 173.

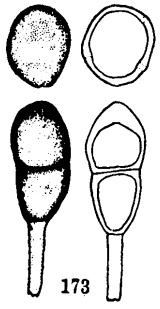
(N. A. F. 7: 323, 780, 835.)

Puccinia windsoriae Schw., Trans. Amer. Phil. Soc. II. **4**: 295. 1832.
(*Aecidium pteleae* B. & C.; Berk., Grev. **3**: 60. 1874.)
Dicaeoma windsoriae Ktze., Rev. Gen. **3**[3]: 471. 1898.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous and caulicolous, in groups, cupulate; aeciospores globoid or ellipsoid, 15–18 by 16–23 μ; wall nearly colorless, 1–1.5 μ thick, finely verrucose.

On Rutaceae: **Ptelea trifoliata** L., Ala., Ill., Ind., Kans., Ky., Md., Mo., N.Y., Ohio, Va.

Uredia amphigenous, linear, cinnamon-brown; urediospores globoid or obovoid, 23–26 by 29–31 μ; wall cinnamon-brown, 1.5–2 μ thick, finely verrucose, the pores 5 or 6, scattered. Telia chiefly hypophyllous and caulicolous, oblong, dark chocolate-brown; teliospores ellipsoid or oblong, 15–20 by 29–37 μ, rounded at each end or tapering below, slightly constricted at septum; wall chestnut-brown, 2–2.5 μ thick at sides, 4–7 μ above; pedicel golden-brown, once to twice length of spore.


173

On Poaceae (tribe *Festuceae*): **Triodia flava** (L.)Hitchc. (*Windsoria poaeformis* Nutt., *Sieglingia seslerioides* Scribn., *Tridens f.* Hitchc.), Ala., Ark., Del., Ill., Ind., Kans., Ky., La., Md., Mo., Miss., N.J., Ohio, Okla., Pa., S.C., Tenn., Tex., Va., W.Va.; Ont.

Range: Southeastern New York to southern Ontario and eastern Kansas, southward to Alabama and Texas.

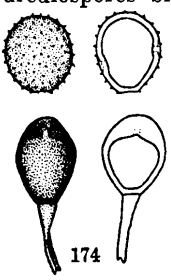
Cultures were made in 1899, using aeciospores, and in 1902, 1904 and 1915, using teliospores, all by Arthur (Bot. Gaz. **29:** 273. 1900; same **35:** 16. 1903; Jour. Myc. **11:** 56. 1905; Mycol. **8:** 135. 1916). The cultures were repeated with teliospores by Kellerman (Jour. Myc. **9:** 10. 1903) in 1902, and by Mains (Mycol. **25:** 414. 1933) in 1921.

46. UROMYCES ERAGROSTIDIS. Fig. 174.

(N. A. F. 7: 227, 748, 827.)

Uromyces eragrostidis Tracy, Jour. Myc. **7:** 281. 1893.
Nigredo eragrostidis Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia and aecia unknown. Uredia amphigenous, light cinnamon-brown; urediospores broadly ellipsoid, 15–19 by 20–26 μ; wall pale cinnamon-brown, 1–1.5 μ thick, finely echinulate, the pores 4–6, scattered, indistinct. Telia chiefly epiphyllous, dark cinnamon-brown; teliospores obovoid or globoid, 16–23 by 19–27 μ; wall dark chestnut-brown, 1.5–2.5 μ thick at sides, 5–7 μ above; pedicel colored, about as long as spore.


174

On Poaceae (tribe *Festuceae*): **Eragrostis capillaris** (L.)Nees, Tex.—**E. lugens** Nees, Ariz.—**E. pectinacea** (Michx.)Steud., Ala., Del., Miss., Neb., N.J., Okla., Tex. **Range:** Nebraska, southward to southern Alabama and Arizona, and in New Jersey and Delaware; also in West Indies, Mexico, Central and South America.

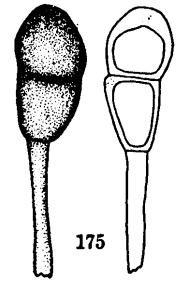
47. PUCCINIA CRANDALLII. Fig. 175.

(N. A. F. 7: 328, 780, 815, 836.)

(*Aecidium abundans* Peck, Bot. Gaz. **3:** 34. 1878.)
Puccinia crandallii Pam. & Hume; Hume, Proc. Davenport Acad. **7:** 250. 1899.
Dicaeoma abundans A. & F., N. Am. Flora **7:** 328. 1920.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in crowded groups, cylindric; aeciospores globoid or ellipsoid, 18–26 by 21–33 μ; wall colorless, 1.5–2 μ thick, finely verrucose.

On Caprifoliaceae: **Symphoricarpos albus** (L.) Blake(*S. racemosus* Michx.), Calif., Colo., Ida., Mont., Neb., Ore., S.D., Wash., Wyo.; B.C.—**S. mollis** Nutt., Calif.—**S. occidentalis** Hook., Colo., Mont., N.D., Wyo.; Sask.—**S. orbiculatus** Moench(*S. vulgaris* Michx., *S. symphoricarpos* MacM.), Kans., Mo., Okla.—**S. oreophilus** Gray, Calif., Colo., Ida., Mont., Nev., Utah, Wyo.—**S. vaccinioides** Rydb., Mont., Utah, Wyo.


175

Uredia hypophyllous, light chestnut-brown; urediospores ellipsoid or obovoid, 23–27 by 29–35 μ; wall light-yellow, 2–2.5 μ thick, finely echinulate, the pores 6–8, scattered. Telia hypophyllous, oblong, dark-brown; teliospores ellipsoid, 15–24 by 35–50 μ, rounded or obtuse at both ends or truncate above, somewhat constricted at septum; wall cinnamon-brown, 1.5–2.5 μ thick at sides, 5–12 μ and darker above; pedicel pale cinnamon-brown, once to once and a half length of spore.

On Poaceae (tribe *Festuceae*): **Festuca confinis** Va-

sey(*Poa kingii* Wats.), Calif., Colo., Mont., Utah, Wyo.—**F. elmeri** Scribn.& Merr., Calif.—**F. ingrata** (Hack.) Rydb., Colo., Mont., Ore., Wyo.—**F. occidentalis** Hook., Colo.—**F. ovina** L., N.D.—**F. rubra** L., Ore., Wyo.—**F. saximontana** Rydb., Sask.—**F. subulata** Trin., Ore., Wash.—**Poa brevipaniculata** Scribn.&Will., Colo.—**Poa longiligula** Scribn.&Will., Colo.

Range: North Dakota to British Columbia, southward to Oklahoma and central California.

Cultures with teliospores from *Festuca confinis* were made in 1910 by Arthur (Mycol. **4:** 27. 1912), resulting in aecia on *Symphoricarpos albus.*

Puccinia symphoricarpi.

(N. A. F. 7: 570, 847.)

Puccinia symphoricarpi Hark., Bull. Calif. Acad. **1:** 35. 1884.
Micropuccinia symphoricarpi A. & J., N. Am. Flora **7:** 570. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, in densely packed groups, long covered by the gray epidermis, otherwise as in *Puccinia crandallii.*

On Caprifoliaceae: **Symphoricarpos albus** (L.)Blake(*S. racemosus* Michx.), Alas., Calif., Mont., Ore., Wash.; B.C.—**S. mollis** Nutt., Calif. **Range:** Southeastern Alaska southward to western Montana and central California.

The correlation of this species with the preceding was pointed out in 1914 by Travelbee (Proc. Indiana Acad. Sci. **1914:** 233. 1915).

48. PUCCINIA COCKERELLIANA. Fig. 176.

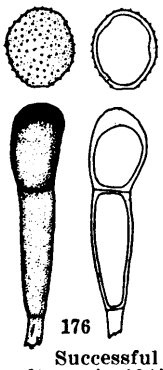
(N. A. F. 7: 329.)

Puccinia cockerelliana Bethel; Arth., Bull. Torrey Club **46:** 113. 1919.
Dicaeoma cockerellianum A. & F., N. Am. Flora **7:** 329. 1920.

Pycnia amphigenous, in groups. Aecia hypophyllous or caulicolous, with evanescent peridium; aeciospores globoid or ellipsoid, 18–24 by 20–29 μ; wall nearly or quite colorless, 1.5–2.5 μ thick, finely verrucose.

On Ranunculaceae: **Thalictrum fendleri** Engelm., Colo.

Uredia epiphyllous, cinnamon-brown; urediospores ellipsoid, 19–26 by 24–32 μ; wall nearly or quite colorless, 1.5–2 μ thick, finely echinulate, the pores obscure, probably scattered. Telia epiphyllous, long covered by epidermis, without subepidermal paraphyses; teliospores cylindric or clavate-cylindric, 13–21 by 50–85 μ, rounded or truncate above, narrowed below, lower cell much longer than upper, slightly or not constricted at septum; wall chestnut-brown above, paler below, about 1 μ thick at sides, 5–7 μ above; pedicel short, tinted.



176

On Poaceae (tribe *Festuceae*): **Festuca scabrella** Torr., Alta.—**F. thurberi** Vasey, Colo.

Range: High altitudes in Colorado and one locality in east central Alberta.

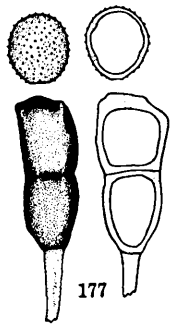
Successful cultures were made out of doors by Bethel, who supplied material for cultures in 1915 by Arthur (Mycol. **8:** 133. 1916), using teliospores in each instance. The details of Bethel's results were not published.

49. PUCCINIA PIPERI. Fig. 177.

(N. A. F. 7: 329, 780.)

Puccinia piperi Ricker, Jour. Myc. **11**: 114. 1905.
Dicaeoma piperi A. & F., N. Am. Flora **7**: 329. 1920.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 15–18 by 21–26 μ; wall pale- or brownish-yellow, 1.5–2 μ thick, finely echinulate, the pores 8–10, scattered. Telia hypophyllous, long covered by epidermis, surrounded by thin layer of brown subepidermal paraphyses; teliospores oblong or oblong-clavate, 19–26 by 42–62 μ, rounded or truncate above, usually narrowed below, slightly constricted at septum; wall dark chestnut-brown, 1.5–2.5 μ thick at sides, twice as thick above, frequently with a few longitudinal angles giving a striate appearance; pedicel colorless, one-half to once length of spore. Mesospores common.


177

On Poaceae (tribe *Festuceae*): **Festuca elatior** L., Utah. —**F. megalura** Nutt., Calif.—**F. pacifica** Piper, Calif., Ore.—**F. reflexa** Buckl., Calif. **Range:** Oregon to Utah and southern California.

50. PUCCINIA POARUM.

(N. A. F. 7: 327.)

(*Lycoperdon epiphyllum* L., Sp. Pl. 1185. 1753.)
(*Aecidium tussilaginis* Pers., in J. F. Gmel., Syst. Nat. **2**: 1473. 1791.)
Puccinia poarum Niels., Bot. Tidsskr. III. **2**: 34. 1877.
Puccinia epiphylla Wettst., Verh. Zool.-Bot. Ges. Wien **35**: 541. 1886.
Dicaeoma epiphyllum Ktze., Rev. Gen. **3**[3]: 468. 1898.
Puccinia petasiti-pulchellae Lüdi, Centr. Bak. II. **48**: 76. 1918.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate, with peridial cells abutted; aeciospores globoid or oblong, 15–21 by 19–26 μ; wall nearly or quite colorless, 1–1.5 μ thick, minutely verrucose, appearing smooth when wet.

On Carduaceae (tribe *Senecioneae*): **Petasites corymbosus** (R.Br.)Rydb. (*Tussilago c.*), Alas.—**P. frigidus** (L.)Fries, Alas.—**Tussilago farfara** L., N.S.

Uredia chiefly epiphyllous, orange-yellow or cinnamon-brown, with paraphyses absent or few and hyphoid; urediospores globoid or ellipsoid, 16–24 by 19–29 μ; wall colorless or golden-yellow, 1–1.5 μ thick; echinulate, the pores 6–8, scattered, obscure. Telia hypophyllous, long covered by epidermis, with subepidermal paraphyses; teliospores oblong, cylindric or clavate, 17–28 by 35–65 μ, truncate, rounded or obtuse above, narrowed below, slightly or not constricted at septum; wall dark chestnut-brown, paler below, 1–1.5 μ thick at sides, 3–7 μ above; pedicel colored, very short.

On Poaceae (tribe *Festuceae*): **Festuca** and **Poa** species in Europe, not observed in America.

Range: Nova Scotia and southern Alaska; also in Europe and Japan.

Reciprocal cultures with spores from *Poa annua* and *Tussilago farfara* were made in 1874 and 1875 by Nielsen (Bot. Tidsskr. III. **2**: 26. 1877). Confirmatory cultures

have been made in 1882 by Plowright (Grev. **11:** 56. 1882), in 1906 by Klebahn and Tranzschel (Zeits. Pflanzenkr. **17:** 131. 1907; Beitr. Biol. Ured. III. 16. 1909), and in 1931 by Jørstad (Mag. Naturv. **70:** 131. 1932). Aeciospores from *Petasites niveus* were successfully sown in 1915 on *Festuca pulchella* and also in 1916 on *Poa alpina, P. nemoralis* and *Festuca pulchella,* but nine other species of *Festuca* proved immune; teliospore from *F. pulchella* sown on *P. niveus* were successful, but gave only slight infection on *Tussilago,* all by Lüdi (Centr. Bak. II. **48:** 76–88. 1918). The form derived from *Petasites* is doubtless to be considered a race or variety.

51. PUCCINIA PERIDERMIOSPORA. Fig. 178.

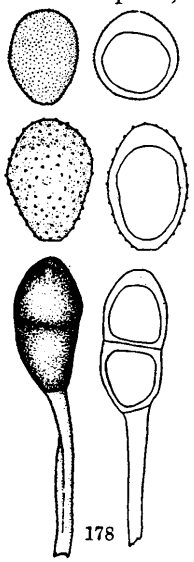
(N. A. F. 7: 316, 779, 835.)

(*Aecidium fraxini* Schw., Schr. Nat. Ges. Leipzig **1:** 66. 1822.)
(*Caeoma fraxinatum* Link, in Willd., Sp. Pl. **6**[2]**:** 62. 1825.)
Uredo peridermiospora Ellis & Tr., Jour. Myc. **6:** 77. 1890.
Puccinia sparganioides Ellis & Barth., Erythea **4:** 2. 1896.
Puccinia peridermiospora (Ellis & Tr.) Arth., Science II. **10:** 565. 1899.
Puccinia fraxinata Arth., Bot. Gaz. **34:** 6. 1902.
Dicaeoma fraxini Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906. Not *Puccinia fraxini* Kom. 1898.

Pycnia epiphyllous, in groups, conspicuous. Aecia chiefly hypophyllous, in crowded groups, prominent; aeciospores globoid or ellipsoid, 21–27 by 26–35 μ; wall colorless, 2–3 μ thick at sides, 7–13 μ above, finely verrucose.

On Oleaceae: **Forestiera porulosa** (Michx.)Poir.(*Adelia p.*), Fla.—**Fraxinus americana** L., Colo., Conn., D.C., Iowa, Mass.; Mo., N.Y., Pa., Wis.—**F. berlandieriana** DC., Tex.—**F. campestris** Britt., Mont., Neb.—**F. caroliniana** Mill., Fla.—**F. nigra** Marsh., Md., Mass., Wis.—**F. lanceolata** Borkh. (*F. viridis* Michx.), Del., Fla., Iowa, Kans., La., Minn., Miss., Mo., Neb., N.D., S.D.; Sask.—**F. pennsylvanica** Marsh., Iowa, Conn., Mass., Md., N.Y., Pa., Vt.—**F. profunda** Bush, Ind.—**F. quadrangulata** Michx., Ill.

Uredia hypophyllous, on smooth surface, pale-yellowish; urediospores obovoid or ellipsoid, 18–29 by 27–48 μ; wall colorless, 1.5–3 μ thick at sides, 7–10 μ above, sparsely verrucose-echinulate, the pores 4, equatorial, obscure. Telia chiefly hypophyllous, oblong-linear, 1–3 mm. long, compact, blackish-brown; teliospores oblong or ellipsoid, 16–24 by 35–62 μ, rounded or obtuse at each end, slightly constricted at septum; wall chocolate-brown, about 1.5 μ thick at sides, 5–7 μ above; pedicel light-brown, once to twice length of spore.


178

On Poaceae (tribe *Chlorideae*): **Spartina alterniflora glabra** (Muhl.)Fern.(*S. glabra* Muhl.), Del., Fla., Miss., N.H., N.C.—**S. bakeri** Merr., Fla.—**S. cynosuroides** (L.)Roth(*S. polystachya* Ell.), Del., Fla., La., Md., S.C.—**S. gracilis** Trin., Kans., Neb., N.D., Okla., S.D.—**S. michauxiana** Hitchc.(*S. cynosuroides* Gray, not Roth), Ark., Conn., Ill., Ind., Iowa, Kans., Me., Md., Minn., Miss., Neb., N.H., N.Y., N.D., Ohio, Okla., S.D., Vt., Wis.—**S. patens** (Ait.)Muhl.(*S. juncea* Willd.), Conn., N.J., N.Y.

Range: New Hampshire to Saskatchewan southward to Florida and Texas.

Successful cultures were made in 1899, 1904, 1905, 1907, 1908 and 1909 by Arthur (Bot. Gaz. **29:** 275. 1900; Jour. Myc. **11:** 57. 1905; same **12:** 16. 1906;

same **14:** 14. 1908; Mycol. **1:** 236. 1909; same **2:** 225. 1910), sowing teliospores on *Fraxinus pennsylvanica.*

This species shows marked similarity between the aeciospores and urediospores, especially in appearance of walls and their markings and in shape. It was this striking resemblance which led to the first cultural test of the relationship.

52. PUCCINIA SEYMOURIANA. Fig. 179.

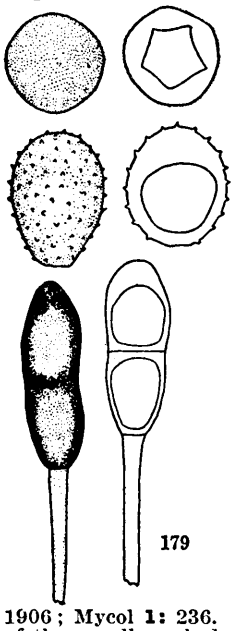
(N. A. F. 7: 318, 779, 835.)

(*Aecidium cephalanthi* Seym.; Burr., Bot. Gaz. **9:** 191. 1884.)
Puccinia seymouriana Arth., Bot. Gaz. **34:** 11. 1902.
Dicaeoma cephalanthi Jacks., Proc. Ind. Acad. **1915:** 444. 1916.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or broadly ellipsoid, 28–35 by 32–42 μ; wall colorless, 5–12 μ thick, forming an angular or stellate cavity, closely verrucose.

On Apocynaceae: **Amsonia salicifolia** Pursh, Mo.—**Apocynum cannabinum** L., Ind., N.J., N.Y.—**A. sibiricum** Jacq.(*A. hypericifolium* Ait.), Ill., Kans., Neb., Okla., S.D.; on Asclepiadaceae: **Asclepias pulchra** Ehrh., N.Y.—**A. speciosa** Torr., S.D.—**A. syriaca** L.(*A. cornuti* Dec.), Mo., Wis.; on Rubiaceae: **Cephalanthus occidentalis** L., Conn., Fla., Ill., Ind., Kans., Mo., Neb., N.J., N.Y.; Queb.

Uredia epiphyllous, on rough surface, orange-yellow; urediospores broadly ellipsoid or obovoid, 19–35 by 29–45 μ; wall colorless, 2–3 μ thick at sides, 9–15 μ above, sparsely verrucose-echinulate, the pores obscure. Telia epiphyllous, oblong, compact, chocolate-brown; teliospores oblong or cylindric, 16–23 by 37–58 μ, rounded or acute above, narrowed below, slightly constricted at septum; wall chestnut-brown, about 1.5 μ thick at sides, 5–9 μ above; pedicel colorless, once to twice length of spore.



179

On Poaceae (tribe *Chlorideae*): **Spartina alterniflora glabra** (Muhl.)Fern.(*S. glabra* Muhl.), N.Y.—**S. cynosuroides** (L.)Roth(*S. polystachya* Ell.), N.Y.—**S. michauxiana** Hitchc.(*S. cynosuroides* Gray, not Roth), Ill., Ind., Iowa, Kans., Mass., Mont., Neb., N.Y., N.D., Okla., Wis.; Ont., Queb.—**S. junciformis** Engelm.&Gr. (*S. spartinae* Merr.), Tex.

Range: Prairies from Wisconsin to Montana, southward to southern Texas, from central St. Lawrence river region southward to central New York, and on the Atlantic coast from Massachusetts to Florida.

Successful cultures were made in 1905, 1908 and 1910 using teliospores sown on *Cephalanthus*, and in 1915 on *Apocynum* and *Asclepias*, all by Arthur (Jour. Myc. **12:** 24. 1906; Mycol **1:** 236. 1909; same **4:** 19. 1912; same **8:** 134. 1916). Indications of three well marked races or varieties were shown by the cultures, corresponding to the three families supporting the aecia.

53. PUCCINIA DISTICHLIDIS. Fig. 180.

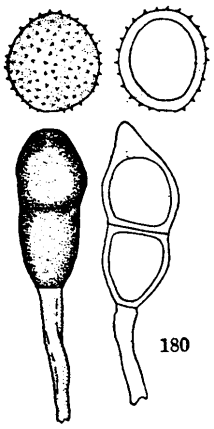
(N. A. F. 7: 317, 779, 835.)

Puccinia distichlidis E. & E., Proc. Acad. Phila. **1893:** 152. 1893.
Dicaeoma distichlidis Ktze., Rev. Gen. **3³:** 468. 1898.
Puccinia kelseyi Syd., Monog. Ured. **1:** 806. 1904.

Pycnia chiefly epiphyllous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 15–24 by 18–27 μ; wall colorless, 1.5–2 μ thick, finely verrucose.

On Primulaceae: **Glaux maritima** L., Mont., Wyo.; Sask.—**Steironema ciliatum** (L.)Raf., Colo., N.D.; Man.

Uredia epiphyllous, on rough surface, oval, yellowish; urediospores globoid or broadly ellipsoid, 23–28 by 26–35 μ; wall pale-yellow, 3–4 μ thick, strongly echinulate, the pores 6–8, scattered, indistinct. Telia epiphyllous, oblong or linear, blackish-brown; teliospores oblong or lance-oblong, 21–27 by 42–64 μ, obtuse or acute above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 7–13 μ above; pedicel golden-brown, as long as spore or longer.



180

On Poaceae (tribe *Chlorideae*): **Spartina gracilis** Trin., Mont., Neb., S.D., Wyo.—**S. michauxiana** Hitchc.(*S. cynosuroides* Gray, not Roth), Colo., Iowa, Mont., Neb., N.Y., N.D., S.D.; Man.—**S. pectinata** Bosc, Mont.; Sask.

Range: Prairies, Manitoba to Saskatchewan, southward to Nebraska, and in western New York.

Successful cultures were made in 1915 and 1916 by Arthur (Mycol. **8:** 136. 1916; **9:** 299. 1917), using teliospores sown on *Steironema*, and in 1920 by Fraser (Mycol. **14:** 228. 1922), with sowings on *Glaux maritima*. The close similarity in gross appearance between *Spartina gracilis* and *Distichlis spicata* led to an erroneous identification of the host for the type collection.

Uromyces acuminatus.

(N. A. F. 7: 231, 751, 827.)

(*Aecidium polemonii* Peck, Bot. Gaz. **4:** 230. 1879.)
Uromyces acuminatus Arth., Bull. Minn. Acad. **2**[2]**:** 35. 1883.
Uromyces spartinae Farl., Proc. Am. Acad. **18:** 77. 1883.
Nigredo polemonii Arth., N. Am. Flora **7:** 231. 1912.

Pycnia and aecia as in *Puccinia distichlidis*.

On hosts: listed under the varieties.

Uredia and telia as in *P. distichlidis*, except the teliospores are one-celled, 15–24 by 23–39 μ, the wall 1–1.5 μ thick at sides, 5–12 μ above.

On Poaceae (tribe *Chlorideae*): **Spartina alterniflora glabra** (Muhl.) Fern.(*S. glabra* Muhl.), Conn., Del., Fla., Mass., N.J., N.Y.; N.S.—**S. cynosuroides** (L.)Roth(*S. polystachya* Ell.), Fla.—**S. gracilis** Trin., Mont., N.D., Wyo.; Alta.—**S. michauxiana** Hitchc.(*S. cynosuroides* Gray, not Roth), Colo., Ill., Ind., Iowa, Neb., N.Y., N.D., Minn., Mont., S.D., Wis.; Man., N.S.—**S. patens** (Ait.)Muhl.(*S. juncea* Willd.), Me., Mass.

Range: Plains, western New York to Alberta, southward to Indiana and Nebraska, and along the Atlantic coast from Nova Scotia to Florida.

The correlation of this species with *Puccinia distichlidis* was first pointed out by Orton (Mycol. **4:** 201. 1912). Cultures were made with teliospores in 1905 and 1907

by Arthur (Jour. Myc. **12:** 24. 1906; same **14:** 17. 1908), with positive results on *Steironema ciliatum* and negative on *Polemonium*, also in 1910 (Mycol. **4:** 29. 1912), with positive results on *Polemonium reptans* and negative on *Steironema* and *Phlox*, again in 1912 (Mycol. **7:** 77. 1915) with positive results on *Collomia linearis* and negative on *Steironema*, and again in 1917 (Mycol. **9:** 309. 1917), with positive results on *Smilacina stellata* and *Polygonatum biflorum* and negative on *Steironema*, in each instance using teliospores from *S. michauxiana*. Cultures were made in 1911 by Fraser (Mycol. **4:** 186. 1912), with teliospores from *S. alterniflora glabra* on *Arenaria lateriflora*, but negative results on *Spergularia* and *Glaux*, and again with teliospores from *S. patens* on *Spergularia canadensis* but negative results on *Arenaria* and *Salicornia*. In 1919 Davis (Trans. Wis. Acad. Sci. **20:** 422. 1922) used teliospores from *S. michauxiana* in successful cultures on *Smilacina racemosa*, *S. stellata*, *Polygonatum biflorum*, *P. commutatum* and *Uvularia sessilifolia*. In 1921 cultures by Mains (Mycol. **25:** 415. 1933) with teliospores from *S. michauxiana* gave results on *Phlox* and *Polemonium*.

By combining the cultural, microscopic and geographic studies now available this species can be separated into the following intergrading varieties:

(1). **Uromyces acuminatus spartinae** (Farl.) n. comb. (*U. spartinae* Farl.), with teliospores usually broad, and rounded above, the aeciospores 14–19 by 15–23 μ; on CARYOPHYLLACEAE: **Moehringia lateriflora** (L.)Fenzl. (*Arenaria l.*), N.S.—**Spergularia canadensis** (Pers.)D.Don(*Tissa c.* Britt.), N.S.—**S. macrotheca** (Hornem.)Heynh.(*T. m.* Britt.), Calif.—**S. marina** (L.) Griseb.(*T. m.* Britt.), Calif. **Range:** Salt marshes of coast, Nova Scotia to Florida (telia in Delaware and Florida), and southern California (telia not known on Pacific coast).

Cultures by Fraser on *Moehringia* and *Spergularia* are given above.

(2). **Uromyces acuminatus steironematis** (Arth.) J. J. Davis, with teliospores mostly blunt or truncate above, the aeciospores 16–23 by 18–29 μ; on PRIMULACEAE: **Dodecatheon meadia** L., Neb.—**D. pauciflorum** (Durand) Greene, Sask.—**D. thornense** Lunell, N.D.—**Steironema ciliatum** (L.)Raf., Colo., Conn., Ill., Iowa, Kans., Neb., N.Y., S.D., Wis., Wyo.—**S. verticillatum** Greene(*S. lunellii* Greene), N.D. **Range:** Moist plains, Connecticut to North Dakota and Saskatchewan, southward to central Indiana and Colorado.

Cultures by Arthur on *Steironema* are given above.

(3). **Uromyces acuminatus polemonii** (Peck) J. J. Davis (*Aecidium polemonii* Peck), with teliospores narrow, and mostly acuminate above, the aeciospores 15–23 by 16–26 μ; on POLEMONIACEAE: **Collomia linearis** Nutt., Colo., Neb., N.D.—**Gilia spicata** Nutt., Colo.—**Phlox divaricata** L., Iowa, Minn.—**P. maculata** L., Ind.—**P. paniculata** L., Iowa.—**P. pilosa** L., Iowa, S.D., Wis.—**Polemonium reptans** L., Ind., Iowa, Wis. **Range:** Dry plains and thickets, Manitoba to Alberta, southward to Indiana and Colorado.

Cultures by Arthur on *Collomia* and *Polemonium* and by Mains on *Phlox* and *Polemonium* are given above.

(4). **Uromyces acuminatus magnatus** (Arth.) J. J. Davis (*U. magnatus* Arth.), with teliospores generally blunt or somewhat acute, the aeciospores 18–24 by 21–29 μ, with wall 1.5–2.5 μ thick; on CONVALLARIACEAE: **Maianthemum canadense** Desf.(*Unifolium c.* Greene), Mich., N.Y., Wis.; N.S.—**Polygonatum commutatum** (R.&S.)Dietr., Ill., Iowa, Minn., Neb., N.D., S.D.—**Smilacina racemosa** (L.)Desf.(*Vagnera r.* Morong), Colo., Conn., Minn.,

Wis.—**S. stellata** (L.)Desf.(*V. s.* Morong), Colo., Conn., Ill., Ind., Mont., Neb., N.Y., N.D., S.D., Wis.—**Uvularia sessilifolia** L.(*Oakesia s.* Wats.), Miss., Wis. **Range:** Nova Scotia to central Montana, southward to Connecticut, northern Mississippi and Colorado.

Cultures by Arthur and by Davis on *Smilacina* and *Polygonatum* and by Davis on *Uvularia* are given above.

Each of the above varieties can doubtless be further segregated. Cultures so far made give evidence of two races for *U. a. spartinae*, and also two for *U. a. polemonii*.

Puccinia dayi.

(N. A. F. 7: 553, 804.)

Puccinia dayi G. W. Clint.; Peck, Ann. Rep. N. Y. State Mus. **28:** 60. 1876.
Micropuccinia dayi A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia mostly hypophyllous, in groups, light chocolate-brown, becoming cinereous by germination; teliospores 16–24 by 40–58 μ; wall cinnamon-brown, 1.5–2.5 μ thick at sides, 5–10 μ above; otherwise as in *Puccinia distichlidis*.

On Primulaceae: **Steironema ciliatum** (L.)Raf., Ind., Iowa, Mich., Mont., N.Y., W.Va.; Alta., Ont., Sask.—**S. lanceolatum** (Walt.) Gray, Wis. **Range:** Eastern Ontario to Saskatchewan, southward to West Virginia and Iowa.

The correlation of this microcyclic species with the preceding species was recorded in the N. Am. Flora **7:** 553. 1922. The assignment of *Glaux maritima* (erroneous determination for *Honkenya peploides*) from Nova Scotia (N. Am. Flora **7:** 553) to this species was an error (see *P. arenariae*, page 236).

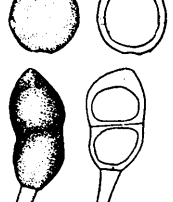
*. **Uromyces argutus** Kern (*Nigredo a.* Arth.), with amphigenous uredia, urediospores broadly ellipsoid, 19–23 by 25–32 μ, the wall light cinnamon-brown, 2–3 μ thick, finely echinulate, the pores 3, or sometimes 4, equatorial, distinct; teliospores ellipsoid or obovoid, 16–19 by 24–32 μ, narrowed at each end, the wall dark chestnut-brown, 1.5–2 μ thick at sides, 7–10 μ above, with pedicel colored next to spore, twice length of spore; occurs on Poaceae (tribe *Chlorideae*): **Spartina alterniflora glabra** (Muhl.)Fern.(*S. glabra* Muhl.), known only from Miami, Florida. (N. A. F. **7:** 232.)

54. PUCCINIA CYNODONTIS. Fig. 181.

(N. A. F. 7: 315, 814, 835.)

(*Aecidium plantaginis* Ces., Erb. Critt. Ital. *247*. 1859.)
Puccinia cynodontis Lacroix, in Desm., Pl. Crypt. II. *655*. 1859.
Dicaeoma cynodontis Ktze., Rev. Gen. **3**[3]: 468. 1898. Not *D. plantaginis* Ktze. 1898.

Pycnia epiphyllous. Aecia hypophyllous, the aeciospores differ from those of *Puccinia aristidae* by being oblong, 19–24 by 23–29 μ, the wall 1.5–2 μ thick.



181

On Plantaginaceae: **Plantago** spp. in Europe and Japan, but unknown in America.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid, 19–23 by 20–26 μ; wall cinnamon-brown, 1.5–3 μ thick, very finely verrucose, the pores 2, sometimes 3, equatorial. Telia chiefly hypophyllous, blackish-brown; teliospores ellipsoid or oblong, 16–22 by 28–42 μ, obtuse or attenuate at each end, slightly constricted at septum; wall dark chestnut-brown, paler at each end, 1.5–2.5 μ thick at sides, 6–12 μ above; pedicel nearly colorless, one and a half times length of spore or less.

On Poaceae (tribe *Chlorideae*): **Cynodon dactylon** (L.)Pers.(*Capriola d.* Ktze.), Ariz., Calif., Fla., N.M., Tex.

Range: Northern Florida to southern California; also in West Indies, Central and South America, and in the warmer parts of Europe, Asia, Africa and Japan.

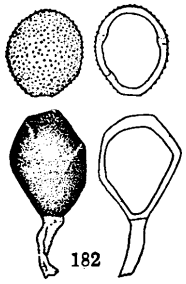
Cultures were made in 1905 by Tranzschel (Trav. Mus. Bot. Acad. Imp. St.-Petersb. **3:** 39. 1906), using teliospores from *Cynodon dactylon* on *Plantago lanceolata.* Reciprocal cultures were made in 1906, by Bubák (Centr. Bakt. II. **18:** 74. 1907), with the same hosts, and extended to *Plantago major* and *P. media.* Field observations were made by Tranzschel (Trans. Russian Acad. Sci. **1926:** 99. 1927), later confirmed by cultures (1928, *in litt.*), on *Adonis, Delphinium, Mercurialis* and *Veronica,* showing the species to be plurivorous, like *Puccinia aristidae.*

*. **Uromyces archerianus** A. & F. (*Nigredo a.* Arth.), has been collected only from a small area on the campus of the Agricultural College at Mesilla Park, New Mexico, from which it has entirely disappeared since 1915. It possesses urediospores 19–23 by 21–26 μ, with wall cinnamon-brown, 2–3 μ thick, minutely verrucose, and 2 equatorial pores, and teliospores globoid or broadly ellipsoid, 18–26 by 25–32 μ, rounded above and below, with wall dark chestnut-brown, 1.5–2 μ thick at sides, 7–9 μ above, smooth, and nearly colorless pedicel, once to twice length of spore; occurs on Poaceae (tribe *Chlorideae*): **Chloris elegans** H.B.K. (N. A. F. **7:** 747.)

55. UROMYCES BECKMANNIAE. Fig. 182.

(N. A. F. 7: 749.)

Uromyces beckmanniae Jacks., Brooklyn Bot. Gard. Mem. **1:** 274. 1918.
Nigredo beckmanniae Arth., N. Am. Flora **7:** 749. 1926.

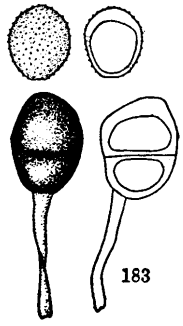


182

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 19–24 by 23–29 μ; wall nearly or quite colorless, 2–2.5 μ thick, finely verrucose-echinulate, the pores 8–10, scattered. Telia amphigenous, tardily naked, blackish-brown; teliospores obovoid or ellipsoid, angular, 20–26 by 29–40 μ, rounded or angular above, narrowed below; wall chestnut-brown, 1–2 μ thick at sides, 3–6 μ above, smooth but showing distinct longitudinal lines; pedicel colorless, except next to spore, as long as spore.

On Poaceae (tribe *Chlorideae*): **Beckmannia erucaeformis** (L.)Host, Ore. **Range:** Western Oregon.

*. **Puccinia leptochloae** A. & F. (*Dicaeoma l.* A. & F.), with amphigenous uredia, urediospores globoid, 21–24 by 23–26 μ, the wall light cinnamon-brown, 2–2.5 μ thick, minutely verrucose, the pores 4, sometimes 6, scattered; teliospores oblong or broadly ellipsoid, 21–27 by 26–35 μ, rounded at both ends, the wall dark chestnut-brown, 2 μ thick at sides, 3–7 μ above, with colored pedicel as long as spore; occurs on Poaceae (tribe *Chlorideae*): **Leptochloa filiformis** (Lam.)Beauv., in southern Texas; also in West Indies, Mexico and South America. (N. A. F. **7:** 321, 779.)



183

56. PUCCINIA CHLORIDIS. Fig. 183.

(N. A. F. 7: 318, 779.)

Puccinia chloridis Speg., Rev. Arg. Hist. Nat. **1:** 172. 1891.
Dicaeoma chloridis Ktze., Rev. Gen. **3³:** 468. 1898.

Pycnia and aecia unknown. Uredia amphigenous, brownish; urediospores ellipsoid or obovoid, 18–21 by 23–26 μ; wall golden-yellow, finely verrucose-echinulate, 1.5–2 μ thick, often 3–7 μ above, the pores about 6, scattered, indistinct. Telia amphigenous, dark chocolate-brown; teliospores oblong, 18–26 by 27–42 μ, rounded or obtuse above, rounded or narrowed below, slightly or not constricted at septum; wall dark chest-

nut-brown, 2–2.5 μ thick at sides, 5–7 μ above; pedicel colored, once to twice length of spore, often attached obliquely.

On Poaceae (tribe *Chlorideae*): **Chloris verticillata** Nutt., Kans., N.M., Okla., Tex. **Range:** North-central Kansas to Texas and New Mexico; also in South America.

57. PUCCINIA BARTHOLOMAEI. Fig. 184.

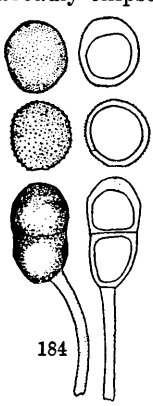
(N. A. F. **7:** 320, 779, 835.)

(*Aecidium jamesianum* Peck, Bot. Gaz. **5:** 34. 1880.)
Puccinia bartholomaei Diet., Hedw. **31:** 290. 1892.
Puccinia diplachnis Arth., Bull. Torrey Club **31:** 4. 1904.
Dicaeoma jamesianum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, in large groups. Aecia amphigenous, in large groups, sometimes becoming locally systemic, cupulate or cylindric; aeciospores globoid or ellipsoid, 16–23 by 18–26 μ; wall colorless, 2–3 μ thick at sides, 7–10 μ above, finely verrucose.

On Asclepiadaceae: **Acerates hirtella** Pennell(*A. floridana* Hitchc., in part), S.D., Wis.—**A. lanuginosa** (Nutt.)Dec., Wis.—**A. viridiflora** (Raf.) Eaton, Kans., Neb.—**Asclepias arenaria** Torr., Neb., Tex.—**A. brachystephana** Engelm., Ariz., N.M.—**A. galioides** H.B.K., Ariz., Colo., N.M.—**A. latifolia** (Torr.)Raf.(*A. jamesii* Torr.), N.M.—**A. ovalifolia** Dec., N.D.—**A. pumila** (Gray)Vail, Ariz., Kans., Neb., S.D., Tex.—**A. speciosa** Torr., Kans., Neb., S.D.—**A. syriaca** L.(*A. cornuti* Dec.), Ill., Ind., Iowa, Mo., Neb.—**A. tuberosa** L., Iowa, Kans., Okla., Wis.—**A. verticillata** L., Neb., S.D.—**Asclepiodora decumbens** (Nutt.)Gray, Okla., Tex.—**A. viridis** (Walt.) Gray, Kans., Okla.—**Philibertia heterophylla** (Engelm.)Jepson(*Philibertella h.* Cockerell), Ariz.

Uredia chiefly epiphyllous, pale cinnamon-brown; urediospores globoid or broadly ellipsoid, 16–23 by 18–26 μ; wall nearly or quite colorless, 1.5–2 μ thick, finely verrucose-echinulate, the pores probably 4–8, scattered, indistinct. Telia chiefly epiphyllous, dark chocolate-brown; teliospores broadly ellipsoid or oblong, 19–24 by 29–42 μ, usually rounded at each end, slightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 5–9 μ above; pedicel colored, once to twice length of spore or more, sometimes attached obliquely. Mesospores occasionally intermixed.


184

On Poaceae (tribe *Chlorideae*): **Bouteloua barbata** Lag., Tex.—**B. curtipendula** (Michx.)Torr.(*B. racemosa* Lag.), Ariz., Iowa, Kans., Miss., Neb., N.M., Okla., S.D., Tex.—**B. gracilis** (H.B.K.)Lag.(*B. oligostachya* Torr.), Ariz., Colo., Kans., Mont., Neb., N.D., S.D., Tex.—**B. hirsuta** Lag., Neb.—**Leptochloa dubia** (H.B.K.)Nees(*Diplachne d.* Benth.), Tex.

Range: Wisconsin to Montana, southward to Mississippi and Arizona; also in Mexico and Central America.

Successful cultures were made by Arthur (Bot. Gaz. **35:** 18. 1903; Mycol. **4:** 19. 1912), by sowing teliospores from *Bouteloua curtipendula* on *Asclepias incarnata* and *A. syriaca* in 1902, and again in 1910 on the latter species. The aecia are well characterized by the apically thickened spores.

Puccinia obliqua.

(N. A. F. 7: 555, 804.)

Puccinia obliqua B. & C.; Berk., Jour. Linn. Soc. **10:** 356. 1869.
Puccinia gonolobi Rav.; Berk., Grev. **3:** 54. 1874.
Puccinia cynanchi Lagerh., Bol. Soc. Brot. **7:** 129. 1889.
Puccinia philibertiae E. & E., Bull. Torrey Club **22:** 60. 1895.
Micropuccinia obliqua A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, in groups, often confluent, sometimes systemic, even forming witches' brooms, cinnamon- or chocolate-brown, cinerous by germination; teliospores as in *Puccinia bartholomaei*, but more variable, often nearly globoid, and usually smaller, 15–23 by 24–35 μ; wall variable in thickness, 1.5–3.5 μ at sides, 3–6 μ above; pedicel often attached obliquely. Mesospores occasionally intermixed.

On Asclepiadaceae: **Philibertia clausa** (Jacq.)Schum.(*Cynanchum c.*), Fla.—**P. cynanchoides** Gray(*Philibertella c.* Vail), Ariz., N.M.—**P. hirtella** (Gray)Parish, Calif.—**P. heterophylla** (Engelm.)Jepson(*P. h.* Cockerell), Ariz., Calif.—**Gonolobus laevis** Michx.(*Enslenia albida* Nutt.), Tex.—**Metastelma bahamense** Griseb., Fla.—**M. barbigerum** Scheele, Tex.—**Seutera palustris** (Pursh)Vail(*Metastelma p.* Schl.), Fla., Miss.—**Vincetoxicum gonocarpos** Walt.(*Gonolobus macrophyllus* Michx.), Miss., S.C.—**V. hirsutum** (Michx.) Britt.(*G. h.*), Miss.—**V. productum** (Torr.)Vail(*G. p.*), Ariz.—**V. suberosum** (L.)Britt.(*G. s.* R.Br.), S.C.—**V.** sp., La., Tex. **Range:** South Carolina and Florida to southern California; also in West Indies, Central and South America.

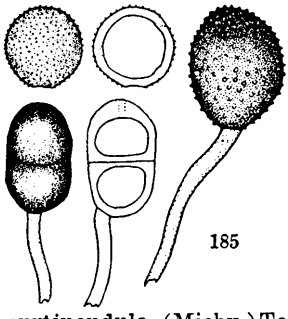
The correlation between the long and short cycle species is especially striking.

58. PUCCINIA VEXANS. Fig. 185.

(N. A. F. 7: 320, 779.)

Uromyces brandegei Peck, Bot. Gaz. **4:** 127. 1879. Not *Puccinia brandegei* Peck, 1882.
Puccinia vexans Farl., Proc. Am. Acad. **18:** 82. 1883.
Dicaeoma vexans Ktze., Rev. Gen. **3³:** 471. 1898.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 24–29 by 26–34 μ; wall cinnamon-brown (or yellow when immature or mixed with the amphispores), 2–3 μ thick, finely echinulate, the pores 8, scattered; amphispores often numerous, 26–35 by 34–42 μ, the wall 3–4 μ thick at sides, 7–12 μ above, verrucose, the pores 3 or 4, equatorial, the pedicel mostly persistent, colored. Telia amphigenous, dark chocolate-brown; teliospores broadly ellipsoid, 23–29 by 32–40 μ, rounded at both ends, slightly or not constricted at septum; wall dark chestnut-brown, 2.5–3 μ thick at sides, 6–8 μ above; pedicel colorless, as long as spore.



185

On Poaceae (tribe *Chlorideae*): **Bouteloua curtipendula** (Michx.)Torr.(*B. racemosa* Lag.), Ariz., Colo., Ind., Iowa, Kans., Neb., N.M., N.D., Okla., S.D., Tex., Wis. **Range:** Central Indiana to North Dakota, southward to Oklahoma and Arizona; also in Mexico and South America.

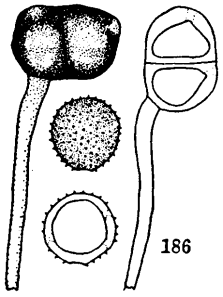
Amphispores may wholly replace the teliospores and give the same gross appearance; when mixed with urediospores the teliospores are usually paler and thinner-walled than usual. Cultures were made in 1897 by Carleton (Bull. Plant Industry **63:** 24. 1904), sowing the urediospores on *Bouteloua curtipendula* and obtaining urediospores again in twelve days and amphispores nine days later.

59. PUCCINIA BOUTELOUAE. Fig. 186.

(N. A. F. 7: 319.)

Diorchidium boutelouae Jennings, Bull. Texas Exper. Sta. No. 9. 25. 1890.
Puccinia boutelouae (Jennings) Holw., Ann. Myc. **3:** 20. 1905.
Puccinia exasperans Holw., Ann. Myc. **3:** 21. 1905.
Dicaeoma exasperans A. & F., N. Am. Flora **7:** 319. 1920.
Dicaeoma boutelouae A. & F., N. Am. Flora **7:** 319. 1920.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or obovoid, 18–25 by 21–29 μ; wall cinnamon-brown, 1–1.5 μ thick, strongly echinulate, the pores about 8, scattered, indistinct; amphispores globoid or ellipsoid, 24–26 by 27–32 μ; wall chestnut-brown, 2.5–3 μ thick, echinulate, the pores 6–8, scattered; pedicel mostly persistent, nearly or quite colorless, once to twice length of spore. Telia amphigenous, blackish-brown; teliospores globoid or broadly ellipsoid, 18–24 by 25–32 μ, rounded at both ends, not constricted at septum, which is usually oblique; wall, dark chestnut-brown, 1.5–3 μ thick at sides, 3–7 μ above; pedicel nearly or quite colorless, twice or thrice length of spore, usually attached obliquely.


186

On Poaceae (tribe *Chlorideae*): **Bouteloua curtipendula** (Michx.)Torr.(*B. racemosa* Lag.), Ariz., Tex. **Range:** Texas to southern Arizona; also in Mexico.

As in *Puccinia vexans*, when urediospores are intermixed with teliospores the latter are usually smaller, paler and somewhat thinner-walled than usual, indicating a state of immaturity or restricted growth.

60. PUCCINIA GRAMINIS. Fig. 187.

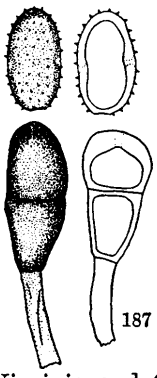
(N. A. F. 7: 295, 775, 833.)

(*Lycoperdon poculiforme* Jacq., Coll. **1:** 122. 1786.)
Lycoperdon lineare Schr., Bairische Flora **2:** 669. 1789.
(*Aecidium berberidis* Pers., in Gmel., Syst. Nat. **2:** 1473. 1791.)
Puccinia graminis Pers., Neues Mag. Bot. **1:** 119. 1794; Syn. Fung. 228. 1801.
Puccinia linearis Röhl., Deutschlands Flora Ed. 2. **3²:** 132. 1813.
Puccinia poculiformis Wettst., Verh. Zool.-Ges. Wien **35:** 544. 1886.
Dicaeoma poculiforme Ktze., Rev. Gen. **3³:** 466. 1898.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate or cylindric; aeciospores globoid or oblong, 15–19 by 16–23 μ; wall colorless, 1–1.5 μ thick at sides, 5–9 μ above, finely verrucose.

On Berberidaceae: **Berberis canadensis** Mill., Ind., Va., W.Va.—**B. vulgaris** L., and other cultivated species of similar habit of growth, and also to a limited extent on cultivated species of **Mahonia**, throughout the northeastern United States and Canada and sparingly in the northwestern part; also in Mexico and the eastern Hemisphere.

Uredia caulicolous and epiphyllous, reddish-brown; urediospores oblong or ellipsoid, 13–24 by 21–42 μ; wall golden-brown at maturity, 1.5–2 μ thick,



187

strongly echinulate, the pores 4, rarely 5, equatorial. Telia chiefly caulicolous, blackish-brown; teliospores ellipsoid or oblong-clavate, 16–23 by 35–58 μ, rounded or narrowed both above and below, moderately constricted at septum; wall dark chestnut-brown above, paler below, 1–1.5 μ thick at sides, 5–10 μ above; pedicel colored next to spore, as long as spore or longer.

On Poaceae (tribe *Paniceae*): **Echinochloa crus-galli** (L.)Beauv.(*Panicum c.*), Iowa; (tribe *Phalarideae*): **Anthoxanthum aristatum** Boiss., Miss.—**A. odoratum** L., Del., Me., N.J., N.Y.; N.S.—**Phalaris angusta** Nees, Okla.—**P. arundinacea** L., Calif., N.Y.; (tribe *Agrostideae*): **Agrostis alba** L., common from Maine to South Dakota, southward to Virginia and Oklahoma, and in southern California.—**A. diegoensis** Vasey, Calif.—**A. exarata** Trin., Mont., Neb., Ore.—**A. hyemalis** (Walt.)B.S.P.(*A. scabra* Willd.), Iowa, Conn., Me., Mass., Minn., Wis.—**A. palustris** Huds., N.S.—**A. perennans** (Walt.)Tuckerm., Conn., Me., Mass., Pa.; N.B., N.S.—**Alopecurus aristulatus** Michx., Calif., Ind., Wis.—**A. californicus** Vasey, Ore.—**A. pratensis** L., Minn., S.D.—**Calamagrostis canadensis** (Michx.)Beauv., Conn., Wis.—**C. hyperborea** Lange, Calif.—**Cinna arundinacea** L., Conn., Ind., Mich., Mo., Neb., N.Y., Ohio, Va., Wis.; Ont.—**C. latifolia** (Trev.)Griseb., Conn., N.Y.; Ont.—**Milium effusum** L., Wis.; Ont.—**Muhlenbergia cuspidata** (Torr.)Rydb.(*Sporobolus c.* Wood), Iowa.—**M. mexicana** (L.)Trin., Iowa, Mo.—**Polypogon monspeliensis** (L.)Desf., Neb.—**Sporobolus asper** (Michx.) Kunth(*S. longifolius* Wood), Ill.—**S. cryptandrus** (Torr.)Gray, Colo., S.D.—**Stipa coronata** Thunb., Calif.; (tribe *Aveneae*): **Arrhenatherum elatius** (L.)Beauv.(*A. avenaceum* Beauv.), Ind., Wash.—**Avena barbata** Brot., Calif.—**A. fatua** L., Calif., Iowa, Mont., N.M., N.D., S.D., Utah, Wash.; Man.—**A. fatua glabrata** Peterm., Ore., Wash.—**A. sativa** L., common where oats are grown.—**Deschampsia caespitosa** (L.)Beauv.(*Aira c.*), Calif.; Sask.—**D. danthonioides** Trin.(*A. d.* Munro, *D. calycina* Presl), Calif.—**D. elongata** (Hook.)Munro(*A. e.*), Ore.—**D. holciformis** Presl(*A. h.* Steud.), Calif.—**Koeleria cristata** (L.)Pers., Calif., Kans., Neb., N.D., S.D.—**Sphenopholis obtusata** (Michx.)Scribn.(*Eatonia o.* Gray), Kans.—**S. obtusata lobata** (Trin.)Scribn., Calif.—**Trisetum canescens** Buckl., Calif.; (tribe *Chlorideae*): **Beckmannia erucaeformis** (L.)Host, Ore., Utah; (tribe *Festuceae*): **Briza maxima** L., Minn., Wis.—**B. minor** L., Ont.—**Bromus hordeaceus** L.(*B. mollis* L.), Sask.—**B. japonicus** Thunb., Colo.—**B. polyanthus** Scribn., Mont.—**B. pumpellianus** Scribn., Sask.—**B. purgans** L., Ind.—**B. secalinus** L., Ill., Ind., Iowa, Wis.—**B. tectorum** L., Colo.—**B. tectorum nudum** Mert.&Koch, Wash.—**Dactylis glomerata** L., Calif., Colo., Conn., Ind., Iowa, Ky., Minn., Mo., N.Y., Ore., Pa., S.D., Va., Wis.—**Festuca arizonica** Vasey, Colo.—**F. californica** Vasey, Calif.—**F. eastwoodae** Piper, Calif.—**F. elatior** L., Ind., Iowa, Ore., Pa., Tenn., Wash., Wyo.—**F. elmeri** Scribn.&Merr., Calif.—**F. megalura** Nutt., Calif., Ore.—**F. myuros** L., Minn., Ore.—**F. octoflora** Walt.(*F. tenella* Willd.), Calif., S.D.—**F. pacifica** Piper, Calif., Ore.—**Glyceria grandis** Wats.(*Panicularia g.* Nash), Wis.; Ont.—**G. pauciflora** Presl(*P. g.* Ktze.), Calif., Mont.—**Lam-**

arckia aurea (L.)Moench(*Achyrodes a.* Ktze.), Calif.—**Poa arida** Vasey (*P. pratericola* Rydb.), Tex.—**P. compressa** L., Mich., Pa.—**P. howellii** Vasey& Scribn., Calif.—**P. pratensis** L., Ind.—**P. sandbergii** Vasey, Calif.—**P. trivialis** L., Tenn.—**Puccinellia nuttalliana** (Schult.)Hitchc.(*Poa n.*), Calif.; (tribe *Hordeae*): **Agropyron caninum** (L.)Beauv., Calif., Colo., Minn., N.Y., N.D., S.D., Utah, Wis., Wyo.; Man.—**A. dasystachyum** (Hook.)Scribn., Mont., Ore. —**A. pseudorepens** Scribn.& Sm., Colo., Neb., N.D.—**A. repens** (L.)Beauv., Ind., Iowa, Ky., Me., Mass., Mich., N.Y., N.D., Pa., S.D., Vt., Wis.; Ont.—**A. richardsonii** (Trin.)Schrad., N.D., S.D.—**A. smithii** Rydb.(*A. occidentale* Scribn.), Colo., Neb., N.M., N.D., S.D., Wyo.; Man.—**A. tenerum** Vasey, Colo., Iowa, Mich., Minn., Mont., Neb., N.M., N.D., S.D., Utah, Wyo.; Man.—**Elymus australis** Scribn.&Ball, Ark.—**E. canadensis** L.(*E. robustus* Scribn.&Sm.), Colo., Iowa, Kans., Mich., Minn., Mont., Neb., N.M., N.D., S.D., Tex., Utah, Wash., Wis., Wyo.—**E. condensatus** Presl, Calif., Colo., Ida., Utah, Wash., Wyo.—**E. curvatus** Piper, Man.—**E. flavescens** Scribn.&Sm., N.Y.—**E. glabriflorus** Scribn.&Sm., Tex.—**E. glaucus** Buckl., Colo., Calif., Ore., Utah, Wash.— **E. macounii** Vasey, Colo., Minn., N.D., Utah, Wash.; Man.—**E. striatus** Willd., Wis.—**E. triticoides** Buckl., Calif., Wash.—**E. virginicus** L., Ind., S.D., Wis.— **Hordeum caespitosum** Scribn., Mont.—**H. distichon** L., Mo., Ore.—**H. gussoneanum** Parl., Calif.—**H. jubatum** L., Colo., Ill., Ind., Iowa, Kans., Ky., Mich., Minn., Mo., Mont., Neb., N.M., N.D., Ohio, S.D., Tex., Wash., Wis., Wyo.; Alta., Man.—**H. murinum** L., Calif.—**H. nodosum** L., Wash.—**H. tetrastichon** L., Mo.—**H. vulgare** L., Calif., Ind., Iowa, Kans., Ky., Minn., Mo., N.Y., Ore., Pa., S.D., Wis., Wyo.; Alta., Man.—**Hystrix patula** Moench(*H. hystrix* Millsp.), Minn.—**Secale cereale** L., Conn., Ind., Mass., Wis.; Ont.—**Sitanion hystrix** (Nutt.)J.G.Sm.(*S. elymoides* Raf.), Colo., N.M., Utah.—**Triticum aestivum** L.(*T. vulgare* Vill.), everywhere that wheat is grown.—**T. compactum** Host, Minn., Ore., Wash.—**T. dicoccoides** Körn., Minn., Tex.—**T. dicoccum** Schrank, Mo., Okla., Tex.—**T. durum** Desf., N.D., S.D., Minn., Mo., Neb.—**T. freycenctii** Host, Mo.—**T. monococcum** L., Mo.—**T. polonicum** L., Iowa, Minn., Mo.— **T. spelta** L., Kans., Minn., Mo., Wyo.—**T. tumonia** Schrad., Mo.—**T. turgidum** L., Minn., Mo.

Range: Throughout North America on wild and cultivated grasses and cereals; a cosmopolitan species.

This species was first published under the name *Lycoperdon lineare* Schr. (1789), and five years later received the name *Puccinia graminis* Pers. (1794), which has since been in general use, being the only species in which usage has supplanted an earlier specific name.

Field cultures were made in 1805 by Knight (in Banks, A short account of the cause of the disease in corn, 2nd edition. 1806; see also Ramsbottom, Proc. Linn. Soc. Lond., Feb. 1933, p. 80) and in 1816 by Schøler (Land. Tidender. **8:** 150. 1818), both using aeciospores. The first controlled indoor cultures were made in 1864 by de Bary (Monatsb. Preuss. Acad. Wiss. Berlin **1865:** 26. 1865) using teliospores. Since then many persons have made cultures using a large number of gramineous hosts, bringing to light a considerable degree of specialization. Levine & Cotter (U. S. Dep. Agric., Techn. Bull. 300, pages 14–16. 1932) report successful cultures with teliospores from *P. gr. tritici* on 40 species and varieties of *Berberis* (including 2 species of *Mahonia*), from *P. gr. secalis* 78, from *P. gr. avenae* 10, from *P. gr. agrostis* 13, and from *P. gr. poae* 6. Extensive cultures with urediospores have established many physiologic races, the principal recognized ones, based on hosts and cultures with urediospores, are *Puccinia graminis tritici* Erikss. & Henn., *P. gr. bromi* Erikss., *P. gr. secalis* Erikss. & Henn., *P. gr. avenae* Erikss. & Henn., *P. gr. airae* Erikss. & Henn., *P. gr. agrostis* Erikss., and *P. gr. poae* Erikss. & Henn. Each race has also been found to be

separable to a greater or less extent into physiologic forms, usually designated by numbers or letters. Over four score such forms have been recorded for *P. gr. tritici* in the United States. Their detection is of importance in connection with measures for cereal rust control.

(1). **Puccinia graminis phlei-pratensis** (Erikss.&Henn.)Stak.&Piem.(*P. phlei-pratensis* Erikss.&Henn.), with pycnia and aecia on **Berberis**, but rarely formed; uredia abundant, urediospores 13–18 by 21–30 μ; teliospores 14–20 by 38–32 μ; otherwise as in *Puccinia graminis;* occurs on POACEAE (tribe *Agrostideae*): **Phleum pratense**, nearly throughout the United States and southern Canada; also in Europe. (N. A. F. 7: 295, 833.)

Cultures with teliospores on *Berberis vulgaris* by Eriksson and Henning (Zeits. Pflanzenkr. **4:** 141. 1894) in 1892 and 1893 gave positive results in only one instance, pycnia being formed in 16 days and aecia in 16 days more, the latter very small. Many other attempts have been made by the same and other authors with only negative results, the latest being by Levine and Cotter (U. S. Dept. Agric., Techn. Bull. 300. p. 2. 1932).

The variety differs not only by having noticeably smaller spores in all stages, but also a more slender mycelium (Pole Evans, Ann. Bot. **21:** 463. 1907). It was first reported in the United States by Trelease (Trans. Wis. Acad. Sci. **7:** 131. 1885), based on two collections made by L. H. Pammel at Madison, Wis., in the fall and early winter of 1882, and now in the herbarium of the Missouri Botanical Garden. It had spread widely in the next few years (Kern, Torreya **9:** 3. 1909).

61. PUCCINIA ANOMALA. Fig. 188.

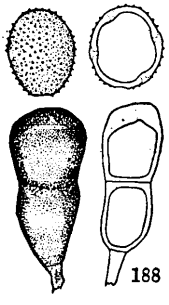
(N. A. F. 7: 339, 782, 837.)

Puccinia straminis simplex Körn., Land. Forstw. Zeit. no. 50. 1865.
Puccinia hordei Otth, Mitt. Nat. Ges. Bern **1870:** 114. 1871. Not *P. hordei* Fckl., 1860.
Puccinia anomala Rostr.; Thüm., Flora **61:** 92. 1878.
Puccinia simplex Erikss. & Henn., Zeits. Pflanzenkr. **4:** 260. 1894. Not *P. simplex* Peck, 1881.
(*Aecidium ornithogaleum* Bubák, Ann. Myc. **3:** 223. 1905.)
Dicaeoma anomalum A. & F., N. Am. Flora **7:** 339. 1920.

Pycnia amphigenous, in groups or widely scattered. Aecia amphigenous, scattered, cupulate; aeciospores globoid or ellipsoid, 19–23 by 23–27 μ; wall colorless, 1.5–2 μ thick, minutely verrucose.

ON LILIACEAE: **Ornithogalum** spp., in Europe only.

Uredia amphigenous, cinnamon-brown; urediospores broadly ellipsoid, 16–24 by 22–29 μ; wall yellowish, 1.5–2 μ thick, finely echinulate, the pores 8–10, scattered, indistinct. Telia amphigenous, blackish-brown, long covered by the epidermis, surrounded by a thin layer of subepidermal brownish paraphyses; teliospores angularly oblong or clavate, 18–25 by 39–58 μ, truncate or obtuse above, narrowed below, slightly constricted at septum; wall chestnut-brown, about 1.5 μ thick at sides, darker and 3–6 μ above; pedicel colored, short. Mesospores abundant, usually more numerous than the two-celled spores, 15–25 by 26–32 μ.


188

ON POACEAE (tribe *Hordeae*): **Hordeum vulgare** L., Calif., Ind., Iowa, Ky., Mich., Mont., N.Y., Ohio, Okla., Ore., Tenn., Wash., Wis.; Man., Ont.

Range: New York to Manitoba southward to Tennessee and Oklahoma, and from Washington to Utah and southern California; also in Mexico, Europe, Japan and New Zealand.

Successful cultures were made in 1915 in Russia by Tranzschel (Myc. Centr. **4:** 70. 1914), using aeciospores from *Ornithogalum umbellatum* and in 1928 Mayor (Bull. Soc. Neuch. Sci. Nat. **54:** 54. 1929) was successful using teliospores. In 1922 Mains (Jour. Agric. Res. **28:** 1124. 1924), used teliospores from four widely separated American localities with success sown on *O. umbellatum,* but when sown on *Nothoscordium bivalve* there was no infection.

Uromyces hordeinus.

(N. A. F. 7: 228, 749, 827.)

Uromyces hordei Tracy, Jour. Myc. **7:** 281. 1893. Not Nielsen, 1875.
Nigredo hordei Arth., N. Am. Flora **7:** 228. 1912.
Nigredo hordeina Arth., N. Am. Flora **7:** 749. 1926.
Uromyces hordeinus n. comb.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores as in *Puccinia anomala.*

On Liliaceae: **Nothoscordium bivalve** (L.)Britt.(*Allium striatum* Jacq.), Kans., Okla., Tex.

Uredia and urediospores as in *Puccinia anomala.* Telia as in *P. anomala* but without subepidermal paraphyses; teliospores one-celled, angularly obovoid or clavate, 15–25 by 26–32 μ; wall and pedicel as in *P. anomala.*

On Poaceae (tribe *Hordeae*): **Festuca octoflora** Walt.(*F. tenella* Willd.), Miss., Tex.—**Hordeum nodosum** L., Colo., Utah.—**H. pusillum** Nutt., Ark., Ind., Iowa, Kans., La., Mo., Neb., Okla., Tex.

Range: Southern Indiana to northern Utah southward to Mississippi and Texas.

The correlation of the one- and two-celled forms was pointed out by the writer (Mycol. **8:** 139. 1916). Outdoor cultures were made by Long in 1904 and 1910, as reported along with cultures in 1915 by Arthur (Mycol. **8:** 139. 1916). Mains (Jour. Agric. Res. **28:** 1124. 1924) also made cultures. Both Arthur and Mains were unable to infect *Ornithogalum umbellatum.* Although structurally *U. hordeinus* and *P. anomala* are correlated, yet they appear to be physiologically distinct.

62. PUCCINIA RUBIGO-VERA. Fig. 189.

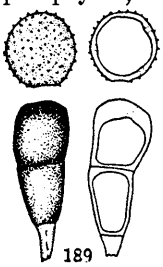
(N. A. F. 7: 311, 331, 332, 333, 337, 778, 781, 782, 835, 836, 837.)

(*Aecidium asperifolii* Pers., Obs. Myc. **1:** 97. 1796.)
Uredo rubigo-vera DC., Fl. Fr. **6:** 83. 1815.
Puccinia elymi Westend., Bull. Acad. Brux. **18²:** 408. 1851.
Puccinia rubigo-vera (DC.) Wint., in Rab., Krypt Fl. **1:** 217. 1881.
(*Aecidium phaceliae* Peck, Bull. Torrey Club **11:** 50. 1884.)
Puccinia perplexans Plowr., Quart. Jour. Micr. Sci. **25:** 164. 1885.
Puccinia tomipara Trel., Trans. Wis. Acad. Sci. **6:** 127. 1885.
Puccinia persistens Plowr., Brit. Ured. Ustil. 180. 1889.
Rostrupia elymi Lagerh., Jour. de Bot. **3:** 188. 1889.
Puccinia clematidis Lagerh., Tromsø Mus. Aarsh. **17:** 54. 1895.
Puccinia holcina Erikss., Ann. Sci. Nat. VIII. **9:** 274. 1899.
Dicaeoma clematidis Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Puccinia perminuta Arth., Bull. Torrey Club **34:** 584. 1907.
Puccinia alternans Arth., Mycol. **1:** 248. 1909.
Puccinia obliterata Arth., Mycol. **1:** 250. 1909.
Dicaeoma holcinum A. & F., N. Am. Flora **7:** 311. 1920.

Pycnia chiefly epiphyllous, in small groups. Aecia hypophyllous, in crowded groups, cupulate or rarely cylindric; aeciospores globoid or ellipsoid, 13–26 by 19–29 μ; wall colorless, 1–2 μ thick, finely verrucose.

On hosts, listed under the several varieties.

Uredia usually amphigenous, cinnamon-brown, with few or no colorless paraphyses; urediospores globoid or broadly ellipsoid, 13–24 by 16–32 μ; wall pale cinnamon-brown or yellowish, 1–2 μ thick, finely echinulate, the pores 6–8, sometimes 4–6, scattered, usually distinct. Telia chiefly hypophyllous, oblong, scattered, long covered by epidermis, with thin layers of dark-brown subepidermal paraphyses; teliospores oblong, clavate or cylindric, 13–24 by 32–65 μ, or on some hosts 10–18 by 26–45 μ, rounded or truncate above, narrowed below, usually not constricted at septum; wall chestnut-brown, paler below, 1 μ or less thick at sides, 3–7 μ above; pedicel colored, very short.



189

On Poaceae: listed under the several varieties.

Range: A cosmopolitan species, occurring throughout the world.

The gramineous leaf rusts placed here as one variable species can be separated into a number of varieties depending upon the combination of aecial and telial hosts, as established by cultures, and to some extent by structure and geographic range. The state of knowledge is at present wholly insufficient to permit such an arrangement to be fully and consistently carried out, but the following divisions should be helpful, and form a basis for further taxonomic study.

(1). **Puccinia rubigo-vera agropyri** (Erikss.)n.comb.(*P. agropyri* E. & E., *Aecidium clematitis* DC.); pycnia often few and poorly developed; aeciospores 15–23 by 15–29 μ.

On Ranunculaceae: **Aconitum delphinifolium** DC., Alas.—**Actaea alba** (L.)Mill.(*A. eburnea* Rydb.), Alas.—**A. arguta** Nutt., Alas., Wash.—**Anemone piperi** Britt., Ida., Wash.—**Aquilegia coerulea** James, Colo., N.M., Utah, Wyo.—**A. elegantula** Greene, Colo.—**A. flavescens** Wats., Ida., Mont., Wyo.; Alta.—**A. formosa** Fisch., Alas., Ida., Ore., Wash.; B.C.—**A. laramiensis** Nels., Wyo.—**A. truncata** Fisch.&Mey., Calif., Ore.—**Clematis lasiantha** Nutt., Calif., Colo.—**C. ligusticifolia** Nutt., Ariz., Calif., Colo., Ida., Mont., Neb., N.M., Ore., S.D., Utah, Wash., Wyo.; Alta., B.C.—**C. pauciflora** Nutt., Calif.—**Delphinium bicolor** Nutt., Mont., S.D.—**D. cucullatum** Nels., Colo.—**D. depauperatum** Nutt., Ore.—**D. geraniifolium** Rydb., Colo.—**D. geyeri** Greene, Colo., Wyo.—**D. glaucescens** Rydb., Wyo.—**D. nelsoni** Greene, Colo., Ida., Wyo.—**D. occidentale** Wats., Utah.—**D. reticulatum** Nels., Wyo.—**D. robustum** Rydb., Colo.—**Ranunculus aleophilus** Nels., Ida.—**R. californicus** Benth., Calif.—**R. cymbalaria** Pursh(*Halerpestes c.* Greene), Alas., Calif., Colo., Mont., Neb., Nev., N.M., S.D., Utah, Wyo.; B.C.—**R. glaberrimus** Hook, Colo., Ida., Mont., Wash.—**R. occidentalis** Nutt., Alas.—**Thalictrum alpinum** L., Colo.; Alta.—**T. fendleri** Engelm., Ariz., Calif., Colo., Ida., Mont., N.M., Utah, Wyo.—**T. occidentale** Gray, Ida., Ore., Utah, Wash., Wyo.; Alta., B.C.—**T. sparsiflorum** Turcz., Calif., Colo.—**Viorna hirsutissima** (Pursh)Heller(*Clematis douglasii* Hook.), Colo., Ida., Mont., Wash., Wyo.—**V. jonesii** (Ktze.)Rydb., Colo., Utah.—**V. scottii** (Porter)Rydb., Colo.

On Poaceae (tribe *Aveneae*): **Avena barbata** Brot., Calif.—**A. fatua** L., Calif.—**A. sativa** L., Alta.—**Holcus lanatus** L.(*Notholcus l.* Nash), Calif., Mass., N.Y., Ore., Wash.; B.C.—**Trisetum montanum** Vasey, Colo.—**T. spicatum** (L.)Richter(*T. subspicatum* Beauv.), Colo.; (tribe *Festuceae*): **Bromus carinatus hookerianus** (Thurb.)Shear(*B. h.*), Calif., Neb., Ore., Wash., Wis.; B.C.—**B. commutatus** Schrad., Ore.—**B. eximius** (Shear)Piper, Calif., Mont.,

Ore.—**B. grandis** (Shear)Hitchc., Ore.—**B. hordeaceus** L.(*B. mollis* L.), Calif., Ore.—**B. madritensis** L., Calif., Miss.—**B. marginatus** Nees, Calif., Colo., Ore., Tex., Utah, Wash., Wyo.—**B. polyanthus** Scribn., Wash., Wyo.—**B. porteri** (Coult.)Nash, Colo., N.M.; Alta.—**B. porteri lanatipes** Shear, Colo.—**B. pumpellianus** Scribn., Colo.; Alta., B.C., Sask.—**B. racemosus** L., Ore.—**B. richardsonii** Link, Colo., Mont., N.M., Utah.—**B. rigidus** Roth, Calif.—**B. rubens** L., Calif.—**B. scoparius** L., Calif.—**B. sitchensis** Bong., Ore., Wash.—**B. sterilis** L., Utah.—**B. subvelutinus** Shear, Wash.—**B. tectorum** L., Calif., Ore.—**B. villosus** Forsk.(*B. maximus* Desf.), Calif., Ore.—**B. villosus gussonei** Aschers.&Graebn., Calif.—**Festuca rubra** L., B.C.—**Melica geyeri** Munro(*M. bromoides* Gray), Calif.—**Poa ampla** Merr., Ore.—**P. arida** Vasey(*P. pratericola* Rydb.), Colo., Mont., Neb.; Man.—**P. fendleriana** (Steud.)Vasey, Utah.—**P. interior** Rydb., Colo.—**P. juncifolia** Scribn., Colo.—**P. longipedunculata** Scribn., Colo.—**P. lucida** Vasey, Colo., Wyo.—**P. nervosa** (Hook.)Vasey, Mont.—**P. nevadensis** Vasey, Wyo.—**P. pratensis** L., Colo.—**P. sandbergii** Vasey, Alta.—**P. scabrella** (Thurb.)Benth., Calif.—**P. scabriuscula** T.A.Will., Colo.—**P. wheeleri** Vasey, Utah.—**Puccinellia nuttalliana** (Schult.)Hitchc. (*Poa n.*), Calif., Colo., N.D., Wyo.; Alta.; (tribe *Hordeae*): **Agropyron caninum** (L.)Beauv., Mont.; Alta.—**A. dasystachyum** (Hook.)Scribn., Ore.; Alta., Sask.—**A. flexuosum** Piper, Ida.—**A. lanceolatum** Scribn.&Sm., Colo., Ore.—**A. molle** (Scribn.&Sm.)Rydb., Colo.—**A. pseudorepens** Scribn.&Sm., Colo., Ida., Neb.—**A. smithii** Rydb.(*A. occidentale* Scribn.), Colo., Mont., N.M., Utah; Alta.—**A. tenerum** Vasey, Calif., Colo., N.M., Utah, Wyo.; Alta.—**A. spicatum** (Pursh)Scribn.&Sm., Colo., Mont., Ore., Utah, Wyo.; Alta.—**A. violaceum** (Hornem.)Lange, Alta.—**Elymus ambiguus** (Vasey&Scribn.) Scribn., Colo., Ida., Wyo.—**E. arenarius** L., Wash.—**E. arenicola** Scribn.&Sm., Ore.—**E. brachystachys** Scribn.&Ball, Colo.—**E. canadensis** L.(*E. robustus* Scribn.&Sm.), Colo., Ida., Mont., N.M., Wyo.—**E. condensatus** Presl, Calif., Colo., Ida., Mont., Neb., N.M., Ore., Utah, Wash., Wyo.—**E. glaucus** Buckl., Calif., Colo., Mont., Ore., Wash., Wyo.—**E. howellii** Scribn.&Merr., Alas.—**E. mollis** Trin., Alas.—**E. striatus** Willd., Colo.—**E. triticoides** Buckl., Ariz., Calif., Colo., Ida., N.M., Ore., Utah.—**E. vancouverensis** Vasey, Wash.; B.C.—**E. virescens** Piper, Alas.—**Sitanion californicum** J.G.Sm., Ore.—**S. hystrix** (Nutt.)J.G.Sm.(*S. elymoides* Raf.), Ariz., Calif., Colo., N.M., Ore., Utah.—**S. jubatum** J.G.Sm., Ore., Utah. **Range:** Mountainous regions from western Manitoba to southeastern Alaska, southward to Texas and California, and on the Atlantic Coast in Massachusetts and New York; also in Europe.

Successful cultures were first made at Leipzig in 1892 by Dietel (Oesterr. Bot. Zeits. **42:** 262. 1892), using teliospores from "*Agropyron glaucum*", *i.e.*, *A. smithii*, sown on *Clematis vitalba*. The telial material was from Montana, supplied by Ellis from the type collection of *Puccinia agropyri*. Other cultures followed with European material. American cultures were begun in 1907 by Arthur (Jour. Myc. **14:** 16. 1908) with teliospores from *Agropyron pseudorepens*, sown on *Clematis virginiana* and *Viorna scottii*, continued in 1908 and 1911 (Mycol. **1:** 246. 1909; same **4:** 54. 1912) with teliospores from *Puccinellia nuttalliana* sown on *Ranunculus cymbalaria*, in 1908 (Mycol. **1:** 248. 1909) with teliospores from *Bromus porteri* on *Thalictrum sparsiflorum* (basis for *P. alternans*), in the same year with teliospores from *Agropyron violaceum* on *Aquilegia canadensis* (basis for *P. obliterata*), in 1909 (Mycol. **2:** 161. 1910) with teliospores from *Agropyron* sp. on *Thalictrum alpinum* and sparingly on *T. dioicum*, and finally in 1912 (Mycol. **7:** 73. 1915) with teliospores from *Elymus canadensis* on *Clematis ligusticifolia* and from *Agropyron smithii* on the same host. The telial material for these several cultures came from various localities in Colorado. Other cultures have been reported by Mains (Papers Mich. Acad. **17:** 298–356. 1933).

(2). **Puccinia rubigo-vera agropyrina** (Erikss.)n.comb.(*P. agropyrina* Erikss.), with pycnia abundant; aeciospores 13–19 by 16–24 μ.

On Ranunculaceae: **Actaea brachypoda** Ell.(*A. alba* Big., not Mill.), Iowa, Mich., Minn., N.Y., Ohio, Tenn., Wis.; Ont.—**A. rubra** (Ait.)Willd., Minn., N.Y.—**Anemone canadensis** L.(*A. pennsylvanica* L.), N.Y.—**A. cylindrica** Gray, Colo., Iowa, Mich., Minn., Mo., Neb., N.Y., N.D., S.D.; Alta., B.C., Ont., Sask.—**A. globosa** Nutt., Mont., S.D.; Alta., Sask.—**A. hudsoniana** Richards.(*A. multifida* Gray, not Poir.), Queb.—**A. nemorosa** L., Iowa.—**A. quinquefolia** L., Iowa, Wis.; Ont.—**A. riparia** Fern., Vt.; Ont.—**A. virginiana** L., Ind., Iowa, Minn., Wis.—**Cimicifuga racemosa** (L.)Nutt., Ind., N.Y., Ohio, Pa., Tenn., W.Va.—**Clematis drummondii** T.&G., Ariz., Tex.—**C. virginiana** L., Conn., Ind., Iowa, Me., Md., Mich., Mo., Neb., N.H., N.Y., N.C., Pa., Tenn., Vt.—**Cyrtorhyncha ranunculina** Nutt.(*Ranunculus nuttallii* Gray), Colo.—**Delphinium tricorne** Michx., Neb.—**D. virescens** Nutt., Neb.—**Isopyrum biternatum** (Raf.)T.&G., Iowa.—**Ranunculus abortivus** L., Wis.—**R. acris** L., N.S.—**R. affinis** R.Br., Alta.—**R. cardiophyllus** Hook., Alta.—**R. cymbalaria** Pursh(*Halerpestes c.* Greene), N.D.; Alta., N.S., Sask.—**R. sceleratus** L.(*R. eremogenes* Greene), N.D.—**R. septentrionalis** Poir., N.Y.—**Syndesmon thalictroides** (L.)Hoffm.(*Anemone t.*), Ind., Mo.—**Thalictrum dasycarpum** Fisch.&Lall.(*T. purpurascens* Auth., not L.), Colo., Conn., Iowa, Mont., Neb., N.H., N.Y., N.D., S.D., Vt., Wis., Wyo.; Man., Sask.; Newf.—**T. dioicum** L., Mass., Mich., Minn., Mont., N.Y., Pa., S.D., Vt.; Sask.—**T. megacarpum** Torr., Mont., Wyo.—**T. revolutum** DC., N.Y., W.Va.—**T. venulosum** Trel.(*T. thyrsoideum* Greene), Colo., Mont., N.D.; Alta.—**Viorna fremontii** (Wats.)Heller, Kans.—**V. reticulata** (Walt.)Small, Tex.—**V. urnigera** Spach(*Clematis viorna* L., *V. v.* Small), Iowa.

On Poaceae (tribe *Agrostideae*): **Alopecurus pratensis** L., N.S.; (tribe *Festuceae*): **Bromus ciliatus** L., Minn., N.H., S.D., Wis.; Alta., Man., N.S., Ont., Sask.—**B. ciliatus laeviglumis** Scribn., Wis.; Ont.—**B. japonicus** Thunb., Ind.—**B. latiglumis** (Shear)Hitchc., Man., Sask.—**B. purgans** L., Ind., Iowa, Mich., Mo., Neb., N.D., W.Va., Wis.; Ont.—**B. secalinus** L., Ind., N.C., Ore.—**Fluminia festucacea** (Willd.) Hitchc. (*Scolochloa f.* Link), Mont., N.D.—**Puccinellia angustata** (R.Br.)Rand&Redf., Me.—**P. maritima** (Huds.) Parl., N.S.—**P. tenuiflora** (Griseb.)Scribn.&Merr., Sask.; (tribe *Hordeae*): **Agropyron albicans** Scribn.&Sm., Alta.—**A. repens** (L.)Beauv., common east of the Rocky Mountains.—**A. richardsonii** (Trin.)Schrad., Man.—**A. smithii** Rydb.(*A. occidentale* Scribn.), Ind., Iowa, Kans., Minn., Neb., N.D., Okla., S.D.—**A. tenerum** Vasey, Iowa, Mont., Neb., N.D., S.D., Wis.; Man.—**Elymus australis** Scribn.&Ball, Ark.—**E. curvatus** Piper, Man.—**E. canadensis** L.(*E. robustus* Scribn.&Sm.), Iowa, Kans., Neb., N.D.—**E. diversiglumis** Scribn.& Ball, Sask.—**E. jejunus** (Ram.)Rydb., Man.—**E. macounii** Vasey, Alta.—**E. virginicus** L., Iowa, Kans., Neb., Okla., Tex.; Man.—**Glyceria grandis** Wats. (*Panicularia g.* Nash), Ind., Iowa, Minn., S.D.; Queb.—**Hordeum jubatum** L., Colo., Ind., Ill., Iowa, Minn., Mo., Neb., N.D., Wis.; Man.—**H. vulgare** L., Tex.—**Hystrix patula** Moench(*H. hystrix* Millsp.), Minn.; Queb. **Range:** Plains and foothills east of the Rocky Mountains; also in Europe and Japan.

Successful cultures were made in 1885 by Plowright (Quart. Jour. Micr. Sci. **25:** 165. 1885), by using both aeciospores from *Ranunculus acris* and teliospores from *Alopecurus pratensis* (basis for *P. perplexans*), which were confirmed by Tranzschel in 1913 (Myc. Centr. **4:** 71. 1914) by sowing teliospores from *A. brachystachyus* on *R. acris*, and with American material in 1911 by Fraser (Mycol. **4:** 179. 1912), who sowed aeciospores from *R. acris* on *A. pratensis*. Again cultures in 1888 by Plowright (Brit. Ured. Ustil. 181. 1889) with reciprocal sowings between aecia-bearing *Thalictrum flavum* and telia-bearing *Triticum repens* gave basis for *P. persistens*. American cultures were made in 1904, 1906 and 1908 by Arthur (Jour. Myc. **11:** 62. 1905; same **13:** 197. 1907; Mycol. **1:** 236. 1909), with teliospores from *Bromus ciliatus* applied to *Clematis virginiana*, and in 1912 (Mycol. **7:** 73. 1915), with teliospores from *Elymus canadensis*, sown on *Anemone cylindrica* and in 1914 (Mycol. **7:** 82. 1915) from *E. virginicus* on *Clematis drummondii*. In 1918 Fraser (Mycol. **11:** 131. 1919) used aeciospores from *Thalictrum dasycarpum* successfully on *Elymus canadensis, E. virginicus, Bromus ciliatus,* and *Hordeum jubatum*. On *Bromus* the teliospores obtained were pluricellular (*P. tomipara*), although the aeciospores were from the same source as in the other instances. Again in 1922 aeciospores from *Anemone cylindrica* and *A. globosa* were successfully used by Fraser (Mycol. **17:** 78. 1925) on *Agropyron tenerum, A. spicatum, A. dasystachyum* and *Elymus canadensis*, and repeated in 1923 (*l.c.*) on *A. spicatum, A. richardsonii, Elymus canadensis, E. diversiglumis,* and weak infection on a number of other grasses. In the same series of cultures aeciospores from *Actaea* sp. gave infection on *Hystrix patula*. Further cultures have been reported by Mains (Papers Mich. Acad. **17:** 298–351. 1933).

(3). **Puccinia rubigo-vera tritici** (Erikss. & Henn.) Carl. (*P. triticina* Erikss.); aeciospores 14–22 by 17–26 μ.

On Ranunculaceae: **Thalictrum** sp.; no field collections of aecia on native species have yet been identified with the wheat rust, although undoubtedly such do occur.

On Poaceae (tribe *Hordeae*): **Aegilops ovata** L., Ore.—**Triticum aestivum** L.(*T. vulgare* Vill.), everywhere that wheat is grown.—**T. compactum** Host, Calif., Mo.—**T. dicoccoides** Körn., Tex.—**T. dicoccum** Schr., Mo., Tex.—**T. durum** Desf., Mo., Neb.—**T. monococcum** L., Mo.—**T. polonicum** L., Man.—**T. spelta** L., Minn., Mo., Okla., Tex.

Successful cultures to ascertain the aecial connection were first made in 1919 and 1920 by Jackson and Mains (Jour. Agric. Res. **22:** 154–164. 1921), by sowing teliospores from *Triticum aestivum*, received from various parts of the United States, chiefly east of the Rocky Mountains, on various foreign species of *Thalictrum*, and on *T. dioicum, T. polygamum* (*T. purpurascens*) and *T. dasycarpum*. Infection was weaker on the native species than on the foreign ones. Aeciospores from these cultures were sown on *Aegilops* and *Triticum* with success, (see also Papers Mich. Acad. **17:** 302–304, 318–322. 1933). More recently similar cultures have been carried out in France, Germany, Russia and Japan. Judging from measurements of culture material, the spores of this variety appear to be intermediate in size between those of *P. r. agropyri* and *P. r. agropyrina*.

(4). **Puccinia rubigo-vera secalis** (Erikss.) Carl. (*P. dispersa* Erikss. & Henn. in part, *P. secalina* Grove, *Dicaeoma asperifolii* Ktze., *P. a.* Wettst.); aeciospores 13–21 by 23–29 μ.

On Boraginaceae: **Lycopsis arvensis** L.(*Anchusa a.* Bieb.), Ind.—**L. capensis** Thunb.(*A. c.*), Ind.

Uredia and telia as in the other races of *P. rubigo-vera*, except that the teliospores usually germinate upon maturity, but sometimes they overwinter before germinating, as usually occurs in the other races.

On Poaceae (tribe *Hordeae*): **Secale cereale** L., over much of the northern area of the United States and southern Canada, wherever rye is cultivated; and throughout the temperate part of the world.

Successful cultures were made in 1865 by de Bary (Monatsb. Preuss. Akad. Sci. Berlin **1866**: 208. 1866), using both aeciospores and teliospores, and have been repeated many times in Europe. The cultures with American material were made in 1908 and an outdoor culture in 1915 by Arthur (Mycol. **1**: 237. 1909; same **8**: 133. 1916), with teliospores sown on *Anchusa arvensis*, but without maturing aecia, and in 1920 by Mains & Jackson (Jour. Agric. Res. **28**: 1122. 1928), using teliospores sown on *Anchusa arvensis* and aeciospores from *A. capensis* on *Secale* (see also Papers Mich. Acad. **17**: 361. 1933). Owing to the rarity of susceptible species of *Lycopsis* in America, the aecia may not often be seen.

(5). **Puccinia rubigo-vera apocrypta** (Ellis&Tr.)n.comb.(*P. apocrypta* Ellis & Tr., *Dicaeoma a.* Ktze.); aeciospores 16–26 by 21–29 μ.

On Hydrophyllaceae: **Ellisia nyctelea** L.(*Nyctelea n.* Britt., *Macrocalyx n.* Ktze.), Iowa, Kans., Neb., Okla.—**Hydrophyllum albifrons** Heller(*H. congestum* Wieg.), Ida., Ore., Wash.—**H. appendiculatum** Michx., Ill.—**H. capitatum** Dougl., Colo., Ida., Mont., Ore., Utah, Wash., Wyo.—**H. fendleri** (Gray)Heller, Colo., Ida., N.M., Utah, Wyo.—**H. occidentale** Gray, Calif.—**H. tenuipes** Heller, Ore., Wash.—**H. virginianum** L., Iowa, Minn., Neb., N.Y., N.D.—**H. watsoni** (Gray)Rydb., Calif., Utah.—**Phacelia alpina** Rydb., Utah.—**P. californica** Cham., Calif.—**P. circinata** Jacq., Calif.—**P. distans** Benth., Calif.—**P. heterophylla** Pursh, Colo., Mont., N.M., Ore., Utah, Wyo.; B.C.—**P. hispida** Gray, Calif.—**P. leucophylla** Torr., Colo., Ida., Mont., Ore., Wyo.—**P. ramosissima** Dougl., Calif.—**P. tanacetifolia** Benth., Calif.—On Boraginaceae: **Lithospermum canescens** (Michx.)Lehm., N.D.—**L. linearifolium** Goldie(*L. angustifolium* Michx.), Neb., N.D., S.D.—**Mertensia laevigata** Piper, Ida., Ore.—**M. lanceolata** (Pursh)DC., Colo.—**M. paniculata** (Ait.)G.Don, Mont.—**M. subcordata** Greene, Ida.—**Onosmodium occidentale** Mack., Colo., Kans., Neb., N.D.

On Poaceae (tribe *Hordeae*): **Agropyron smithii** Rydb.(*A. occidentale* Scribn.), Colo., N.D.—**A. tenerum** Vasey, Colo., Neb., N.D., Utah.—**A. violaceum** (Hornem.)Lange, Colo.—**Elymus canadensis** L.(*E. robustus* Scribn.& Sm.), Kans., Neb.—**E. glaucus** Buckl., Calif., Colo., Ore., Utah, Wash.—**E. virginicus** L., Kans.—**Sitanion hystrix** (Nutt.)J.G.Sm.(*S. elymoides* Raf.), Calif., Colo. **Range**: Minnesota to British Columbia, southward to Oklahoma and southern California.

A successful culture in 1915 by Arthur (Mycol. **8**: 138. 1916), employed aeciospores from *Hydrophyllum capitatum* sown on *Agropyron tenerum*, with a weak infection on *Elymus virginicus*. Outdoor cultures with heavy infections were obtained in 1913 by Bethel at Denver, Colorado, using teliospores from *Agropyron tenerum* sown both on *Phacelia heterophylla* and *Onosmodium occidentale*, the record being in the Arthur Herbarium, but was not published. Cultures were also made by Mains (Papers Mich. Acad. **17**: 365–6, 372–4. 1933) using aeciospores from *Onosmodium occidentale* sown on *Agropyron smithii*, the resulting teliospores sown on *O. occidentale* and *Ellisia nyctelea*, and aeciospores from the latter sown on *A. smithii*, and from *Hydrophyllum* sp. sown on *Elymus glaucus*, *E. virginicus* and *Hystrix patula*, and also aeciospores from *Phacelia distans* sown on *Bromus brizaeformis* and other species of *Bromus*.

(6). **Puccinia rubigo-vera impatientis** (Arth.) Mains (*P. impatientis* Arth., *Dicaeoma i.* Arth.); Aeciospores small, 16–21 by 19–24 μ.

On Balsaminaceae: **Impatiens biflora** Walt.(*I. fulva* Nutt., *I. maculata* Muhl.), Ark., Conn., Ind., Mich., Miss., Neb., N.J., N.Y., N.C., N.D., Ohio, Pa., S.D., Vt., Wash.; Man., Ont., Queb.—**I. pallida** Nutt.(*I. aurea* Wats.),

Conn., Del., D.C., Ind., Iowa, Kans., Md., Mich., Minn., Mo., Neb., N.Y., N.D., Pa., S.D., Tenn., Wis., W.Va.; Ont.

Urediospores 13–18 by 16–22 μ, the pores 4–6; teliospores 10–15 by 25–39 μ.

On Poaceae (tribe *Agrostideae*): **Agrostis alba** L., N.Y.—**A. hyemalis** (Walt.)B.S.P.(*A. scabra* Willd.), Del., Me., N.Y.—**A. perennans** (Walt.)Tuckerm., Del., D.C., Ind., Ky., Me., Mo., Ohio, Pa., Tenn., W.Va., Wis.; N.S.—**Cinna arundinacea** L., Md., Mo., N.Y., Wis.—**C. latifolia** (Trev.)Griseb., N.H., Wis. (tribe *Hordeae*): **Elymus canadensis** L.(*E. robustus* Scribn.&Sm.), Conn., Del., Ind., Iowa, Kans., Minn., Mo., Neb., N.Y., N.D., Ohio, Okla., Tenn., Tex., W.Va.—**E. striatus** Willd., Ind., Neb., N.Y., Okla., Tenn., Wis.—**E. striatus arkansanus** (Scribn.&Ball)Hitchc., Ind.—**E. virginicus** L., Ark., Ill., Ind., Kans., Ky., Mo., Neb., N.Y., Okla., Pa., Tenn., Tex., Va., W.Va., Wis.; Ont., Queb.—**Hordeum jubatum** L., Man.—**Hystrix patula** Moench(*H. hystrix* Millsp.), Ind., Ky., Wis. **Range**: Nova Scotia to eastern Washington, southward to North Carolina and Texas, mainly east of the Rocky Mountains.

This variety, besides having aecial hosts in a different family, is especially notable for the small size of all the spores. Cultures were made in 1902, 1903 and 1904 by Arthur (Bot. Gaz. **35:** 18. 1903; Jour. Myc. **10:** 11. 1904; same **11:** 57. 1905), by sowing teliospores from *Elymus virginicus* on *Impatiens pallida*, and in 1909 (Mycol. **2:** 226. 1910) from *E. striatus* on same host, and in same year by sowing aeciospores from same host on *Elymus canadensis*, *E. striatus* and *E. virginicus* with good results. In 1918 Fraser (Mycol. **11:** 131. 1919) successfully sowed aeciospores from *I. biflora* on *Hordeum jubatum*. Further cultures are recorded by Mains (Papers Mich. Acad. **17:** 374–377. 1933) using teliospores from *Agropyron tenerum*, *Elymus canadensis*, *E. virgatus* and *Hordeum jubatum* sown on *I. biflora*, and reciprocal cultures from each.

Uromyces alopecuri.

(N. A. F. 7: 227, 748, 827.)

Uromyces alopecuri Seym., Proc. Bost. Soc. Nat. Hist. **24:** 186. 1889.
Nigredo alopecuri Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia and aecia as in *Puccinia rubigo-vera*, with aeciospores 13–18 by 19–23 μ.

On Ranunculaceae: **Ranunculus macounii** Britt., Man., Sask.—**R. micranthus** Nutt., Alta.—**R. sceleratus** L.(*R. eremogenes* Greene), Colo.; Man.

Uredia and telia as in *P. rubigo-vera*, except the teliospores one-celled, subpyriform or obovate; wall 1.5–2 μ thick at sides, 2–4 μ above, subepidermal paraphyses poorly developed.

On Poaceae (tribe *Agrostideae*): **Alopecurus aristulatus** Michx., Colo., Minn., Neb., Wyo.; Man., Sask.

Range: Manitoba to Saskatchewan, southward to Nebraska and Colorado; also in Japan and Formosa.

Cultures were made in 1918 by Fraser (Mycol. **11:** 129. 1919), by sowing aeciopores from *Ranunculus macounii* on *Alopecurus aristulatus*, and again in 1920 (same **14:** 229. 1922), with aeciospores from *R. apetalus* on *A. aristulatus*. This species is correlated with *Puccinia rubigo-vera agropyrina*.

Uromyces dactylidis.

(N. A. F. 7: 229, 750.)

Uromyces dactylidis Otth, Mitt. Nat. Ges. Bern **1861:** 85. 1861.
Uromyces poae Rabh., Unio itin. no. 38. 1866.

Nigredo poae Arth., N. Am. Flora **7:** 229. 1912.
Nigredo dactylidis Arth., N. Am. Flora **7:** 750. 1926.

Pycnia and aecia as in *Puccinia rubigo-vera.*

On Ranunculaceae: **Ranunculus repens** L., N. S.

Uredia and telia as in *P. rubigo-vera,* except the teliospores one-celled, obovate, 15–19 by 24–29 μ, usually surrounded by abundant subepidermal paraphyses; wall 1.5 μ thick at sides, 3–4 μ above.

On Poaceae (tribe *Festuceae*): **Dactylis glomerata** L., Mass., N.C., Tenn., Va.—**Poa crocata** Michx., Alta.—**P. pratensis** L., Vt.; Alta.—**P. trivialis** L., N.S.

Range: Widely scattered localities east of the Rocky Mountains; much more common in Europe and New Zealand.

The forms on *Dactylis* and *Poa* are usually kept distinct although morphologically not clearly distinguishable. Much culture work has been done in Europe, resulting in many races (*cf.* Sydow, Monog. Ured. **2:** 312–316), and some in New Zealand, but no cultures have been made in America. The correlation is apparently with *Puccinia rubigo-vera agropyrina,* judging from the range, although corresponding two-celled forms in the same region are rare.

Uromyces amphidymus.

(N. A. F. 7: 228, 749.)

Uromyces amphidymus Syd., Ann. Myc. **4:** 29. 1906.
Uromyces glyceriae Arth., Bull. Torrey Club **37:** 572. 1910.
Nigredo amphidyma Arth., N. Am. Flora **7:** 228. 1912.

Pycnia and aecia unknown. Uredia and telia as in *Puccinia rubigo-vera,* except the teliospores one-celled, obovate, 14–19 by 21–34 μ, with subepidermal paraphyses apparently absent; wall 1–1.5 μ thick at sides, 5–7 μ above.

On Poaceae (tribe *Festuceae*): **Glyceria acutiflora** Torr. (*Panicularia a.* Ktze.), R.I.—**G. septentrionalis** Hitchc. (*P. s.* Bickn.), Ill., Ind., Wis. **Range:** A few localities in mid-western states, and one collection from Rhode Island.

This species appears to be correlated with the two-celled variety on *Glyceria, Puccinia rubigo-vera agropyrina,* in which the subepidermal paraphyses are scantily developed.

Puccinia pulsatillae.

(N. A. F. 7: 527.)

Puccinia compacta de Bary, Bot. Zeit. **16:** 83. 1858. Not Berk., 1855.
Puccinia pulsatillae Kalchbr., Math. Term. Kozlem **3:** 307. 1865.
Puccinia debaryana Thüm., Flora **58:** 364. 1875.
Puccinia trautvetteriae Syd. & Holw.; Syd., Monog. Ured. **1:** 552. 1903.
Micropuccinia pulsatillae A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, blackish, covered by shining epidermis, with golden-brown subepidermal paraphyses; teliospores oblong-clavate or cylindric, 12–22 by 30–75 μ, rounded or acute above, narrowed below, slightly constricted at septum; wall 1.5–3 μ thick at sides, 4–8 μ above; pedicel colored, short.

On Ranunculaceae: **Anemone drummondii** Wats., Ore.—**A. parviflora** Michx., B.C., Queb.—**Clematis lasiantha** Nutt., Calif.—**Pulsatilla ludoviciana** (Nutt.) Heller (*P. hirsutissima* Britt., *Anemone patens nuttalliana* Gray), Colo., Iowa, N.D., S.D.; Alta., Sask.—**Trautvetteria grandis** Nutt., Ida., Ore., Wash.;

B.C. **Range:** Eastern Quebec to British Columbia, southward to Colorado and central California; also in Europe, eastern Asia and Japan.

This microcyclic species is correlated largely with *Puccinia rubigo-vera agropyri*, as shown by Travelbee (Proc. Ind. Acad. Sci. **1914:** 233. 1915), but the range extends somewhat farther over the plains and to one northern locality in Quebec.

Puccinia phaceliae.

(N. A. F. 7: 557, 804.)

Puccinia phaceliae Syd. & Holw.; Syd., Monog. Ured. **1:** 314. 1902.
Micropuccinia phaceliae A. & J., N. Am. Flora **7:** 557. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia and teliospores as in *Puccinia rubigo-vera*, occasionally with mesospores.

On Hydrophyllaceae: **Phacelia sericea** (Grah.)Gray, Wash. **Range:** Known only from Mount Tacoma, Wash.

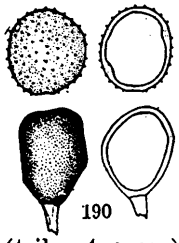
This microcyclic species is closely correlated with *Puccinia rubigo-vera apocrypta* as pointed out in the N. Am. Flora **7:** 557. 1922.

63. UROMYCES JACKSONII. Fig. 190.

(N. A. F. 7: 748.)

Uromyces jacksonii A. & F., Torreya **15:** 260. 1915.
Nigredo jacksonii Arth., N. Am. Flora **7:** 748. 1926.

Pycnia and aecia unknown. Uredia amphigenous, tardily dehiscent by slit in the epidermis, yellow, without paraphyses; urediospores globoid or broadly ellipsoid, 21–27 by 24–30 μ; wall pale-yellow, 1.5–2 μ thick, finely echinulate, the pores 6–8, scattered. Telia amphigenous, long covered by the epidermis, blackish; teliospores angularly globoid or ellipsoid, 19–25 by 20–30 μ; wall light chestnut-brown, uniformly 1.5 μ thick; pedicel colorless, about half length of spore.



190

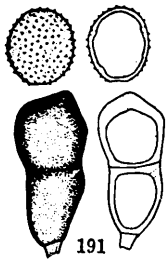
On Poaceae (tribe *Agrostideae*): **Agrostis hallii** Vasey, Ore.—**A. pallens** Trin., Calif.—**A. palustris** Huds., Ore.; (tribe *Aveneae*): **Deschampsia caespitosa** (L.)Beauv.(*Aira c.*), Calif., Ore.—**D. danthonioides** Trin.(*A. d.* Munro, *D. calycina* Presl), Calif.—**D. elongata** (Hook.)Munro(*A. e.*), Ore., Wash., (tribe *Hordeae*): **Hordeum boreale** Scribn. &Sm., Calif.—**H. jubatum** L., Ore.—**H. nodosum** L., Calif., Ore., Wash.—**Scribneria bolanderi** (Thurb.)Hack., Ore. **Range:** Northern Washington to central California.

64. PUCCINIA HORDEI. Fig. 191.

(N. A. F. 7: 339, 782.)

Puccinia hordei Fckl., Jahrb. Ver. Nat. Nassau **15:** 16. 1860.
Dicaeoma hordei A. & F., N. Am. Flora **7:** 339. 1920.

Pycnia and aecia unknown. Uredia mostly epiphyllous, opening by a longitudinal slit, pale-yellow or cinnamon-brown; urediospores ellipsoid or obovoid, 18–24 by 22–28 μ; wall pale-yellow or colorless, 1–1.5 μ thick, finely echinulate, the pores 9–12, large, scattered, distinct. Telia mostly hypophyllous, chocolate-brown, long covered by the epidermis, surrounded by a thin layer of chocolate-brown subepidermal paraphyses; teliospores angularly obovoid or cla-


191

vate, 16–24 by 39–58 μ, obtuse or truncate above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, darker and 3–7 μ above; pedicel colorless, short. Mesospores few, angularly obovoid, 16–23 by 32–40 μ.

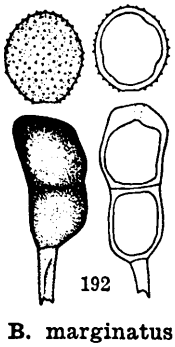
On Poaceae (tribe *Hordeae*): **Hordeum gussoneanum** Parl., Calif.—**H. montanense** Scribn., Ore.—**H. murinum** L., Calif., Ore.—**H. nodosum** L., Calif., Ore. **Range:** Oregon to southern California; also in Europe.

65. PUCCINIA GLUMARUM. Fig. 192.

(N. A. F. 7: 338, 782, 837.)

Uredo glumarum Schmidt, Nat. Landw. Schädl. Pilze. 1819.
Puccinia neglecta Westend., Bull. Soc. Bot. Belg. **2:** 248. 1863.
Puccinia glumarum (Schmidt) Erikss. & Henn., Zeits. Pflanzenkr. **4:** 197. 1894.
Dicaeoma glumarum A. & F., N. Am. Flora **7:** 338. 1920.

Pycnia and aecia not positively known. Uredia epiphyllous and on sheaths and inflorescence, in long lines on golden-yellow streaks, orange-yellow, with hyphoid paraphyses sometimes present; urediospores globoid or ellipsoid 16–26 by 19–30 μ; wall colorless, 1–2 μ thick, very finely echinulate, the pores 10–15, small, scattered, indistinct. Telia hypophyllous, in long fine lines, long covered by the epidermis, blackish, with a thin layer of subepidermal paraphyses; teliospores oblong-clavate, 13–24 by 32–56 μ, truncate or rounded above, narrowed below, slightly constricted at septum; wall chestnut-brown, paler below, 1 μ thick at sides, 3–6 μ above; pedicel colored, short. Mesospores sometimes present, 12–16 by 26–32 μ.


192

On Poaceae (tribe *Festuceae*): **Bromus carinatus hookerianus** (Thurb.)Shear(*B. h.*), Wash.—**B. ciliatus** L., Alta.—**B. marginatus** Nees, Wash.; B.C.—**B. pacificus** Shear, Wash.—**B. sitchensis** Bong., Wash.; B.C.—**B. unioloides** (Willd.)H.B.K., Calif.; (tribe *Hordeae*): **Aegilops cylindrica** Host, Wash.—**A.** sp., Sask.—**Agropyron cristatum** Beauv., Calif., Ida., Wash.; Alta.—**A. dasystachyum** (Host) Scribn., Alta.—**A. desertorum** Schult., Alta.—**A. elongatum** Host, Alta.—**A. griffithsii** Scribn. &Sm., Alta.—**A. obtusiosculum** Lange, Alta.—**A. repens** (L.)Beauv., Alta.—**A. richardsonii** (Trin.)Schrad., Alta., B.C.—**A. smithii** Rydb.(*A. occidentale* Scribn.) Colo.; Alta., B.C.—**A. spicatum** (Pursh)Scribn.&Sm., Alta.—**A. tenerum** Vasey, Alta.—**Elymus canadensis** L.(*E. robustus* Scribn.&Sm.), Wash.—**E. glaucus** Buckl., Calif., Ore., Utah, Wash., Wyo.; B. C.—**E. howellii** Scribn. &Merr., B.C.—**E. marginalis** Rydb., B.C.—**Hordeum caespitosum** Scribn., B.C. —**H. depressum** (Scribn.&Sm.)Rydb., Calif.—**H. gussoneanum** Parl., Ore.—**H. jubatum** L., Colo., Ida., Mont., Utah, Wash., Wyo.; Alta., B.C., Sask.—**H. murinum** L., Calif.—**H. nodosum** L., Calif., Colo., Wash.—**H. pusillum** Nutt., Utah. —**H. vulgare** L., Ore., Wash.; Alta.—**Secale cereale** L., Ida.—**Sitanion hystrix** (Nutt.)J.G.Sm.(*S. elymoides* Raf.), Colo., Ore.—**S. jubatum** J.G.Sm., Calif., Ore., Wash.—**Triticum aestivum** L.(*T. vulgare* Vill.), Ariz., Ida., Mont., Ore., Wash.; Alta., B.C., Sask.—**T. compactum** Host, Ore.—**T. dicoccum** Schrank,

Ore.—**T. durum** Desf., Ida.—**T. spelta** L., Ida. **Range:** Western Saskatchewan to British Columbia, southward to Colorado and Arizona; also in Mexico, South America, Europe, northern Africa and Japan.

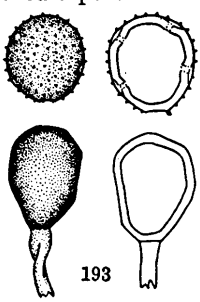
From field observations Tranzschel (Trans. Russian Acad. Sci. **1926:** 99. 1927) considers that the systemic *Aecidium valerianellae* Biv. may be the aecial form of this species, while Mains (Mycol. **25:** 411. 1933) considers that the aecia probably occur on *Mahonia.*

66. UROMYCES MYSTICUS. Fig. 193.

(N. A. F. 7: 228, 750, 827.)

Uromyces mysticus Arth., Bull. Torrey Club **38:** 377. 1911.
Nigredo mystica Arthur., N. Am. Flora **7:** 228. 1912.

Pycnia and aecia unknown. Uredia chiefly epiphyllous, golden-brown; urediospores broadly ellipsoid, 24–28 by 27–32 μ; wall yellow, 2–2.5 μ thick, finely echinulate, the pores 8–12, scattered. Telia chiefly hypophyllous, long covered by the epidermis, blackish; teliospores angularly obovoid, 18–26 by 26–33 μ, rounded or angular above, rounded or narrowed below; wall chestnut-brown, uniformly 2–2.5 μ thick, smooth but appearing granular when wet; pedicel light-yellow, one half to once length of spore.


193

On Poaceae (tribe *Hordeae*): **Hordeum jubatum** L., Colo., Ida., N.M., Utah.—**H. nodosum** L., Utah, Wash. **Range:** Colorado to Washington, southward to New Mexico and Utah.

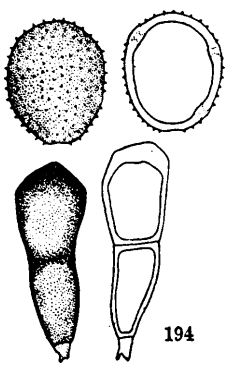
67. PUCCINIA PROCERA. Fig. 194.

(N. A. F. 7: 330, 781.)

Puccinia procera D. & H.; Diet., Erythea **1:** 249. 1893.
Dicaeoma procerum Ktze., Rev. Gen. **3³:** 469. 1898.

Pycnia epiphyllous. Aecia hypophyllous, grouped, cupulate; aeciospores globoid, 26–32 by 29–38 μ; wall colorless, 1.5–2.5 μ thick, verrucose.

On Hydrophyllaceae: **Ellisia chrysanthemifolia** Benth. (*Eucrypta c.* Greene), Calif.—**Phacelia distans** Benth., Calif.


194

Uredia chiefly epiphyllous, cinnamon-brown; urediospores obovoid or ellipsoid, 26–32 by 32–48 μ; wall cinnamon-brown, 1.5–2.5 μ thick, finely echinulate, the pores about 8, scattered. Telia hypophyllous, long covered by the epidermis, blackish; teliospores oblong or cylindric, 15–23 by 45–80 μ, truncate or angled above, narrowed below, slightly or not constricted at septum; wall light chestnut-brown, 1–1.5 μ thick at sides, darker and 3–7 μ above; pedicel colored, short.

On Poaceae (tribe *Hordeae*): **Elymus condensatus** Presl, Calif.—**E. mollis** Trin., Calif.

Range: Southern California.

Reciprocal cultures were made in the greenhouse at Lafayette by Mains in 1921 (Papers Mich. Acad. **17:** 372. 1933) by sowing teliospores from *Elymus condensatus*

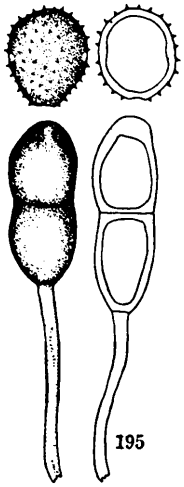
and producing aecia on *Phacelia distans* and then infecting *E. condensatus* with the aecia thus produced.

68. PUCCINIA ARUNDINARIAE. Fig. 195.

(N. A. F. 7: 340, 783.)

Puccinia arundinariae Schw., Schr. Nat. Ges. Leipzig **1:** 72. 1822.
Dicaeoma arundinariae Ktze., Rev. Gen. **3³:** 467. 1898.

Pycnia and aecia unknown. Uredia hypophyllous, dark cinnamon-brown; urediospores globoid or broadly ellipsoid, 26–29 by 29–34 μ; wall dark cinnamon-brown, 2–2.5 μ thick, strongly echinulate, the pores 4, sometimes 3, equatorial. Telia chiefly hypophyllous, prominent, chocolate-brown; teliospores oblong or cylindric, 18–24 by 47–77 μ, somewhat narrowed at each end, slightly constricted at septum; wall light chestnut-brown, 2–2.5 μ thick at sides, 4–7 μ above; pedicel colorless, once to twice length of spore.


195

On Poaceae (tribe *Bambuseae*): **Arundinaria macrosperma** Michx., Ala., N.C., Okla., S.C., Tex.—**A. tecta** (Walt.)Muhl., Ala., La., Miss., S.C. **Range:** North Carolina to Oklahoma, southward to Alabama and southeastern Texas.

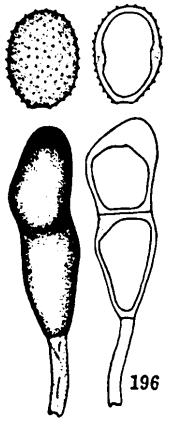
*. **Puccinia melanocephala** Syd. (*Dicaeoma m.* A. & F.), with hypophyllous uredia having light-brown paraphyses, urediospores ellipsoid, 23–26 by 23–37 μ, the wall cinnamon-brown, 2.5–3 μ thick, prominently echinulate, the pores 4 or 5, equatorial; teliospores oblong, 19–22 by 35–45 μ, rounded at each end, constricted at septum, the wall light-brown, 1.5 μ thick at sides, 3 μ above, with short, colorless pedicel; occurs on Poaceae (tribe *Bambuseae*): **Phyllostachys bambusoides** Sieb.&Zucc., in southern Georgia and **P. aurea** Riv., **P. newinii lupehensis** Rendle and **Bambos aureostriata** Regel, in southern Florida; also in India. (N. A. F. **7:** 340, 783.)

69. PUCCINIA OBTECTA. Fig. 196.

(N. A. F. 7: 341, 783, 837.)

Puccinia obtecta Peck, Bull. Buffalo Soc. Nat. Sci. **1:** 66. 1873.
(*Aecidium compositarum bidentis* Burr.; De-T., in Sacc., Syll. Fung. **7:** 799. 1888.)
Dicaeoma obtectum Ktze., Rev. Gen. **3³:** 469. 1898.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 13–19 by 18–21 μ; wall colorless, 1 μ thick, finely verrucose.


196

On Carduaceae (tribe *Heliantheae*): **Bidens connata** Muhl., Wis.—**B. frondosa** L., Ill., Ind., Neb., N.J., Wis.—**B. glaucescens** Greene, Colo., Kans., Neb., N.M.—**B. trichosperma** (Michx.)Britt., Ind.

Uredia amphigenous, cinnamon-brown; urediospores ellipsoid, 13–20 by 25–35 μ; wall light cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, blackish-brown, long covered by the epidermis, with brownish subepidermal paraphyses; teliospores clavate or subcylindric, 16–23 by 58–64 μ, rounded or narrowed above, usually narrowed below, slightly constricted at septum; wall chestnut-brown, 1–2 μ thick at sides, 5–12 μ above; pedicel colored, half length of spore or less.

On Cyperaceae: **Scirpus americanus** Pers.(*S. pungens* Vahl), Calif., Colo., Ida., Ill., Ind., Mass., Mont., Mo., Neb., N.J., N.M., N.Y., Okla., Ore., S.D., Utah, Wyo.—**S. californicus** (C.A.Mey.)Britt., Calif., N.M.—**S. occidentalis** (Wats.)Chase, Calif.—**S. olneyi** Gray, Calif.—**S. validus** Vahl(*S. lacustris* Bart., not L.), Calif., Colo., Ind., Iowa, Kans., Mich., Neb., N.Y., N.D., Va., Wis.; Ont., Sask.

Range: Massachusetts to northern Saskatchewan and Oregon, southward to Virginia and southern California; also in Mexico.

Successful cultures were made in 1907 by Arthur (Jour. Myc. **14:** 20. 1908), sowing teliospores from *Scirpus americanus* on *Bidens connata* and *B. frondosa.*

70. PUCCINIA CANALICULATA. Fig. 197.

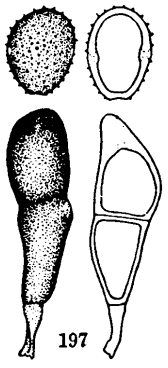
(N. A. F. 7: 344, 783, 837.)

Sphaeria canaliculata Schw., Trans. Am. Phil. Soc. II. **4:** 209. 1832.
(*Aecidium compositarum xanthii* Ellis, N. Am. Fungi *1018b.* 1883.)
Puccinia canaliculata (Schw.) Lagerh., Tromsø Mus. Aarsh. **17:** 51. 1894.
Dicaeoma canaliculatum Ktze., Rev. Gen. **3**[3]: 466. 1898.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 13–16 by 15–19 μ; wall colorless, 1 μ thick or less, finely verrucose.

On Ambrosiaceae: **Ambrosia trifida** L., Conn., Ind., Mo.—**Xanthium** sp., Ark., Del., Ind., Iowa, Neb., N.M., Okla., Pa.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 13–19 by 19–29 μ; wall cinnamon-brown, 1–2 μ thick, finely echinulate, the pores 2, equatorial. Telia chiefly hypophyllous, blackish, long covered by the epidermis, surrounded by brownish subepidermal paraphyses; teliospores clavate-oblong, 15–21 by 39–64 μ, acuminate or rounded above, narrowed below, slightly or not constricted at septum; wall dark cinnamon-brown, lighter below, 1–1.5 μ thick at sides, 3–10 μ above; pedicel colored, short.


197

On Cyperaceae: **Cyperus cylindricus** (Ell.)Britt.(*C. torreyi* Britt.), Del.—**C. erythrorhizos** Muhl., Mo.—**C. esculentus** L., Ariz., Calif., Del., D.C., Fla., Ind., Kans., Ky., Md., Mich., Mo., Neb., N.J., N.M., N.Y., Ohio, Okla., Tex., Wis.—**C. fendlerianus** Böck., N.M.—**C. hallii** Britt., Mo.—**C. houghtonii** Torr., Neb., Wis.—**C. rotundus** L., Fla., Kans., Miss., Okla.—**C. speciosus** Vahl, Ind., Kans.—**C. strigosus** L., Ala., Ark., Conn., Del., Ill., Ind., Iowa, Kans., La., Mass., Mich., Miss., Mo., Neb., N.Y., N.C., Ohio, Okla., Pa., Va., W.Va., Wis.; Ont.—**C. surinamensis** Rottb., Tex.

Range: Massachusetts to Nebraska, southward to Florida and New Mexico; also in Mexico, Central and South America, West Indies and Hawaii.

Successful cultures were made in 1905 by Arthur (Jour. Myc. **12:** 23. 1906), by sowing aeciospores from *Xanthium* sp. on *Cyperus esculentus.*

Puccinia xanthii.

(N. A. F. 7: 571, 805, 847.)

Puccinia xanthii Schw., Schr. Nat. Ges. Leipzig **1:** 73. 1822.
Micropuccinia xanthii A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, blackish-brown, early naked, subepidermal paraphyses scanty, otherwise as in *Puccinia canaliculata*.

On Ambrosiaceae: **Ambrosia coronopifolia** T.&G.(*A. psilostachya* Gray, not DC.), Colo., Kans., Mont., Neb., S.D., Wis.—**A. elatior** L.(*A. artemisiaefolia* Gray, not L.), Fla., Kans., Neb., N.C., Tex.—**A. media** Rydb., Colo.—**A. trifida** L., Ark., Colo., Del., Ill., Ind., Iowa, Kans., Mo., Neb., N.Y., N.D., Okla., Pa., S.D., Tex., Va., W.Va., Wis.; Ont.—**Xanthium acerosum** Greene, Minn., N.D.—**X. cenchroides** Millsp.&Sherff, Colo.—**X. chinense** Mill.(*X. glabratum* Britt.), Ala., Ark., Ind., Iowa, Kans., Ky., N.Y., N.C., Ohio, Okla., Pa., Tenn., Tex., Va.; Ont.—**X. echinatum** Murr., N.Y.—**X. inflexum** Mack.& Bush, Mo.—**X. italicum** Mor.(*X. commune* Britt.), Ark., Calif., Colo., Ind., Iowa, Mo., Neb., N.M., N.Y., N.D., Okla., Pa., S.D.—**X. oviforme** Wallr., S.D.—**X. pennsylvanicum** Wallr., Calif., Colo., Ill., Ind., La., Mich., Mo., Neb., Okla., Tenn.—**X. speciosum** Kearney, Mont., Okla., S.D.—**X. spinosum** L., Ind. **Range:** New York to Montana, southward to Florida and New Mexico, and in central and southern California; also in Mexico, West Indies and Hawaii.

The correlation of this microcyclic species with *P. canaliculata* was pointed out by Dietel (Centr. Bakt. **48:** 492. 1918).

*. **Puccinia cyperi-tagetiformis** (P. Henn.) Kern (*Dicaeoma c.* Arth.), with hypophyllous uredia, cinnamon-brown, urediospores broadly ellipsoid, 15–21 by 19–26 μ, the wall cinnamon-brown, 1.5–2.5 μ thick, often lighter and 3 μ above, verrucose, less so below, the pores 2, equatorial; telia long covered by the epidermis, with abundant subepidermal paraphyses, teliospores clavate-oblong, 14–18 by 31–48 μ, usually narrowed above and below, slightly constricted at septum, the wall light cinnamon-brown, 1 μ thick at sides, 6–10 μ above, the pedicel colored, short; occurs on Cyperaceae: **Cyperus flavicomus** Michx., in southern Texas; also in West Indies, India, Japan and the Philippine Islands. (N. A. F. **7:** 346, 783.)

*. **Puccinia fimbristylidis** Arth. (*Dicaeoma f.* Arth.), with hypophyllous uredia, urediospores globoid or broadly ellipsoid, 15–20 by 18–26 μ, the wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 2, superequatorial; telia tardily naked, with abundant subepidermal paraphyses, teliospores oblong, 16–19 by 34–55 μ, narrowed above and below, slightly constricted at septum, the wall cinnamon-brown, 1.5–2.5 μ thick at sides, 4–9 μ above, the pedicel colored, about as long as spore; occurs on Cyperaceae: **Fimbristylis puberula** (Michx.) Vahl, in Texas; also in Mexico, South America and West Indies. (N. A. F. **7:** 350, 784, 838.)

71. PUCCINIA CYPERI. Fig. 198.

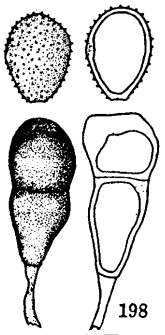
(N. A. F. 7: 345, 783, 837.)

Puccinia cyperi Arth., Bot. Gaz. **16:** 226. 1891.
Dicaeoma cyperi Ktze., Rev. Gen. **3³:** 466. 1898.
(*Aecidium erigerontis* Kern & Whetzel, Jour. Dep. Agric. Porto Rico **14:** 342. 1930.)

Pycnia amphigenous, in groups. Aecia hypophyllous, cupulate; aeciospores globoid or broadly ellipsoid, 15–20 by 17–26 μ; wall colorless, 1–1.5 μ thick at sides, 3–6 μ above, minutely verrucose.

On Carduaceae (tribe *Astereae*): **Chrysopsis falcata** (Pursh)Ell., N.Y.—**Erigeron annuus** (L.)Pers., Ark., Del., Iowa, Md., N.Y., Pa., Va.—**E. ramosus** (Walt.)B.S.P.(*E. strigosus* Muhl.), Ind., Kans., N.J., N.Y., Okla., Wis.—**Heterotheca subaxillaris** (Lam.)Britt.&Rusby, Tex.—**Leptilon canadense** (L.)Britt.(*Erigeron c.*), Conn., Iowa, Ind., Md., Neb., N.Y., Tex., Wis.

Uredia chiefly hypophyllous; urediospores ellipsoid or obovoid, 18–24 by 24–35 μ; wall light cinnamon-brown, 1.5–2 μ thick, minutely echinulate,


198

the pores 2–4, usually 3, equatorial. Telia chiefly hypophyllous, rather tardily naked, dark chocolate-brown or blackish, with few or no subepidermal paraphyses; teliospores broadly clavate-oblong, 18–26 by 35–61 μ, rounded or truncate above, narrowed below, slightly constricted at septum; wall chestnut-brown, paler below, 1–1.5 μ thick at sides, 7–12 μ above; pedicel colored, short.

On Cyperaceae: **Cyperus bushii** Britt., Kans.—**C. cylindricus** (Ell.)Britt.(*C. torreyi* Britt.), Ala., Tex.—**C. filiculmis** Vahl, Conn., Del., Ind., Kans., Mass., Neb., N.Y., Okla., Tex., W.Va., Wis.—**C. globosus** Aubl.(*C. echinatus* Wood), Ala.—**C. grayi** Torr., N.J., N.Y.—**C. houghtonii** Torr., Wis.—**C. lancastriensis** Porter, Del.—**C. ovularis** (Michx.)Torr., Ala., Ark., Del., S.C.—**C. pseudo-vegetus** Steud., Okla.—**C. refractus** Engelm., Del., Tenn.—**C. retrofractus** (L.)Torr., Ala.—**C. schweinitzii** Torr., Ill., Ind., Iowa, Neb., N.D., Okla., Wis.—**C. strigosus** L., Ark., Ind., Mo., N.Y., Tenn., W.Va.

Range: Massachusetts to North Dakota, southward to South Carolina and Texas; also in Mexico, Central and South America and West Indies.

Cultures completing the life cycle of this species were made in 1930 by Davis (Trans. Wis. Acad. **27:** 187. 1932), using teliospores from *Cyperus schweinitzii* sown on *Leptilon canadense.* This culture brought to light the fact that the aecia of this species had been confused with those of *Puccinia extensicola,* although the aeciospores are somewhat larger and are thickened above.

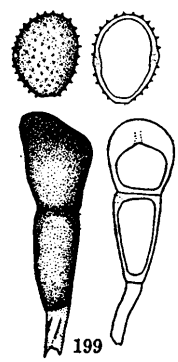
*. **Puccinia fuirenae** Cooke (*Dicaeoma f.* Ktze.), with hypophyllous uredia, chestnut-brown, urediospores ellipsoid or obovoid, 16–23 by 24–37 μ, the wall cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 3 or 4, equatorial; telia hypophyllous, blackish-brown, teliospores clavate, 15–18 by 55–74 μ, narrowed at each end, slightly constricted at septum, the wall chestnut-brown, 2–2.5 μ thick at sides, 7–10 μ above, the pedicel tinted, about length of spore; occurs on Cyperaceae: **Fuirena breviseta** Cov., in Florida, **F. hispida** Ell., in Alabama, **F. simplex** Vahl, in Texas and **F. squarrosa** Michx., in southern South Carolina. (N. A. F. **7:** 348, 784.)

72. PUCCINIA MCCLATCHIEANA. Fig. 199.

(N. A. F. 7: 342, 783, 837.)

Puccinia mcclatchieana D. & H.; Diet., Erythea **2:** 127. 1894.
Dicaeoma mcclatchieanum Arth., N. Am. Flora **7:** 342. 1920.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 19–26 by 24–35 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, equatorial. Telia chiefly hypophyllous, blackish-brown; teliospores clavate, 13–23 by 45–77 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall light chestnut-brown, 1–1.5 μ thick at sides, 7–13 μ above; pedicel colored, short.


199

On Cyperaceae: **Scirpus microcarpus** Presl(*S. rubrotinctus* Fern.), Calif., Colo., Ida., Mass., Mont., N.Y., N.D., Ore., Wash., Wyo.; B.C., N.S. **Range:** Widely but sparingly distributed from Nova Scotia to British Columbia, southward to Massachusetts and southern California.

Uromyces scirpi.

(N. A. F. 7: 233, 752, 828.)

Uredo scirpi Cast., Cat. Pl. Mars. 214. 1845.
Uromyces lineolatus Schroet.; Rabenh., Fungi Eur. *2077.* 1876.

Uromyces scirpi (Cast.) Burr., Bot. Gaz. **9:** 188. 1884.
Nigredo scirpi Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous. Aecia amphigenous, cupulate; aeciospores globoid or broadly ellipsoid, 16–21 by 18–24 μ; wall colorless, 1 μ thick, minutely verrucose.

On Ammiaceae (*Umbelliferae*): **Cicuta bulbifera** L., Neb., Wis.—**C. maculata** L., Fla., Colo., D.C., Ill., Ind., Iowa, Neb.—**Hydrocotyle australis** C.&R., Tex.—**H. umbellata** L., Del., Fla., Mass.—**H. verticillata** Thunb., La.—**Oenanthe californica** Wats., Calif.—**Sium cicutaefolium** Schr., N.Y., N.D., Wis.

Uredia same as in *Puccinia mcclatchieana*. Telia amphigenous, tardily naked, blackish-brown; teliospores clavate-ellipsoid, 17–22 by 31–53 μ, obtuse or acute at each end; wall and pedicel as in *P. mcclatchieana*.

On Cyperaceae: **Scirpus americanus** Pers.(*S. pungens* Vahl), Ala., Ind., Tex., Wis.—**S. californicus** (C.A.Mey.)Britt., Calif.—**S. campestris** Britt., N.D., S.D.—**S. fernaldi** Bickn., N.Y.—**S. fluviatilis** (Torr.)Gray, Del., Ill., Iowa, Kans., Neb., N.D., Ohio, S.D., Wis.; Queb.—**S. pacificus** Britt., Calif.—**S. paludosus** Nels., Calif., Me., Ore., Wyo.; N.S., Sask.—**S. robustus** Pursh, La.—**S. validus** Vahl(*S. lacustris* Bart., not L.), Ind., Neb., Wis.; N.S., Ont.

Range: Nova Scotia to Saskatchewan, southward to Florida and Texas, and from Oregon to southern California; also in Bermuda and Europe.

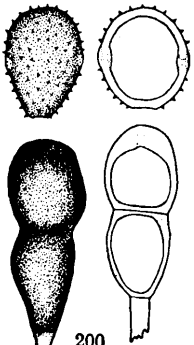
Successful cultures were made in 1906, 1907 and 1908 by Arthur (Jour. Myc. **13:** 199. 1907; same **14:** 17. 1908; Mycol. **1:** 237. 1909), using teliospores from *Scirpus fluviatilis*, sown on *Cicuta maculata*, and in 1914 (Mycol. **7:** 83. 1915), with teliospores from same host, sown on *Sium cicutaefolium*, and in 1911 by Fraser (Mycol. **4:** 178. 1912), with teliospores from *S. paludosus* sown on *C. maculata*. In Europe similar cultures on other hosts were made by Dietel in 1890 (Hedw. **29:** 149. 1890), followed by Bubák, Klebahn, Plowright and others, showing considerable specialization. The correlation of this species needs to be confirmed by discovery of aecia for *Puccinia mcclatchieana*.

73. PUCCINIA CLADII. Fig. 200.

(N. A. F. 7: 350, 784.)

Puccinia cladii Ellis & Tr.; E. & E., Bull. Torrey Club **22:** 61. 1895.
Dicaeoma cladii Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Uredia amphigenous, dark cinnamon-brown; urediospores broadly ellipsoid or obovoid, 20–29 by 27–39 μ; wall cinnamon-brown, 2–2.5 μ thick, finely echinulate, the pores 4, sometimes 3, equatorial. Telia blackish-brown; teliospores ellipsoid or clavate-oblong, 18–26 by 42–51 μ, rounded or obtuse above, usually narrowed below, somewhat constricted at septum; wall dark chestnut-brown, paler below, 1–2 μ thick at sides, 7–9 μ above; pedicel colored, one-third length of spore or less.



200

On Cyperaceae: **Cladium jamaicense** Crantz.(*Mariscus j.* Britt.), Miss., N.C.—**C. mariscus** (L.)R.Br., Ariz.—**Rhynchospora glomerata** (L.)Vahl, Va. **Range:** Virginia southward to southern Mississippi, and in northern Arizona; also in Bermuda and West Indies.

*. **Puccinia sclerlicola** Arth. (*Dicaeoma s.* Arth.), with amphigenous uredia, cinnamon-brown, urediospores broadly ellipsoid or obovoid, 15–22 by 19–26 μ, wall pale-yellow, 1.5 μ thick, finely echinulate, the pores 4, sometimes 3, equatorial, indistinct; teliospores oblong or clavate-oblong, 15–19 by 29–42 μ, truncate or rounded above, narrowed below, slightly constricted at septum, wall cinnamon-brown, 1.5–2 μ thick at sides, 3–6 μ above, with short, colored pedicel; occurs on CYPERACEAE: **Scleria baldwinii** Steud., **S. hirtella** Sw., **S. setacea** Poir., **S. verticillata** Muhl., all in Florida, and **S. pauciflora** Muhl., in southern Georgia; also in West Indies. (N. A. F. **7:** 350.)

74. PUCCINIA ELEOCHARIDIS. Fig. 201.

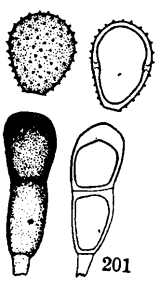
(N. A. F. 7: 347, 784, 838.)

Puccinia eleocharidis Arth., Bull. Iowa Agr. Coll. Dep. Bot. **1884:** 156. 1884.
(*Aecidium compositarum eupatorii* De-T., in Sacc., Syll. Fung. **7:** 798. 1888.)
Dicaeoma eleocharidis Ktze., Rev. Gen. **3**[3]**:** 468. 1898.

Pycnia amphigenous, in small groups. Aecia hypophyllous, cupulate; aeciospores globoid, 16–21 by 18–24 μ; wall colorless, 1 μ thick, finely verrucose.

ON CARDUACEAE (tribe *Eupatorieae*): **Eupatorium aromaticum** L., Tenn.—**E. maculatum** L., Colo., Ind., Iowa, Neb., N.Y., Wyo.—**E. perfoliatum** L., Conn., Del., Ill., Ind., Iowa, Kans., Me., Mass., Mich., Neb., N.J., N.Y., Pa., Wis.; N.S., Ont.—**E. purpureum** L., Ala., Del., Ind., Iowa, Mass., Mich., Neb., N.J., N.Y., Pa., Tenn., Wis.; N.S., Ont.—**E. rotundifolium** L., Del., Miss., Tenn.—**E. serotinum** Michx., La., N.C., Okla.—**E. urticaefolium** Reich. (*E. ageratoides* L.f.), W.Va.—**E. verbenaefolium** Michx., Ala.

Uredia chiefly culmicolous, dehiscent by longitudinal slits; urediospores broadly ellipsoid or obovoid, 17–24 by 26–40 μ; wall light cinnamon-brown, 1.5 μ thick, finely echinulate, the pores 4, sometimes 3 or 5, equatorial. Telia chiefly culmicolous, blackish-brown; teliospores clavate-oblong, 13–19 by 32–65 μ, truncate, rounded or obtuse above, narrowed below, slightly or not constricted at septum; wall light chestnut-brown, paler below, 1 μ thick at sides, 3–7 μ above; pedicel colored, short.


201

ON CYPERACEAE: **Eleocharis arenicola** Torr., Tex.—**E. intermedia** (Muhl.)Schult., Iowa, N.Y., Pa.—**E. obtusa** (Willd.)Schult., Conn., Ind., Ga., Miss., Mo., N.Y., N.C., Okla.—**E. ovata** (Roth)R.&S., N.Y., N.C., W.Va.—**E. palustris** (L.)R.&S., Ind., Iowa, Kans., Mich., Neb., N.Y., Pa., Wis.; Ont., Queb.—**E. tenuis** (Willd.)Schult., Me., Neb., N.Y., Okla.

Range: Nova Scotia to Manitoba, southward to Georgia and Texas; also in Mexico and West Indies.

Successful cultures were conducted in 1905, 1906 and 1908 by Arthur (Jour. Myc. **12:** 23. 1906; same **13:** 197. 1907; Mycol. **1:** 233. 1909), each time sowing teliospores from *Eleocharis palustris* on *Eupatorium perfoliatum*.

Puccinia tolimensis.

(N. A. F. 7: 573.)

Puccinia tolimensis Mayor, Mém. Soc. Neuch. Sci. Nat. **5:** 516. 1913.
Micropuccinia tolimensis A. & J., N. Am. Flora **7:** 573. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, in groups, punctiform, otherwise as in *Puccinia eleocharidis*.

On Carduaceae (tribe *Eupatorieae*): **Eupatorium urticaefolium** Reich.(*E. ageratoides* L.f.), N.Y. **Range:** One locality in western New York; also in central and South America.

This species is correlated with *Puccinia eleocharidis* as shown in the N. Am. Flora **7:** 573. 1922.

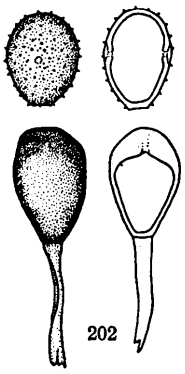
*. **Puccinia liberta** Kern (*Dicaeoma l.* Arth.), with tardily naked culmicolous uredia, urediospores broadly ellipsoid or obovoid, sometimes laterally compressed, 13–21 by 18–27 μ, the wall cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 2, equatorial; teliospores clavate-oblong or fusiform, 14–18 by 40–50 μ, usually narrowed above and below, the wall cinnamon-brown, 1–1.5 μ thick at sides, 4–7 μ above, with pedicel colored, short; occurs on Cyperaceae: **Eleocharis acicularis** (L.)R.&S., **E. montana** (H.B.K.)R.&S., **E. palustris** (L.)R.&S., all in southern California; also in Central America and West Indies. (N. A. F. **7:** 348.)

75. UROMYCES ELEOCHARIDIS. Fig. 202.

(N. A. F. 7: 232, 751, 827.)

Uromyces eleocharidis Arth., Bull. Torrey Club **33:** 514. 1906.
Nigredo eleocharidis Arth., N. Am. Flora **7:** 232. 1912.

Pycnia and aecia unknown. Uredia amphigenous, dark cinnamon-brown; urediospores ellipsoid, 15–19 by 19–29 μ; wall golden-yellow, 1–1.5 μ thick, finely echinulate, the pores 2, equatorial. Telia amphigenous, tardily dehiscent by longitudinal slits, chocolate-brown; teliospores angularly obovoid, truncate or rounded above, narrowed below, 16–22 by 27–45 μ; wall light chestnut-brown, 1–1.5 μ thick at sides, 7–10 μ above; pedicel colored, once to once and a half length of spore.



202

On Cyperaceae: **Eleocharis palustris** (L.)R.&S., Iowa, Kans., Minn., Neb., N.D., S.D., Wis. **Range:** Wisconsin to North Dakota, southward to Kansas.

76. PUCCINIA ANGUSTATA. Fig. 203.

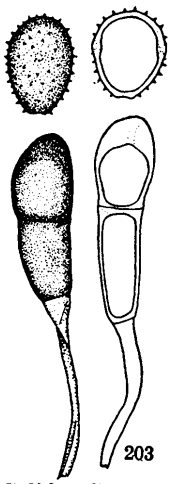
(N. A. F. 7: 343, 344, 351, 783, 784, 837, 838.)

Puccinia angustata Peck, Bull. Buffalo Soc. Nat. Sci. **1:** 67. 1873.
(*Aecidium lycopi* Ger., Bull. Buffalo Soc. Nat. Sci. **1:** 68. 1873.)
Dicaeoma angustatum Ktze., Rev. Gen. **3³:** 467. 1898.

Pycnia epiphyllous, in groups. Aecia hypophyllous, cupulate; aeciospores globoid, 16–19 by 18–23 μ; wall colorless, 1–2 μ thick, finely verrucose.

On Lamiaceae (*Labiatae*): **Lycopus americanus** Muhl., Ind., Kans., Me., Md., Neb., N.J., N.Y., N.D., Wis.; Ont.—**L. asper** Greene, Sask.—**L. rubellus** Moench, Ont.—**L. sessilifolius** Gray, N.Y.—**L. uniflorus** Michx., Ind., Mass., Mich., N.H., N.Y., Pa., Wis.; N.B.—**L. virginicus** L., Ala., Del., Me., Mo., N.Y., Pa.; Ont.—**Mentha arvensis** L., N.S.—**M. canadensis** L., Calif., Mont., S.D.; Man.—**Monarda fistulosa** L., Neb.—**Pycnanthemum virginianum** (L.)Dur.&Jacks.(*Koellia v.* MacM., *P. lanceolatum* Pursh), Ind.; on Carduaceae (tribe *Senecioneae*): **Senecio aureus** L., Conn., Iowa, N.H., N.Y., Wis.—**S. cymbalarioides** Nutt., Utah.—**S. ductoris** Piper, Ore.—**S. robbinsii** Oakes, N.H., Vt.—**S. triangularis** Hook., B.C.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores ellipsoid or obovoid, 16–26 by 23–32 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial or superequatorial. Telia chiefly hypophyllous, blackish-brown, without subepidermal paraphyses; teliospores clavate or nearly cylindric,



203

14–23 by 35–67 μ, rounded or narrowed above, narrowed below, slightly constricted at septum; wall cinnamon- or chestnut-brown, 1–2 μ thick at sides, 4–16 μ above; pedicel colored, about as long as spore.

On Cyperaceae: **Eriophorum alpinum** L.(*Scirpus hudsonianus* Fern.), N.H., Vt.—**E. angustifolium** Roth, Vt. —**E. tenellum** Nutt., Me.—**E. virginicum** L., Conn., Ind., Me., Mass., Wis.—**E. viridicarinatum** (Engelm.)Fern., Conn., Ind., Iowa, Neb., N.Y., Ore., Vt., Wis.; B.C.—**Rhynchospora corniculata** (Lam.)Gray(*R. macrostachya* Torr.), Ala., La., Mo., Tenn., Tex.—**Scirpus americanus** Pers.(*S. pungens* Vahl), Nev.—**S. atrocinctus** Fern., N.H., N.Y.—**S. atrovirens** Muhl., Del., Ill., Ind., Iowa, Kans., Me., Mich., Mo., Neb., N.Y., N.D., Ohio, Pa., S.D., Va., W.Va., Wis.; Ont., Queb.—**S. caespitosus** L., N.Y.—**S. californicus** (C.A.Mey.)Britt., Calif.—**S. congdonii** Britt., Calif.—**C. cyperinus** (L.)Kunth (*Eriophorum c.*), Ala., Del., Ind., Me., Md., Mass., Mich., Minn., Neb., N.H., N.Y., Ohio, Pa., W.Va., Wis., Va.; N.S., Ont., Queb.—**S. fluviatilis** (Torr.)Gray, Wis.—**S. georgianus** Harper, Conn., Del.—**S. microcarpus** Presl(*S. rubrotinctus* Fern.), Man.—**S. pallidus** (Britt.)Fern., Ark., Neb.—**S. pedicellatus** Fern., N.Y.—**S. polyphyllus** Vahl, Md.

Range: Throughout the United States and Canada east of the Rocky Mountains and along the Pacific coast from British Columbia to southern California; also in northern Europe, Asia and Japan.

The species is separable into the three following varieties by both aecial and telial hosts, by slight differences in size of spores, and by cultures.

(1). **Puccinia angustata typica** n. nom. Aecia on lamiaceous hosts; urediospore-pores equatorial or more or less superequatorial even in the same collection; uredia and telia on **Scirpus** (occasionally on **Eriophorum**). Common especially northward, not known south of the United States, or outside of our limits, except in Japan.

Successful cultures were made in 1901, 1904, 1906, 1907, 1910, 1911 and 1912, using teliospores from *Scirpus atrovirens*, sown on *Lycopus americanus*, and in 1908 and 1912 with teliospores from *S. cyperinus*, sown on *L. americanus* and *L. uniflorus*, all by Arthur (Jour. Myc. **8:** 53. 1902; same **11:** 58. 1905; same **13:** 196. 1907; same **14:** 14. 1908; Mycol. **1:** 234. 1909; same **4:** 17, 54. 1912; same **7:** 70. 1915), in 1903 Kellerman (Jour. Myc. **9:** 226. 1903) sowed teliospores from *Scirpus atrovirens* on *Lycopus americanus*, and in 1918 Fraser (Mycol. **11:** 130. 1919) used teliospores from *S. atrovirens* on *Mentha canadensis*, and in 1924 (same **17:** 83. 1925) from *Eriophorum angustifolium* on *Lycopus asper*.

(2). **Puccinia angustata eriophori** (Thüm.) n. comb. (*Puccinia e.* Thüm., *Dicaeoma* e. Ktze.). Aecia on carduaceous hosts; urediospore-pores decidedly superequatorial, with rare exceptions; uredia and telia on **Eriophorum** (occasionally on **Scirpus**). A comparatively rare northern variety ranging from Maine to the alpine meadows of British Columbia and Oregon, southward to Connecticut and northern Nebraska; also in northern Europe, Asia and Japan.

The first successful culture was made in 1907 by Tranzschel (Beitr. Biol. Ured. III. p. 4. 1909), by sowing teliospores from *Eriophorum angustifolium* on *Ligularia sibirica* and *Senecio paluster*. In 1915 a successful sowing of aeciospores from *Senecio aureus* on *Eriophorum viridicarinatum* was made by Arthur (Mycol. **8**: 131. 1916).

(3). **Puccinia angustata angustatoides** (R. E. Stone) n. comb. (*Puccinia a.* R. E. Stone, *Dicaeoma a.* Arth.). Pycnia and aecia unknown; urediospore-pores varying from equatorial to conspicuously superequatorial; uredia and telia on **Rhynchospora**. Mesospores rather common. A rare southern variety, ranging from northern Alabama to southeastern Missouri, southward to Louisiana and Texas; also in Bahamas and West Indies.

Uromyces rhyncosporae.

(N. A. F. 7: 232, 751, 827.)

Uromyces rhyncosporae Ellis, Jour. Myc. **7**: 274. 1893.
Uromyces rhynchosporicola P. Henn., Hedw. **35**: 226. 1896.
Nigredo rhyncosporae Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Uredia as in *Puccinia angustata;* urediospores 13–19 by 18–26 μ, otherwise as in *P. angustata.* Telia as in *P. angustata;* teliospores one-celled, ellipsoid or clavate, 10–15 by 20–29 μ, otherwise as in *P. angustata.*

On Cyperaceae: **Rhyncospora alba** (L.)Vahl, Ind., N.J., R.I., Vt.; Ont.—**R. axillaris** (Lam.)Britt., Del., D.C.—**R. corniculata** (Lam.)Gray(*R. macrostachya* Torr.), Ala., Fla., La., Mo.—**R. distans** (Michx.)Vahl, Fla., Miss.—**R. fasciculata** (Michx.)Vahl, Fla., Miss.—**R. glomerata** (L.)Vahl, Ala., Ark., Conn., Del., D.C., Ga., Ind., Mass., N.J., N.Y., Ohio, Tenn., W.Va.—**R. glomerata paniculata** (Gray)Chapm., Ala., Miss., S.C.—**R. gracilenta** Gray, D.C.—**R. macra** (Clarke)Small(*R. alba m.*), Fla.—**R. microcarpa** Baldw., Fla.—**R. perplexa** Britt., Fla. **Range**: Vermont to southern Ontario, southward to Florida and Louisiana; also in Bermuda, West Indies, South America and Hawaii.

This species is closely correlated with *Puccinia angustata angustatoides,* as pointed out by Orton (Mycol. **4**: 203. 1912), but is much more abundant and has a much wider geographic distribution.

Puccinia recedens.

(N. A. F. 7: 584, 848.)

Puccinia recedens Syd., Monog. Ured **1**: 146. 1902.
Micropuccinia recedens A. & J.; Arth., Bull. Torrey Club **48**: 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia as in *Puccinia angustata,* but often becoming cinereous by germination; teliospores as in *P. angustata,* but usually shorter, 32–48 μ long, with pedicel about one-half length of spore. Mesospores occur occasionally.

On Carduaceae (tribe *Senecioneae*): **Senecio aureus** L., Conn., Del., Mich., N.J., N.Y., Pa., W.Va., Wis.—**S. crocatus** Rydb., Wyo.—**S. harfordii** Greenm., Ore.—**S. pseudaureus** Rydb., Ida., Mont.—**S. robbinsii** Oakes, N.H.—**S. willingii** Greenm., Alta. **Range**: Connecticut and West Virginia to Wisconsin, and in the western mountains from Wyoming to British Columbia and Oregon.

This microcyclic species is correlated with *Puccinia angustata eriophori* as indicated in the N. Am. Flora **7**: 584. 1922.

*. **Puccinia rosenii** Arth. (*Dicaeoma r.* Arth.), with hypophyllous uredia, dark cinnamon-brown, urediospores flattened globoid or broadly ellipsoid, 28–35 by 30–35 μ, the wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, superequatorial; teliospores clavate or nearly cylindric, 16–23 by 43–67 μ, rounded or truncate above, narrowed below, the wall chestnut-brown, lighter below, 1–2 μ thick at sides, 5–10 μ above, with colorless pedicel, somewhat shorter than spore; occurs on CYPERACEAE: **Schoenus nigricans** L., in eastern Florida. (N. A. F. **7:** 351.)

77. PUCCINIA EXTENSICOLA. Fig. 204.

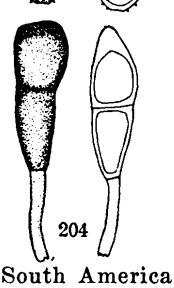
(N. A. F. 7: 361–7, 786, 787, 815, 839.)

(*Aecidium asterum* Schw., Schr. Nat. Ges. Leipzig **1:** 67. 1822.)
Puccinia extensicola Plowr., Brit. Ured. Ustil. 181. 1889.
Puccinia asterum Kern, Mycol. **9:** 224. 1917.
Dicaeoma asterum A. & K., N. Am. Flora **7:** 362. 1920. (32 additional synonyms are recorded in the N. Am. Flora **7:** 361–366.)

Pycnia amphigenous or only epiphyllous, in groups. Aecia chiefly hypophyllous, cupulate; aeciospores globoid, 12–21 by 13–23 μ; wall colorless, 1 μ thick, finely verrucose.

ON HOSTS, listed under the several varieties.

Uredia hypophyllous, light cinnamon-brown; urediospores globoid, broadly ellipsoid or obovoid, 12–20 by 16–26 μ; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, in upper part of spore. Telia hypophyllous, dark chocolate-brown or blackish; teliospores clavate-oblong, 12–22 by 32–50 μ, rounded, truncate or acute above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1–1.5 μ thick at sides, 5–13 μ above; pedicel nearly or quite colorless, one-half to once length of spore.



204

ON CYPERACEAE: **Carex sparganioides** Muhl., and about 100 other species of *Carex* listed in the N. Am. Flora with localities, and **Dulichium arundinaceum** (L.)Britt.

Range: Nova Scotia to British Columbia, southward to the southern border of the United States; also sparingly in South America and Europe.

The species is morphologically homogeneous, but may be separated, chiefly by the aecial hosts and cultures, into the following ten varieties:

(1). **Puccinia extensicola asteris** (Thüm.) n. comb. (*Aecidium a.* Thüm., *P. caricis-asteris* Arth.). Aecia on CARDUACEAE (tribe *Astereae*): **Aster, Boltonia, Doellingeria** and **Eucephalus**; uredia and telia on **Carex festivella, C. foenea, C. trisperma,** and many other species of *Carex*. **Range:** Common in the northern United States, southern Canada and Alaska, and sparingly southward; also in South America and Europe.

Reciprocal cultures were first made in 1888 by Plowright (Brit. Ured. Ustil. 181. 1889), using the hosts *Carex extensa* and *Aster tripolium*, but details were not published. Cultures in 1901 and 1902, with teliospores from *Carex foenea* gave infection on *Aster paniculatus* and *A. cordifolius*, but not on *Erigeron* or *Solidago*, in 1907 from *C. rosea* on *A. paniculatus* but not on *Solidago*, in 1909 and 1910 from *C. festiva* on *A. adscendens*, and in 1912 from *C. scoparia* on *A. paniculatus* and *Euthamia graminifolia*, also from *C. goodenowii* on *A. paniculatus*, all by Arthur (Jour. Myc. **8:** 54. 1902; Bot. Gaz. **35:** 15. 1903; Jour. Myc. **14:** 13. 1908; Mycol. **2:** 224. 1910; same **4:** 16, 28. 1912; same **7:** 69. 1915), and in 1911 with teliospores from *C. trisperma*, sown on *A. acuminatus*, by Fraser (Mycol. **4:** 181. 1912). Evidently there is one strain that will infect both *Aster* and *Euthamia* (see page 198).

(2). **Puccinia extensicola erigerontis** n. nom. (*Caeoma erigeronatum* Schw., *P. caricis-erigerontis* Arth.). Aecia on CARDUACEAE (tribe *Astereae*): **Erigeron** and **Leptilon**; uredia and telia on **Carex brevior**, and other species of *Carex*. **Range:** United States and Canada east of the Rocky Mountains, and from British Columbia to central California.

Cultures in 1901, 1902 and 1904 with teliospores from *Carex festucacea*, gave infection on *Erigeron annuus*, and in 1902 also on *E. philadelphicus* and *Leptilon canadense*, all by Arthur (Jour. Myc. **8:** 53. 1902; Bot. Gaz. **35:** 15. 1903; Jour. Myc. **11:** 58. 1905). Kellerman (Jour. Myc. **9:** 228. 1903) also transfered this rust from *C. festucacea* to *Leptilon canadense* in 1903. Part of the record for *Erigeron annuus, E. ramosus, Heterotheca subaxillaris* and *Leptilon canadense* in the N. Am. Flora (**7:** 363) is erroneous, belonging to *Puccinia cyperi* which has aeciospores with the wall thickened above.

(3). **Puccinia extensicola solidaginis** (Schw.) n. comb. (*Aecidium s.* Schw., *P. caricis-solidaginis* Arth., *P. dulichii* Syd.). Aecia on CARDUACEAE (tribes *Astereae, Helenieae, Heliantheae*): **Brachychaeta, Chrysogonum, Chrysothamnus, Grindelia, Helenium, Oreochrysum, Polymnia, Sericocarpus** and **Solidago**; uredia and telia on **Carex jamesii, C. stipata, C. vulpinoidea,** and many other species of *Carex* and **Dulichium arundinaceum. Range:** Maine to northern Idaho, southward on the plains and foothills of the Rocky Mountains to Florida and New Mexico, and in central California.

Cultures in 1902 by Arthur (Bot. Gaz. **35:** 21. 1903) with teliospores from *Carex jamesii* gave infection on *Solidago canadensis, S. caesia, S. serotina, S. rigida* and *S. ulmifolia*, but not on six species of *Aster*, while from *C. stipata* infection resulted on *S. canadensis* and *S. serotina*, but not on *Erigeron annuus*. Kellerman (Jour. Myc. **9:** 228. 1903) also was successful in 1903 with teliospores from *C. stipata* sown on *S. canadensis* but not on *S. riddellii*. In 1911 teliospores from *C. stipata* were used by Fraser (Mycol. **4:** 181. 1912) to infect *S. rugosa*. In 1905 and 1908 teliospores from *C. sparganioides* infected *S. canadensis*, but not *A. paniculatus* or *A. drummondii*, while in 1913 those from *C. vulpinoidea* infected *S. canadensis, S. glaberrima, S. mollis* and *S. rugosa*, but not *A. paniculatus* or *A. drummondii*, and in 1914 from same host infected *S. canadensis* but not *A. paniculatus*, all by Arthur (Jour. Myc. **12:** 15. 1906; Mycol. **1:** 223. 1909; same **7:** 79, 81. 1915). Teliospores from *Dulichium arundinaceum* obtained in Florida were successfully used in 1914 to infect *S. canadensis*, but not *A. paniculatus* or *A. drummondii*, and again in 1915 from northern Indiana to infect *S. canadensis* but not *A. paniculatus*, all by Arthur (Mycol. **7:** 81. 1915; same **8:** 130. 1916). The telia on *Carex vulpinoidea* are long covered by epidermis, and in gross appearance are unlike those of the species on other hosts. They were long considered to constitute a distinct species.

(4). **Puccinia extensicola euthamii** n. nom. Aecia on CARDUACEAE (tribe *Astereae*): **Euthamia caroliniana** (L.)Greene(*Solidago tenuifolia* Pursh), Mass.—**E. graminifolia** (L.)Nutt.(*S. lanceolata* L.), Del., Me., N.H., N.Y., Ohio, Pa., Vt., Va., W.Va., Wis.; Ont.—**E. occidentalis** Nutt., Ore.; uredia and telia on **Carex scoparia** Schk., Conn., Me., Neb., N.Y., Ohio, Pa., S.D.; N.S., Ont., Queb. **Range:** Nova Scotia to South Dakota, southward to Virginia and Nebraska, and in western Oregon.

In 1910 teliospores from *C. scoparia* obtained in Maine were found by Arthur (Mycol. **4:** 15. 1912) to infect *E. graminifolia* but not *Aster paniculatus, Doellingeria umbellata, Solidago canadensis* or *S. nemoralis*, and in 1911 Fraser (Mycol. **4:** 181. 1912) from same host from Nova Scotia also infected *E. graminifolia*, while in 1912 Arthur (Mycol. **7:** 69. 1915) using same host from Quebec infected both *E. graminifolia* and *Aster paniculatus*. Apparently there are strains of this variety that will infect more than one genus of aecial hosts (see page 197).

(5). **Puccinia extensicola rudbeckiae** n. nom. Aecia on CARDUACEAE (tribe *Heliantheae*): **Rudbeckia** sp. Uredia and telia on **Carex** sp. have not yet been found, although there is good reason to think that they occur.

Cultures on *Rudbeckia laciniata* have been attempted with teliospores from *Carex arctata, C. tenella* and *C. vulpinoidea*, the first also on *R. triloba*, with no infection. Further cultures on *R. laciniata* with teliospores from *C. goodenowii* were attempted in 1910 without success, although giving infection on *Aster paniculatus* (Mycol. **4**: 28. 1912). Although no successful cultures have been made to establish this variety, and no field collections have been referred to it, yet the correlated species, *Uromyces perigynius, U. rudbeckiae* and *Puccinia rudbeckiae* clearly indicate that such a variety exists.

(6). **Puccinia extensicola oenotherae** (Mont.) n. comb. (*Aecidium o.* Mont., *A. peckii* De-T., *Puccinia p.* Kellerm., *Dicaeoma p.* Arth.). Aecia on ONAGRACEAE: **Chamaenerion spicatum** (Lam.)S.F.Gray(*Epilobium angustifolium* L.), Colo.; Sask.—**Gaura coccinea** Nutt.(*G. marginatum* Lehm.), Neb.—**G. parviflora** Dougl., Colo., Neb.—**G. sinuata** Nutt., Tex.—**Oenothera biennis** L.(*Onagra b.* Scop.), Colo., Ill., Ind., Iowa, Mich., Miss., Neb., N.H., N.Y., Ohio, Pa., S.D., W.Va., Wis.; Man.—**O. fruticosa** L.(*Kneiffia f.* Raim.), N.Y.—**O. hookeri** T.&G., Ariz., Calif., Utah.—**O. laciniata** Hill(*O. sinuata* L., *Raimannia l.* Rose), Ala., Kans., Neb.—**O. lavandulaefolia** T.&G.(*Galpinsia l.* Small), Wyo.—**O. pumila** L.(*K. perennis* Pennell), Conn., N.H., Wis.—**O. rhombipetala** Nutt.(*R. r.* Rose), Neb.—**O. serrulata** Nutt.(*Meriolix s.* Walp.), Iowa, Neb., N.D., S.D., Wyo.—**O. strigosa** (Rydb.)Mack.&Bush, Colo., Ida., Kans., Minn., Neb., N.D., S.D.—**O. triloba** Nutt.(*Lavauxia t.* Spach), N.D.—**Pachylophus macroglottis** Rydb.(*P. hirsutus* Rydb.), Colo.; uredia and telia on **Carex lanuginosa** Michx., **C. stipata** Muhl., **C. trichocarpa** Muhl., and fifteen other species of *Carex*, listed in the N. Am. Flora (**7**: 366, 787). **Range:** Maine to Saskatchewan, southward on plains and foothills to Alabama and Texas, and from central California to southern Arizona; also in South America.

The earliest cultural connection was established in 1902 by Kellerman (Jour. Myc. **8**: 20. 1902), using teliospores from *Carex trichocarpa*, sown on *Oenothera biennis*, and was confirmed later in the same year by Arthur (Bot. Gaz. **35**: 13. 1903), also sowing without infection on *Aster, Erigeron, Leptilon* and *Solidago*. The same hosts were used with similar results in 1904, 1906 and 1910 by Arthur (Jour. Myc. **11**: 58. 1905; same **13**: 195. 1907; Mycol. **4**: 15. 1912), who also made the following cultures, sowing teliospores from *C. trichocarpa* on *Gaura biennis* in 1909 (Mycol. **2**: 223. 1910), and on *O. serrulata* in 1910 (the same **4**: 15. 1912), the latter forming pycnia only; from *C. stipata* on *O. biennis* in 1902 and 1908 (Bot. Gaz. **35**: 14. 1903; Mycol. **1**: 233. 1909); from *C. lanuginosa* on *O. biennis* in 1904, 1905, 1906, 1909, 1910 and 1911 (Jour. Myc. **11**: 58. 1905; same **12**: 15. 1906; same **13**: 195. 1907; Mycol. **2**: 222. 1910; same **4**: 15, 54. 1912).

(7). **Puccinia extensicola hieraciata** (Schw.) n. comb. (*Aecidium h.* Schw., *Puccinia h.* Jacks., *Dicaeoma h.* A. & K.). Aecia on CARDUACEAE (tribe *Senecioneae*): **Senecio columbianus** Greene, Sask.—**S. flavulus** Greene, Alta.—**S. integerrimus** Nutt., Neb.; on CICHORIACEAE: **Agoseris, Crepis, Hieracium, Krigia, Lactuca, Nabalus** and **Scorzonella**; uredia and telia on **Carex.** (See N. Am. Flora, **7**: 367, 787.) **Range:** A common northern variety extending from Nova Scotia to Alberta, southward on plains and foothills to Virginia and Missouri, and sparingly from southeastern Alaska to southern California.

Cultures were first made in 1906 by Arthur (Jour. Myc. **13**: 194. 1907) from an undetermined species of *Carex* on *Lactuca canadensis, L. virosa* and *L. sativa*, but without infection on *Oenothera biennis*, and afterward from *C. pratensis* on *Agoseris glauca* (on which was founded *Puccinia patruelis* Arth.) in 1908 (Mycol. **1**: 245. 1909), and from *C. siccata* to *Lactuca canadensis* and *L. sativa* in 1910 (same **4**: 16. 1912). This variety was at first taken to be identical with *Puccinia opizii* Bubák of Europe, but was finally decided to be distinct.

(8). **Puccinia extensicola phrymae** (Halst.) n. comb. (*Aecidium p.* Halst., *Puccinia p.* Arth., *Dicaeoma p.* A. & K.). Aecia on PHRYMACEAE: **Phryma leptostachya** L., Iowa, Minn., Neb., N.Y., S.D., Wis.; uredia and telia on **Carex sprengelii** Dewey(*C. longirostris* Torr.), Iowa, Neb., Wis.; Ont. **Range:** A local variety ranging from western New York to South Dakota and central Nebraska.

Successful cultures were made by Arthur in 1907 (Jour. Myc. **14:** 22. 1908) by using teliospores from *Carex longirostris* sown on *Phryma leptostachya*, and with no infection on *Aster paniculatus, Erigeron annuus* and *Solidago canadensis*. No other rust has been reported on the two hosts of this variety.

(9). **Puccinia extensicola valerianae** n. nom. Aecia on VALERIANACEAE: **Valeriana edulis** Nutt., Colo., N.M.—**V. occidentalis** Heller(*V. acutiloba* Rydb.), Utah; uredia and telia on **Carex** sp., Utah. **Range:** Central Colorado and Utah, southward to northern New Mexico.

Although no cultures have been made, yet the close association of aecial and telial stages, and absence of allied forms, observed by A. O. Garrett, July, 1930, on Mount Timpanogos, in the Wasatch Mountains of central Utah, and the evident agreement in morphology with other varieties of *Puccinia extensicola*, make the assignment reasonably reliable. The aecia have heretofore been placed under *P. commutata*.

(10). **Puccinia extensicola hydnoidea** (B. & C.) n. comb. (*Aecidium h.* B. & C.). Aecia in groups on large pale-yellow spots; aeciospores usually small, 12–17 by 14–19 μ; on THYMELAEACEAE: **Dirca palustris** L., Ala., Ind., Iowa, Mė., Mich., Minn., Mo., N.Y., Ohio, W.Va., Wis.; uredia and telia on **Carex pennsylvanica** Lam., Ind. **Range:** Maine to Minnesota, southward to northern Alabama and Missouri.

Cultures were made in 1932 by Cummins, using aeciospores, sown on *Carex pennsylvanica*. Record in Arthur Herbarium, but not yet published.

Uromyces perigynius.

(N. A. F. 7: 235, 752, 828.)

Uromyces perigynius Halst., Jour. Myc. **5:** 11. 1889.
Nigredo perigynia Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia as in *Puccinia extensicola.*

ON CARDUACEAE (tribes *Astereae* and *Heliantheae*): **Lepachys columnaris** (Sims)T.&G.(*Ratibida c.* D.Don), N.D.—**Rudbeckia laciniata** L., Iowa, Mo., Mont., Neb., N.D., Pa., S.D., Wis., Wyo.; Man.—**R. triloba** L., Del.—**Solidago rugosa** Mill., Me.

Uredia and telia as in *Puccinia extensicola*, except teliospores one-celled, obovoid or ellipsoid, 12–19 by 19–34 μ.

ON CYPERACEAE: **Carex intumescens** Rudge, **C. lanuginosa** Michx., **C. scoparia** Schk., **C. sparganioides** Muhl., and sixteen other species recorded with localities in the N. Am. Flora (7: 235, 753).

Range: Newfoundland to Montana, southward to Florida and Missouri, and from Washington to northern California.

The first cultures were made in 1903 by Arthur (Jour. Myc. **10:** 15. 1904) using teliospores from *C. varia* on *Solidago canadensis, S. caesia, S. flexilis* and *S. serotina*,

and also unsuccessfully on five species of *Aster*. Another collection on *C. lanuginosa* taken at the same place and time failed to infect both *Aster* and *Solidago*. In 1910 a collection on *C. intumescens* infected *Aster paniculatus*, but not *Solidago*, another on *C. deflexa* infected *Solidago rugosa* and *Aster ericoides*, the latter sparingly (Mycol. **4**: 21. 1912), again in 1912 teliospores from the same host-species as the last infected *Aster paniculatus* and *Solidago canadensis*, the latter sparingly, but not *Erigeron*, *Euthamia* or *Oenothera* (Mycol. **7**: 75. 1915). A collection on *C. sparganioides* sown in 1917 on *Rudbeckia laciniata* gave a heavy infection, but did not infect *Aster* or *Solidago* (Mycol. **9**: 307. 1917). Other cultures in 1911 by Fraser (Mycol. **4**: 181. 1912) gave results by sowing teliospores from *Carex deflexa* on *Solidago rugosa* and *S. bicolor*, from *C. intumescens* on *Solidago* sp., and *Aster puniceus*, and from *C. scoparia* on *Euthamia graminifolia*.

The correlation of this species of *Uromyces* with the carduaceous varieties of *Puccinia extensicola* was pointed out in 1912 by Arthur (Mycol. **4**: 21. 1912) and Orton (same **4**: 199. 1912), and is clearly divisable into more or less distinct varieties, particularly corresponding to the first, third and fifth of the above varieties. Several aecial hosts identified by cultures have not been recorded from the field.

Uromyces solidaginis.

(N. A. F. 7: 518.)

Caeoma solidaginis Sommerf., Suppl. Fl. Lapp. 234. 1826.
Uromyces solidaginis (Sommerf.) Niessl, Verh. Nat.-Ver. Brünn **10**: 163. 1872.
Teleutospora solidaginis Arth. & Bisby; Arth., Bull. Torrey Club **48**: 39. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia and teliospores as in *P. extensicola* except the spores one-celled, obovate or ellipsoid, 17–25 by 24–33 μ.

On Carduaceae (tribe *Astereae*): **Solidago elongata** Nutt., Wyo.—**S. pulcherrima** Nels., Colo.—**S. serotina** Ait.(*S. pitcheri* Nutt.), Ida., Mont., Wash., Wyo.—**S.** sp., Ore. **Range:** Washington and Oregon to Colorado; also in northern Europe and northeastern Asia and Japan.

The correlation of this species with *Uromyces junci* was suggested by Ed. Fischer (Beitr. Krypt. Schweiz **1**: 113. 1898), but as both macrocyclic and microcyclic species having *Solidago* in the life cycle seem more closely related, the species is here made to correlate with (3) *Puccinia extensicola solidaginis*.

Uromyces rudbeckiae.

(N. A. F. 7: 519, 802, 846.)

Uromyces rudbeckiae A. & H.; Arth., Bull. Iowa Agr. Coll. Dep. Bot. **1884**: 154. 1884.
Teleutospora rudbeckiae Arth. & Bisby; Arth., Bull. Torrey Club **48**: 39. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia as in *Uromyces perigynius*.

On Carduaceae (tribe *Heliantheae*): **Rudbeckia laciniata** L., Colo., Ill., Ind., Iowa, Md., Mich., Minn., Mo., Mont., Neb., N.M., N.D., Pa., Tenn., Wis., Wyo.; Man., Ont.—**R.** sp., Tex. **Range:** Pennsylvania to Manitoba and Montana, southward east of the Rocky Mountains to Tennessee, southeastern Texas and New Mexico; also in Japan.

This microcyclic species is correlated with (5) the hypothetical *Puccinia extensicola rudbeckiae*. The correlation of this species with *Uromyces perigynius* was indicated by Jackson (Mem. Torrey Club **18**: 29. 1931).

Puccinia rudbeckiae.

(N. A. F. 7: 580, 806.)

Puccinia rudbeckiae Barth.; Arth., N. Am. Flora **7**: 580. 1922; N. Am. Ured. *2862*. 1923.
Micropuccinia rudbeckiae A. & J., N. Am. Flora **7**: 580. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia as in *Puccinia extensicola*, but apical thickness of teliospores usually more variable, often only 3–4 μ thick, and the pedicel shorter.

On Carduaceae (tribe *Heliantheae*): **Rudbeckia maxima** Nutt., Tex. **Range:** Vicinity of Longview in northeastern Texas.

This microcyclic species is correlated with (5) the hypothetical *Puccinia extensicola rudbeckiae.*

Puccinia asteris.

(N. A. F. 7: 575, 806, 848.)

Puccinia asteris Duby, Bot. Gall. **2:** 888. 1830.
Puccinia magnoecia E. & E., Bull. Torrey Club **22:** 59. 1895.
Micropuccinia asteris A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia in circular or circinnating groups, distinct or confluent, sometimes appearing like single, very large sori, early naked, becoming cinereous by germination; teliospores as in *Puccinia extensicola.* Mesospores occasionally present.

On Carduaceae (tribe *Astereae*): **Aster paniculatus,** and 35 other species recorded with localities in the N. Am. Flora.—**Eucephalus glaucus** Nutt.(*Aster g.* T.&G.), Wyo.—**Psilactis asteroides** Gray, N.M. **Range:** Newfoundland to British Columbia, southward to Alabama, New Mexico and central California, chiefly east of the Rocky Mountains; also in Bahamas, Mexico, Central and South America and Europe.

This microcyclic species is correlated with (1) *Puccinia extensicola asteris* as pointed out by Dietel (Centr. Bakt. **48:** 492. 1918).

Puccinia virgaureae.

(N. A. F. 7: 574, 806.)

Xyloma virgaureae DC., Syn. Pl. 63. 1806.
Puccinia virgaureae (DC.) Lib., Crypt. Pl. Arduenna IV. *393.* 1837.
Puccinia minutula Peck, Ann. Rep. N. Y. State Mus. **24:** 91. 1872.
Micropuccinia virgaureae A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia very small, punctiform, distinct, in irregular and somewhat radiating groups; teliospores as in *Puccinia extensicola.* Mesospores occasionally present.

On Carduaceae (tribe *Astereae*): **Solidago puberula** Nutt., Mass.; N.S. —**S. rugosa** Mill., N.H.—**S. ulmifolia** Muhl., Mich., N.Y. **Range:** Nova Scotia to eastern New York, westward to Michigan; also in Europe and Japan.

This microcyclic species is correlated with (3) *Puccinia extensicola solidaginis* as pointed out by Dietel (Centr. Bakt. **48:** 492. 1918).

Puccinia gigantea.

(N. A. F. 7: 549, 847.)

Puccinia gigantea Karst., Bidr. Finl. Nat. Folk **31:** 42. 1879.
Micropuccinia gigantea A. & J., N. Am. Flora **7:** 549. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia and teliospores as in *Puccinia extensicola,* with the spores usually narrower, 10–17 μ wide.

On Onagraceae: **Chamaenerion spicatum** (Lam.)S.F.Gray(*Epilobium angustifolium* L.), Mont., Wash.; Alta., Man. **Range:** Northern Manitoba to southern Alberta and northern Washington; also in northern Europe.

This microcyclic species is correlated with (6) *Puccinia extensicola oenotherae.*

Puccinia maculosa.

(N. A. F. 7: 585, 586.)

Puccinia maculosa Schw., Trans. Am. Phil. Soc. II. **4:** 295. 1832.
Puccinia columbiensis E. & E., Proc. Am. Acad. Sci. Phila. **1893:** 153. 1893.
Micropuccinia columbiensis A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.
Micropuccinia maculosa A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia and teliospores as in *Puccinia extensicola,* but often cinereous by germination, when both are lighter in color.

On Cichoriaceae: **Agoseris glauca** (Nutt.)Greene(*Troximon g.*), Wash., Wyo.; Alta.—**Cynthia virginica** (L.)D.Don.(*Adopogon v.* Ktze., *Krigia amplexicaulis* Nutt.), Ill., Mich., Mo., Pa., Tenn.—**Hieracium cinereum** Howell, Ore.—**H. scouleri** Hook.(*H. griseum* Rydb.), Ore., Wash.—**Nabalus racemosus** (Michx.)DC.(*Prenanthes r.*), Queb. **Range:** Locally from eastern Quebec to Alberta, southward to Tennessee, Missouri and Oregon.

This microcyclic species is correlated with (7) *Puccinia extensicola hieraciata* as indicated in the North American Flora **7:** 788.

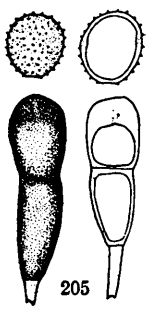
78. PUCCINIA MINUTISSIMA. Fig. 205.

(N. A. F. 7: 360, 786, 815, 839.)

(*Aecidium nesaeae* Ger., Bull. Torrey Club **4:** 47. 1873.)
Puccinia minutissima Arth., Bull. Torrey Club **34:** 587. 1907.
Dicaeoma minutissimum Jacks., Proc. Ind. Acad. Sci. **1915:** 454. 1916.

Pycnia chiefly epiphyllous, in groups. Aecia chiefly hypophyllous or caulicolous, crowded, often causing hypertrophy and much distortion, cupulate; aeciospores globoid or broadly ellipsoid, 16–24 by 19–26 μ; wall colorless, 1–2 μ thick, finely verrucose.

On Lythraceae: **Decodon verticellatus** (L.)Ell.(*Nesaea v.* H.B.K.), Conn., Del., Ind., Mass., Mich., N.J., N.Y., Ohio, Wis.; Ont.


205

Uredia hypophyllous, chestnut-brown; urediospores globoid or broadly ellipsoid, 12–18 by 16–21 μ, wall golden-brown, 1–1.5 μ thick, finely echinulate, the pores 2, slightly superequatorial. Telia hypophyllous, blackish-brown; teliospores oblong-clavate, 15–22 by 39–64 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall dark chestnut-brown, 1–1.5 μ thick at sides, 9–13 μ above; pedicel somewhat colored, one-half length of spore.

On Cyperaceae: **Carex lasiocarpa** Ehrh.(*C. filiformis* Gooden., not L.), Ind., Mich., Mo., N.Y.; Ont.—**C. substriata** (Kükenth.)Mack., Ont.

Range: Massachusetts to Wisconsin, southward to Delaware and Indiana.

A successful culture was made in 1914 by Arthur (Mycol. **7:** 86. 1915), by sowing aeciospores from *Decodon* on *Carex lasciocarpa.*

79. PUCCINIA BOLLEYANA. Fig. 206.

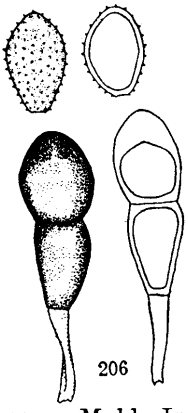
(N. A. F. 7: 368, 787, 840.)

(*Aecidium sambuci* Schw., Schr. Nat. Ges. Leipzig **1:** 67. 1822.)
Puccinia bolleyana Sacc., Syll. Fung. **9:** 303. 1891.
Puccinia atkinsoniana Diet., Bull. Cornell Univ. **3:** 19. 1897.
Dicaeoma sambuci Arth., Proc. Ind. Acad. Sci. **1903:** 151. 1904.

Pycnia chiefly epiphyllous and caulicolous. Aecia hypophyllous and caulicolous, often on hypertrophied or gall-like swellings, cupulate; aeciospores globoid, 15–19 μ in diameter; wall nearly or quite colorless, about 1 μ thick, finely verrucose.

On Caprifoliaceae: **Sambucus canadensis** L., Ala., Conn., Del., D.C., Fla., Ga., Ill., Ind., La., Mass., Mich., Miss., Mo., Neb., N.H., N.J., N.Y., N.C., Ohio, Pa., Tenn., Va., W.Va., Wis.—**S. pubens** Michx.(*S. racemosa* Hook., not L.), Del., D.C., Ind., Mich.

Uredia chiefly hypophyllous, chestnut-brown; urediospores ellipsoid or lenticular, 17–21 by 23–32 μ; wall light chestnut-brown, about 1.5 μ thick, finely echinulate, the pores 2, usually near apex. Telia chiefly hypophyllous, dark chocolate-brown; teliospores clavate-oblong or clavate, 15–25 by 42–65 μ, rounded above, usually narrowed below, somewhat constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 7–13 μ above; pedicel nearly colorless, about length of spore.


206

On Cyperaceae: **Carex bebbii** Olney, Wis.—**C. bullata** Schk., Del.—**C. comosa** Boott, Mich., Ohio, Tex.—**C. crinita** Lam., N.Y.—**C. crus-corvi** Shuttl., Mich.—**C. frankii** Kunth(*C. stenolepis* Torr.), Ark., Ga., Ind., Kans., Ky., Mo., Ohio, Tenn., W.Va.—**C. intumescens** Rudge, N.S.—**C. lupulina** Muhl., Ind., N.Y.—**C. lupuliformis** Sartw., Ind.; Ont.—**C. lurida** Wahl., Ala., Ark., Conn., Del., Ga., Ind., N.Y., Ohio, Pa., Vt.—**C. tribuloides** Wahl., N.Y.—**C. trichocarpa** Muhl., Ind., Ohio, Wis.

Range: Nova Scotia to Wisconsin, southward to Florida and Texas.

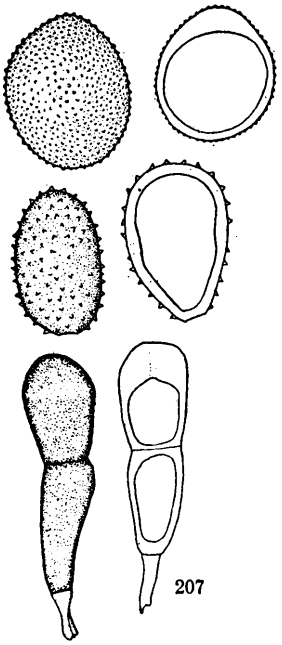
Reciprocal cultures were made in 1901 and 1902 by Arthur (Jour. Myc. **8:** 55. 1902; Bot. Gaz. **35:** 14. 1903), with spores from *Carex trichocarpa* and *Sambucus canadensis.* Cultures with teliospores from *C. trichocarpa* were made in 1902 by Kellerman (Jour. Myc. **9:** 8. 1903) and in 1904 by Arthur (same **11:** 58. 1905), from *C. lurida* in 1902 by Kellerman (same **9:** 7. 1903) and in 1902 and 1908 by Arthur (Bot. Gaz. **35:** 14. 1903; Mycol. **1:** 233. 1909), from *C. frankii* in 1904 by Kellerman (Jour. Myc. **11:** 32. 1905) and in 1906 by Arthur (same **13:** 195. 1907), and from *C. lupulina* by Arthur in 1905 (same **12:** 14. 1906).

80. PUCCINIA MACROSPORA. Fig. 207.

(N. A. F. 7: 353.)

(*Aecidium macrosporum* Peck, Ann. Rep. N. Y. State Mus. **23:** 61. 1873.)
Puccinia macrospora [Peck] Arth., Mycol. **1:** 244. 1909.
Dicaeoma macrosporum A. & K., N. Am. Flora **7:** 353. 1920.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups; aeciospores globoid, 32–42 by 37–51 μ; wall colorless, 1.5–2.5 μ thick at sides, 5–10 μ above, rather coarsely verrucose.



207

On Smilaceae: **Smilax glauca** Walt., N.J.—**S. hispida** Muhl., Kans., N.J.—**S. rotundifolia** L., Del., N.J., N.Y.

Uredia amphigenous, long covered by epidermis; urediospores obovate or narrowly ellipsoid, 26–37 by 35–61 μ, often narrowed below to a thickened hilum; wall golden-yellow, 2.5–3.5 μ thick, echinulate with prominent points 3–4 μ apart, the pores 2 or rarely 3, equatorial, obscure. Telia hypophyllous, chocolate-brown; teliospores clavate, 16–23 by 61–67 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall pale cinnamon-brown, 1.5–2.5 μ thick at sides, 9–16 μ above; pedicel colorless, one-half to once length of spore.

On Cyperaceae: **Carex comosa** Boott, Del.—**C. vestita** Willd., N.J.

Range: Long Island, N. Y., to Delaware near the coast, with a single collection of aecia from Kansas.

Successful cultures were made in 1908 by Arthur (Mycol. **1:** 243. 1909) by sowing teliospores from *Carex comosa* on *Smilax hispida*.

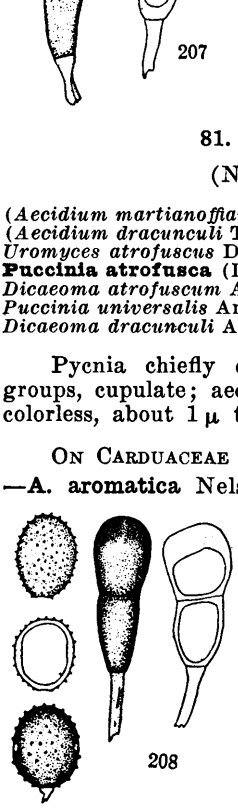
81. PUCCINIA ATROFUSCA. Fig. 208.

(N. A. F. 7: 353, 360, 785, 786, 838, 839.)

(*Aecidium martianoffianum* Thüm., Bull. Soc. Nat. Moscow **52:** 135. 1877.)
(*Aecidium dracunculi* Thüm., Bull. Soc. Nat. Moscow **53:** 212. 1878.)
Uromyces atrofuscus Dudl. & Thomp., Jour. Myc. **10:** 55. 1904.
Puccinia atrofusca (Dudl. & Thomp.) Holw., Jour. Myc. **10:** 228. 1904.
Dicaeoma atrofuscum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Puccinia universalis Arth., Jour. Myc. **14:** 21. 1908.
Dicaeoma dracunculi A. & K., N. Am. Flora **7:** 360. 1920.

Pycnia chiefly epiphyllous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 12–18 by 15–21 μ; wall nearly or quite colorless, about 1 μ thick, minutely verrucose.

On Carduaceae (tribe *Anthemideae*): **Artemisia argophylla** Rydb., Colo.—**A. aromatica** Nels., Mont.—**A. biennis** Willd., N.D.; Alta.—**A. brittonii** Rydb., Colo.—**A. camporum** Rydb. (*A. forwoodii* Rydb., not Wats.), Iowa, Neb.; Alta.—**A. cana** Pursh, Mont., S.D.—**A. carruthii** Wood (*A. kansana* Britt.), Neb., N.D., Tex.—**A. caudata** Michx., Neb.; Alta.—**A. dracunculoides** Pursh, Colo., Neb., S.D.—**A. filifolia** Torr., Neb.—**A. forwoodii** Wats., Neb., N.D.—**A. franserioides** Greene, Colo., N.M.—**A. frigida** Willd., Colo., Mont., Neb., N.D.; Alta.—**A. glaucus** Pall., Colo.—**A. gnaphalodes** Nutt., Colo., Mont., Neb., N.M., N.D., S.D.; Man.—**A. heterophylla** Nutt., Calif.—**A. longifolia** Nutt.,



208

Mont., Neb., N.D.—**A. ludoviciana** Nutt., Utah.—**A. mexicana** Willd.(*A. silvicola* Osterh.), Colo.—**A. pacifica** Nutt.(*A. scouleriana* Rydb.), Colo.—**A. purshiana** Bess., S.D.; Alta.—**A. tripartita** Rydb.(*A. trifida* Nutt.), Mont.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores broadly ellipsoid, 15–21 by 20–26 μ; wall cinnamon-brown, 1–2 μ thick, finely echinulate, the pores 2, nearly or quite equatorial; amphispores in dark chocolate-brown sori, often obovoid, 17–24 by 23–32 μ; wall chestnut-brown, 2.5–3.5 μ thick at sides, 4–7 μ above, sparsely but prominently verrucose-echinulate, the pores 2, equatorial. Telia chiefly hypophyllous, dark chestnut-brown; teliospores clavate-oblong, 16–26 by 30–55 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 5–12 μ above, smooth; pedicel colored, about half length of spore.

On Cyperaceae: **Carex diandra** Schk.(*C. teretiuscula* Gooden.), Neb.—**C. douglasii** Boott, Calif., Colo., Ida., Mont., Neb., N.M., N.D., Ore., Wash., Wyo.; Alta.—**C. eleocharis** Bailey(*C. stenophylla* Am.auth., not Wahl.), Colo., Mont., Neb., N.D., Utah, Wyo.; Yukon.—**C. filifolia** Nutt., Colo., Mont., Neb., N.D., S.D., Wyo.; Alta.—**C. geyeri** Boott, Calif., Colo.—**C. heliophila** Mack., Colo., Minn., Mont., Neb., N.D., Wyo.—**C. hoodii** Boott, Utah.—**C. inops** Bailey, Ore.—**C. multicaulis** Bailey, Calif., Ore.—**C. nigricans** C.A.Mey., Utah.—**C. obtusata** Lilj., Colo., Mont., Utah.—**C. oligocarpa** Schk., Wis.—**C. petasata** Dewey(*C. liddonii* Boott), Colo., Mont., Utah.—**C. praegracilis** W.Boott(*C. marcida* Boott), Calif., Colo., Mont., Neb., Nev., N.M., N.D., Ore., Wyo.; Man.—**C. rossii** Boott, Colo., Ore., Wash., Wyo.; B.C.

Range: Manitoba to central Yukon, southward to western Texas and southern California; also in central Asia, Siberia and Japan.

Cultures were made in 1907, 1909 and 1910 by Arthur (Jour. Myc. **14:** 21. 1908; Mycol. **2:** 224. 1910; same **4:** 16. 1912) by sowing teliospores from *Carex "stenophylla"* on *Artemisia dracunculoides*, and in 1916 (Mycol. **9:** 298. 1917) with teliospores from *C. filifolia* sown on *A. gnaphalodes*.

Puccinia millefolii.

(N. A. F. 7: 582, 806, 848.)

Puccinia millefolii Fckl., Jahrb. Nass. Ver. Nat. **23–24:** 55. 1870.
Puccinia conferta D. & H.; Diet., Erythea **1:** 250. 1893.
Puccinia recondita D. & H.; Diet., Erythea **2:** 128. 1894. Not *P. recondita* Roberge, 1857.
Puccinia artemisiicola Syd., Monog. Ured. **1:** 14. 1902.
Micropuccinia millefolii A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous or caulicolous, solitary or crowded on yellowish spots, early naked, pulvinate, becoming cinereous by germination; teliospores as in *Puccinia atrofusca*. Mesospores occasionally present.

On Carduaceae (tribe *Anthemideae*): **Achillea borealis** Bong., Alas.—**A. lanulosa** Nutt., N.M.—**A. millefolium** L., Calif., Mont., Ore., Wash., Wyo.—**A. multiflora** Hook., Alta.—**Artemisia albula** Wooton, N.M.—**A. californica** Less., Calif.—**A. frigida** Willd., Colo., Mont., N.D., S.D.; B.C.—**A. gnaphalodes** Nutt., Colo., Mont.—**A. heterophylla** Nutt., Calif.—**A. hookeriana** Bess., Utah.—**A. ludoviciana** Nutt., Colo., Okla., Ore.—**A. mexicana** Willd.(*A. silvicola* Osterh.), Tex.—**A. purshiana** Bess., S.D.—**A. suksdorfii** Piper, Wash. **Range.** Eastern North Dakota to southeastern Alaska, southward to northern Texas and central California; also in Japan.

The correlation of this microcyclic species with the preceding macrocyclic species was pointed out by Dietel (Centr. Bakt. **48**: 492. 1918).

82. PUCCINIA CARICIS. Fig. 209.

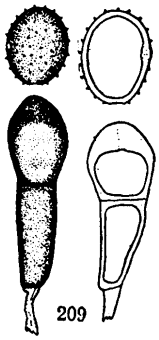
(N. A. F. 7: 355, 358, 368, 785, 787, 838, 839.)

(*Aecidium rumicis β grossulariae* Pers., Syn. Fung. 207. 1801.)
(*Aecidium urticae* Schum., Enum. Pl. Saell. **2**: 222. 1803.)
Uredo caricis Schum., Enum. Pl. Saell. **2**: 231. 1803.
Puccinia caricis (Schum.) Schroet., Krypt. Fl. Schles. **3**[1]: 327. 1887.
Puccinia caricis-strictae Diet., Hedw. **28**: 23. 1889.
Puccinia pringsheimiana Kleb., Zeits. Pflanzenkr. **4**: 194. 1894.
Puccinia grossulariae Lagerh., Tromsø Mus. Aarsh. **17**: 60. 1895.
Dicaeoma urticae Ktze., Rev. Gen. **3**[2]: 467. 1898.
Puccinia garrettii Arth., Bull. Torrey Club **32**: 41. 1905.
Dicaeoma grossulariae Kern, Trans. Am. Micr. Soc. **32**: 64. 1913.
Puccinia eminens Kern, Mycol. **9**: 220. 1917.
Dicaeoma eminens A. & K., N. Am. Flora **7**: 355. 1920.
Dicaeoma caricis-strictae A. & K., N. Am. Flora **7**: 368. 1920.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous, cupulate; aeciospores globoid, 13–19 by 15–23 μ; wall colorless, 1 μ thick, finely verrucose.

On hosts, listed under the varieties.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 15–25 by 19–35 μ; wall cinnamon- or chestnut-brown, 1.5–2 μ thick, finely and sparsely echinulate, the pores 2 to 4, usually 3, equatorial, or sometimes 1 near the hilum. Telia chiefly hypophyllous, oblong, chocolate- or blackish-brown; teliospores broadly clavate, 12–24 by 26–70 μ, rounded above, or narrowed at both ends, slightly or not constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 4–16 μ above; pedicel nearly or quite colorless, half length of spore or less.


209

On Cyperaceae: **Carex** sp.; in the N. Am. Flora (7: 356–359, 785) nearly 100 species are recorded with localities.

Range: Labrador to Alaska, southward to North Carolina, northern Texas and central California; also in temperate Europe, Asia, Japan and New Zealand.

A variable species, usually recorded in large part under two names, *Puccinia caricis* and *P. grossulariae* (or *P. pringsheimiana*), which may now be taken as two well-marked varieties, to be distinguished as *P. caricis urticata* and *P. caricis grossulariata*. The first cultures to show a connection between telia on *Carex* and aecia on *Urtica* were made in 1872 by Magnus (Verh. Bot. Ver. Prov. Brandb. **14**: xi. 1872), followed by Cornu, Plowright, Bubák, Klebahn, Tranzschel and others in Europe, and by Kellerman and Arthur in America. The connection between telia on *Carex* and aecia on *Ribes* (or *Grossularia*) was made first in 1892 by Klebahn (Zeits. Pflanzenkr. **3**: 200. 1893), who followed with many other cultures, and in America many cultures were made by Fraser and Arthur.

In the first cultures by Klebahn teliospores from *Carex acuta* produced aecia both on *Urtica* and *Ribes*, and similar results were obtained in other years. Although recognizing from the first that the two species of *Carex* rusts were morphologically nearly or quite indistinguishable, yet on account of the widely separated relationship of the aecial hosts to consider them one species with only biologic differences seemed paradoxical, and therefore Klebahn reached the conclusion that the inoculation material when producing aecia on both *Urtica* and *Ribes* was mixed, or that contamination occurred from stray spores. As the result of his cultures he gave names to three biologic forms connected with *Urtica* and five connected with *Ribes*, all treated as independent species (Wirtsw. Rostp. 295–301. 1904).

In 1899, 1901, 1902 and 1905 cultures with teliospores from *Carex acuta, C. saxatilis* and eight other species of *Carex* were found by Eriksson (Arkiv Bot. **16**[11]: 4–15. 1920) to produce aecia on both *Urtica* and *Ribes*. In reporting his results (*l. c.* pp. 1–64) the whole problem with much data is discussed, with the decision that the *Urtica-Ribes-Carex* rust should be placed under three species and three subspecies, for which he proposes new names.

Collections on *Carex* can usually be distributed into the following varieties by the size of the spores, particularly the urediospores, and by the urediosporepores.

(1). **Puccinia caricis urticata** (Kern) n. comb. (*P. urticata* Kern). Aecia with aeciospores 15–19 by 18–23 μ; on URTICACEAE: **Urtica breweri** Wats., Calif.—**U. cardiophylla** Rydb., Mont.—**U. dioica** L., Mass.; Ont.—**U. gracilis** Ait., Ariz., Colo., Ill., Ind., Iowa, Kans., Mass., Mich., Mont., Neb., N.Y., N.D., Ohio, Pa., S.D., Wis., Wyo.; Alta., Ont.—**U. holosericea** Nutt., Utah.—**U. lyallii** Wats., Alas., Calif., Ore., Wash.; B.C.

Urediospores 18–25 by 24–35 μ, the pores 3, rarely 4, equatorial; teliospores 15–23 by 39–70 μ, the wall 7–12 μ thick above. On **Carex** sp., about 30 species listed in the N. Am. Flora **7**: 358, 359, 785. **Range:** Southern Canada, United States southward to Massachusetts and central California; also in Europe, Siberia, India, Japan and New Zealand.

Cultures with American material were made by Arthur in 1901, 1902, 1905, 1907, 1909 and 1910 (Bot. Gaz. **35**: 16. 1903; Jour. Myc. **8**: 52. 1902; same **12**: 15. 1906; same **14**: 14. 1908; Mycol. **2**: 223. 1910; same **4**: 17. 1912), using teliospores from *Carex aristata, C. nebraskensis, C. stipata, C. stricta* and *C. riparia*, all sown on *Urtica gracilis*. Teliospores from *C. riparia* and *C. stricta* were also sown in 1902 on *U. gracilis* by Kellerman (Jour. Myc. **9**: 9, 10. 1903).

(2). **Puccinia caricis caricis-strictae** (Diet.) n. comb. (*P. caricis-strictae* Diet.). Aecia with aeciospores as in *Puccinia caricis urticata;* on URTICACEAE, not yet collected from the field.

Urediospores 13–20 by 20–25 μ, the pores 2, rarely 3, equatorial, or somewhat subequatorial; amphispores in chestnut-brown sori, numerous, globoid, obovoid or ellipsoid, 17–24 by 21–31 μ, the wall dark cinnamon-brown, 1.5–2.5 μ thick, finely verrucose, with 2 pores, somewhat subequatorial; pedicel semipersistent; teliospores 16–21 by 32–56 μ, the wall 5–10 μ above; on **Carex stricta** L., Conn., Del., Mass., N.Y.—**C. torta** Boott, W.Va. **Range:** Massachusetts and adjacent parts of New York, southward to Delaware, and in the mountains of eastern West Virginia.

Urediospores are rarely observed, but amphispores are abundant. The amphispores are darker than the urediospores, somewhat larger, and verrucose instead of echinulate. They persist over winter. Very few collections have had the host positively determined, but all agree in being on a narrow-leaved *stricta*-like *Carex*.

Cultures were made by Cummins in 1933, with teliospores from *Carex stricta*, sent by Roy Latham from Long Island, N. Y., sown on *Urtica dioica*, the results not yet published.

(3). **Puccinia caricis grossulariata** n. nom. Aecia with aeciospores 13–18 by 15–21 μ; on GROSSULARIACEAE: **Grossularia cynosbati** (L.)Mill.(*Ribes c., R. gracile* Michx.), Conn., Ind., Iowa, Mich., N.H., N.Y., Ohio, Vt., Wis.; Ont., Queb.—**G. divaricata** (Dougl.)Cov.&Britt. (*R. d.*), Calif., Ore., Wash.—**G. hesperis** (McCl.)Cov.&Britt., Calif.—**G. hirtella** (Michx.)Spach, Ida., Ind., Me., Mass., Pa., Vt.; N.S.—**G. inermis** (Rydb.)Cov.&Britt.(*R. i., R. vallicola* Greene), Colo., Mont.—**G. leptantha** (Gray)Cov.&Britt.(*R. l.*), N.M.—**G. missouriensis** (Nutt.)Cov.&Britt.(*R. m., R. gracile* Pursh, not Michx.), Ill., Ind., Iowa, Kans., Minn., Mo., Neb., N.D., Wis.—**G. oxyacanthoides** (L.)Mill. (*R. o.*), Alas.—**G. reclinata** (L.)Mill.(*R. uva-crispa* L., *R. grossularia* L.), N.D., Iowa, Wis.—**G. rotundifolia** (Michx.)Cov.&Britt.(*R. r.*), Tenn.—**G. setosa** (Lindl.)Cov.&Britt.(*R. s.*), Mont., Wyo.; Alta.—**Ribes acerifolium**

Howell, Wash.—**R. alpinum** L., Alas.—**R. americanum** Mill.(*R. floridum* L'Her.), Conn., Ill., Ind., Iowa, Mich., Minn., Mont., Neb., N.Y., Ohio, S.D., Wis.; Ont.—**R. aureum** Pursh(*Chrysobotrya a.* Rydb.), Colo., Mont.—**R. bracteosum** Dougl., Alas., Wash.; B.C.—**R. echinatum** Lindl.(*Lymnobotrya e.* Rydb.), Alas., Ida., Mont., Ore.—**R. glandulosum** Weber(*R. prostratum* L'Her.), Me., N.H., N.Y., Tenn.; Alta., B.C., N.S.; Lab.—**R. gordonianum** Lem., Alas.—**R. hudsonianum** Richards., Alas.; Alta.—**R. inebrians** Lindl.(*R. pumilum* Nutt.), Colo., Mont.—**R. lacustre** (Pers.)Poir.(*L. l.* Rydb.), N.H., Vt.; Alta., Ont.—**R. laxiflorum** Pursh, Alas.; B.C.—**R. malvaceum** Smith, Calif.—**R. odoratum** Wendl.(*R. longiflorum* Nutt., *Chrysobotrya o.* Rydb.), Kans., Okla., Wis.—**R. petiolare** Dougl., Alas., Ida., Wash.—**R. sanguineum** Dougl., Alas., Calif., Ore.—**R. triste** Pall.(*R. rubrum* Gray, not L.), Alas.—**R. vulgare** Lam., Alas., Ind., Md.

Urediospores 15–21 by 19–24 μ (occasionally larger, up to 25–38 μ long), the pores 3, rarely 4, equatorial, or somewhat subequatorial; teliospores 14–23 by 39–60 μ, the wall 4–10 μ above; on **Carex** sp., about 60 species listed in the N. Am. Flora 7: 357, 785, exclusive of those listed under *P. caricis uniporula.* **Range:** Nearly throughout the United States and Canada; also in Europe.

All the spores of *Puccinia caricis grossulariata* are as a rule smaller than those of *P. caricis urticata.* There are exceptional cases in which the measurements equal those of the latter variety, and one can surmise that they may have been derived from a strain that would infect both *Ribes* and *Urtica,* but no data of this nature are available. Some collections with exceptionally large urediospores have been called *Puccinia garrettii* and *P. eminens.*

Cultures with American material were made by Arthur in 1904 (Jour. Myc. **11:** 59. 1905) with teliospores from *Carex crinita* sown on *Grossularia rotundifolia,* in 1905 (same **12:** 14. 1906) with teliospores from *C. tetanica* on *G. missouriensis* (*Ribes gracile*), in 1906 (same **13:** 196. 1907) with teliospores from *C. squarrosa* on *G. missouriensis* and *G. rotundifolia,* and from *S. tetanica* on *G. cynosbati,* in 1907 (same **14:** 13. 1908) with teliospores from *C. crinita* on *G. cynosbati,* and in 1912 (Mycol. **7:** 67. 1915) with teliospores from *C. crinita* on *G. cynosbati.* Fraser (Mycol. **4:** 180. 1912) in 1911 transferred the rust from *C. crinita* to *R. glandulosum* (*R. prostratum*) and *G. oxyacanthoides,* also from *C. intumescens* to *R. glandulosum.*

(4). **Puccinia caricis uniporula** (Orton) n. comb. (*P. albiperidia* Arth., *P. uniporula* Orton). Aecia usually colorless (white); aeciospores as in *P. caricis grossulariata;* on GROSSULARIACEAE: **Grossularia cynosbati** (L.)Mill. (*Ribes c., R. gracile* Michx.), Ind., Iowa, Wis.; Ont.—**G. missouriensis** (Nutt.) Cov.&Britt.(*R. m., R. gracile* Pursh, not Michx.), Iowa.—**G. reclinata** (L.)Mill. (*R. uva-crispa* L., *R. grossularia* L.), Iowa, Wis.

Uredia with urediospores 16–24 by 21–29 μ, the pores 1, rarely 2, near hilum; teliospores 13–23 by 32–48 μ; on **Carex aestivalis** Curtis, N.C.—**C. arctata** Boott, N.Y., Wis.; N.S., Queb.—**C. complanata** Torr., N.J., Pa.—**C. conoidea** Schk., Ind., N.Y.—**C. flexuosa** Muhl.(*C. tenuis* Rudge, *C. debilis rudgei* Bailey), Me., Mich., N.H., N.Y., Pa., Vt., W.Va.; Newf.; N.S., Queb.—**C. gracillima** Schw., Mich., N.Y., Pa., Vt., Wis.; Ont.—**C. hirtifolia** Mack., N.Y.; Ont.—**C. oblita** Steud., N.J.—**C. pallescens** L., Me., N.H., N.J., N.Y., Vt.; N.S.—**C. plantaginea** Lam., N.S.—**C. pubescens** Muhl., Ind., Iowa, Ohio; Ont.—**C. virescens** Muhl.(*C. costellata* Britt.), N.Y., Ohio, W.Va.

Range: Newfoundland to Wisconsin, southward to Pennsylvania and Iowa.

This variety is fairly well defined, occurring only on the sections Gracillimae, Debiles, Virescentes and Pallescentes of the genus *Carex,* all being narrow-leaved

species with slender inflorescence. In a few instances *P. caricis grossulariata* has been found to occur upon the same hosts. Not infrequently a few urediospores with three equatorial pores occur intermixed with the more abundant one-pored form.

Successful cultures by Arthur were made by sowing teliospores on *Grossularia cynosbati*, taken from *Carex pubescens* in 1901 and 1912 (Jour. Myc. **8:** 53. 1902, type of *Puccinia albiperidia;* Mycol. **7:** 66. 1915), from *C. gracillima* in 1903 and 1904 (Jour. Myc. **10:** 11. 1904; same **11:** 59. 1905), from *C. arctata* in 1912 (Mycol. **7:** 67. 1915), from *C. flexuosa* (*C. tenuis*) in 1912 and 1915 (Mycol. **7:** 67. 1915; same **8:** 130. 1916), and from *C. pallescens* in 1910 (Mycol. **4:** 13. 1912). Success was also attained by sowing teliospores from *C. gracillima* on *G. reclinata* (*Ribes uva-crispa*) in 1905 (Jour. Myc. **11:** 59. 1905). Fraser (Mycol. **4:** 180. 1912) also grew the rust in 1911 from *C. flexuosa* (*C. tenuis*) on *R. glandulosum* (*R. prostratum*), and from *C. arctata* on *G. oxyacanthoides*. The correlation of *Puccinia uniporula* with *P. grossulariae*, both now considered to be varieties, was pointed out in 1912 by Orton (Mycol. **4:** 200. 1912).

(5). **Puccinia caricis quadriporula** n. comb. (*P. quadriporula* Arth.?). No collections or cultures have yet established a variety with aecia on *Grossularia-Ribes* and urediospores having four equatorial pores. It is reasonable to expect that such a variety will be found. The collection on which *P. quadriporula* was founded has three-fourths or more of the urediospores with 3 equatorial pores, and the same is true of other collections.

Uromyces minutus, see page 394.

Uromyces uniporulus.

(N. A. F. 7: 235, 753, 828.)

Uromyces uniporulus Kern, Rhodora **12:** 125. 1910.
Nigredo uniporula Arth., N. Am. Flora **7:** 235. 1912.

Pycnia and aecia unknown. Urediospores globoid, 18–21 by 21–23 μ, with 1 pore near the hilum, otherwise as in *Puccinia caricis uniporula*. Teliospores one-celled, obovoid, 13–16 by 19–27 μ, otherwise as in *P. caricis uniporula*.

On Cyperaceae: **Carex gracillima** Schw., Mich., Wis.—**C. flexuosa** Muhl. (*C. tenuis* Rudge, *C. debilis rudgei* Bailey), Conn., Ga., N.C. **Range:** Locally in eastern United States.

A macrocyclic species correlated with (4) *Puccinia caricis uniporula*.

Uromyces valens.

(N. A. F. 7: 234, 752, 828.)

Uromyces valens Kern, Rhodora **12:** 125. 1910.
Nigredo valens Arth., N. Am. Flora **7:** 234. 1912.

Pycnia and aecia unknown. Urediospores ellipsoid, 16–19 by 19–26 μ, with 4 equatorial pores, otherwise as in *P. caricis grossulariata*. Teliospores one-celled, obovoid, 16–23 by 26–39 μ, with pedicel one to three times length of spore, otherwise as in *P. caricis grossulariata*.

On Cyperaceae: **Carex lupulina** Muhl., Ind., Wis.—**C. utriculata** Boott, Ind. **Range:** Only two localities in central Indiana and one in northwestern Wisconsin.

This macrocyclic species is correlated with the hypothetical (5) *Puccinia caricis quadriporula*, which may be only a variant of (3) *P. caricis grossulariata*.

Puccinia parkerae.

(N. A. F. 7: 539, 803, 846.)

Puccinia parkerae D. & H.; Diet., Erythea **3:** 78. 1895.
Micropuccinia parkerae A. & J., N. Am. Flora **7:** 539. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous and petiolicolous, in crowded groups, large, early naked, blackish-brown; teliospores 13–16 by 32–53 μ, with pedicel once to twice length of spore, otherwise as in *Puccinia caricis grossulariata.*

On Grossulariaceae: **Grossularia divaricata** (Dougl.)Cov.&Britt.(*Ribes d.*), B.C.—**Ribes echinatum** Lindl.(*Lymnobotrya e.* Rydb.), Alas., Ore., Wash.; B.C. **Range:** Southeastern Alaska to northern Oregon; also in Japan.

A microcyclic species correlated with (3) *Puccinia caricis grossulariata,* as pointed out by Dietel (Centr. Bakt. **48:** 493. 1918).

83. PUCCINIA CARICIS-SHEPHERDIAE. Fig. 210.

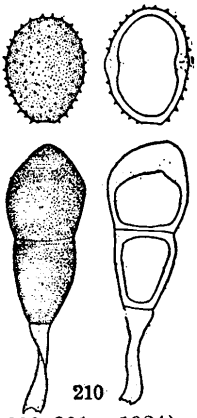
(N. A. F. 7: 631, 785.)

(*Aecidium allenii* G. W. Clint.; Peck, Ann. Rep. N. Y. State Mus. **24:** 93. 1872.)
(*Aecidium arctoum* Arth., Bull. Torrey Club **47:** 477. 1920.)
Puccinia caricis-shepherdiae J. J. Davis, Trans. Wis. Acad. Sci. **21:** 301. 1924.
Dicaeoma allenii A. & F., N. Am. Flora **7:** 785. 1926.

Pycnia epiphyllous, loosely, often stellately grouped. Aecia hypophyllous, in large, uncrowded, indefinite groups, cupulate; aeciospores globoid or broadly ellipsoid, 17–26 by 19–29 μ; wall colorless, about 1.5 μ thick, minutely verrucose.

On Elaeagnaceae: **Elaeagnus angustifolia** L., N.D.; Sask.—**E. commutata** Bernh.(*E. argentea* Pursh), Alta., Man., Sask.—**Shepherdia argentea** Nutt.(*Lepargyraea a.* Greene), Colo., Mont., Neb., S.D., Wyo.; Sask.—**S. canadensis** (L.)Nutt.(*L. c.* Greene), Mich., Mont., N.Y., S.D., Wash., Wis.; Newf.; Alta., Man., Ont., Sask.

Uredia amphigenous, golden-brown; urediospores obovoid or ellipsoid, 18–28 by 27–35 μ; wall golden-brown, 1.5–2.5 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, dark-brown; teliospores oblong-clavate, 17–24 by 42–56 μ, rounded or obtuse above, narrowed below, somewhat constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, 10–15 μ and darker above; pedicel colored, one half to once length of spore.



210

On Cyperaceae: **Carex aquatilis** Wahl., Sask.—**C. atherodes** Spreng.(*C. aristata* R.Br.), Sask.—**C. eburnea** Boott(*C. setifolia* Britt.), Wis.; Ont., Queb.—**C. lanuginosa** Michx., Sask.—**C. viridula** Michx., Mich., Pa.

Range: Newfoundland to Alberta, southward to Pennsylvania and western Colorado, chiefly northward.

The aecia are in larger, indefinite and less crowded groups than in *Puccinia coronata,* with which the species has been confused, and have somewhat larger aeciospores. Successful cultures were made in 1922 and 1923 by Davis (Trans. Wis. Acad. Sci. **21:** 299–301. 1924), sowing teliospores from *Carex eburnea* on *Lepargyraea canadensis.* Reciprocal cultures in 1926 and 1927 were made by Fraser and Ledingham (Mycol. **21:** 86–89. 1929), using aeciospores from *Elaeagnus angustifolia, E. commutata, Lepargyraea argentea* and *L. canadensis,* and teliospores from *Carex aquatilis* and *C. lanuginosa.*

84. PUCCINIA LIMOSAE. Fig. 211.

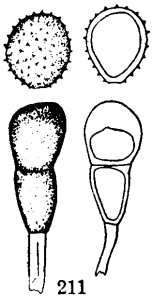
(N. A. F. 7: 354, 785, 838.)

(*Aecidium lysimachiae* Schw., Schr. Nat. Ges. Leipzig **1:** 67. 1822.)
Puccinia limosae Magn., Tagebl. Nat. Vers. München **50:** 199. 1877.
Dicaeoma lysimachiae Ktze., Rev. Gen. **3**[3]**:** 467. 1898.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, in large groups, cupulate; aeciospores globoid, 16–19 by 18–21 μ; wall yellowish, 1 μ thick, finely verrucose.

On Primulaceae: **Lysimachia quadrifolia** L., Conn., Mass., N.J., N.Y., N.C.—**L. terrestris** (L.)B.S.P.(*L. stricta* Ait., *L. racemosa* Michx.), Conn., Del., N.Y., N.C., Pa.—**Naumburgia thyrsiflora** (L.)Duby(*Lysimachia t.*), Ill., Neb., N.Y., Wis.; Ont., Man.

Uredia hypophyllous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 17–19 by 20–25 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, equatorial. Telia hypophyllous, blackish-brown; teliospores oblong or oblong-clavate, 15–19 by 32–45 μ, rounded or truncate above, narrowed below, slightly constricted at septum; wall dark chestnut-brown, 1–1.5 μ thick at sides, 7–10 μ above; pedicel nearly colorless, about three fourths length of spore.


211

On Cyperaceae: **Carex arcta** Boott, Ont.—**C. brunnescens** (Pers.) Poir.(*C. canescens alpicola* Wahl.), Vt.—**C. limosa** L., Neb., Ohio; Ont.—**C. stratiformis** Britt., Queb.

Range: Nova Scotia to Manitoba, southward to Delaware and north-central Nebraska.

Aeciospores both from *Lysimachia vulgaris* and *Naumburgia thyrsiflora* were found in 1899 by Klebahn (Jahr. Wiss. Bot. **34:** 396. 1900) to infect *Carex limosa.*

85. PUCCINIA ULIGINOSA.

(N. A F. 7: 355, 785.)

(*Caeoma parnassiae* Schl., Fl. Berol. **2:** 113. 1824.)
Puccinia uliginosa Juel, Oefv. Sv. Vet.-Akad. Förh. **51:** 409. 1894.
Dicaeoma parnassiae A. & K., N. Am. Flora **7:** 355. 1920.
Puccinia parnassiae Barth., Handb. N. Am. Ured. 147. 1928. Not *P. parnassiae* Arth. 1904.

Pycnia unknown. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 15–18 by 16–19 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Parnassiaceae: **Parnassia palustris** L., Alas.

Uredia amphigenous, dark cinnamon-brown; urediospores obovoid or ellipsoid, 16–21 by 21–28 μ; wall dark cinnamon-brown, 1.5 μ thick, echinulate, the pores 3 or occasionally 4, equatorial. Telia mostly hypophyllous, chestnut-brown; teliospores ellipsoid or clavate, 15–21 by 32–45 μ, rounded above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1–2 μ thick at sides, 3–9 μ above; pedicel colored, about half length of spore.

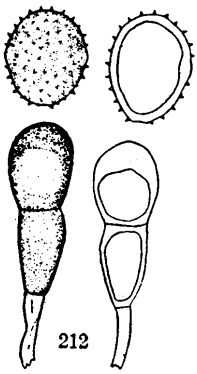
On Cyperaceae: **Carex** spp., not yet found in America.

Range: Kodiak Island in southern Alaska; also in Europe.

Aeciospores from *Parnassia palustris* were found in 1894 by Juel (Oefv. Sv. Vet.-Akad. Förh. **51**: 409. 1894), and in 1895 by Klebahn (Zeits. Pflanzenkr. **6**: 262. 1896) to infect *Carex goodenowii* (*C. vulgaris*). In 1896 Juel (*l.c.* **53**: 214. 1896) used teliospores to infect *Parnassia palustris*.

86. PUCCINIA MINUTA. Fig. 212.

(N. A. F. 7: 354, 785.)



212

Puccinia minuta Diet.; Atks., Bull. Cornell Univ. **3**: 19. 1897.
Dicaeoma minutum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

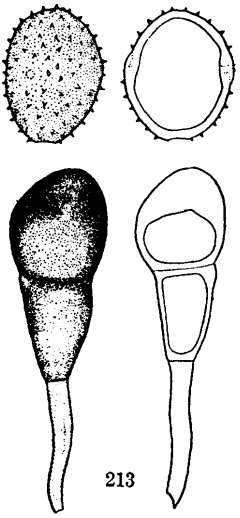
Pycnia and aecia unknown. Uredia hypophyllous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 19–26 by 29–39 μ; wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 3 or sometimes 4, equatorial. Telia hypophyllous, blackish-brown; teliospores clavate-oblong or cuneate, 16–23 by 32–55 μ, usually rounded above, narrowed below, slightly constricted at septum; wall light chestnut-brown, 1–1.5 μ thick at sides, 5–9 μ above; pedicel colored, one-half length of spore.

On Cyperaceae: **Carex verrucosa** Muhl., Ala., Fla. **Range:** Southeastern Alabama and southeastward.

87. PUCCINIA SPATIOSA. Fig. 213.

(N. A. F. 7: 359.)

Puccinia spatiosa Kern, Mycol. **9**: 213. 1917.
Dicaeoma spatiosum A. & K., N. Am. Flora **7**: 359. 1920.



213

Pycnia and aecia unknown. Uredia not seen; urediospores intermixed with teliospores, broadly ellipsoid, 26–29 by 30–39 μ; wall light cinnamon-brown, 2–2.5 μ thick, echinulate, the pores 3, or sometimes 4, nearly equatorial. Telia hypophyllous, blackish; teliospores narrowly obovoid, 24–29 by 45–64 μ, rounded above, rounded or narrowed below, considerably constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 16–23 μ above; pedicel nearly colorless, once to once and a half length of spore.

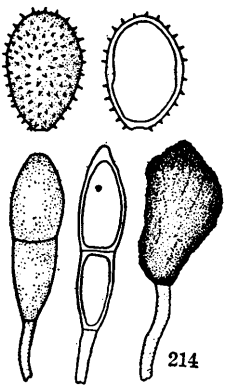
On Cyperaceae: **Carex** sp., N.D., S.D. **Range:** Only two collections known, from stations about 200 miles apart in the eastern Dakotas.

88. PUCCINIA MICROSORA. Fig. 214.

(N. A. F. 7: 359, 786.)

Puccinia microsora Körn.; Fckl., Fungi Rhen. *2637*. 1874.
Dicaeoma microsorum Ktze., Rev. Gen. **3**^{3}: 469. 1898.

Pycnia and aecia unknown. Uredia amphigenous, long covered by epidermis, surrounded by pale-brown, subepidermal paraphyses; urediospores ellipsoid, 20–26 by 26–30 μ; wall nearly colorless, 1–1.5 μ thick, echinulate, the pores apparently 4, equatorial, obscure; amphispores broadly spatulate or obovoid, 20–28 by 32–51 μ; wall chestnut-brown, 2–3 μ thick at sides, 3–5 μ above, inconspicuously verrucose, the pores 2, occasionally 3, equatorial; pedicel persistent, colorless, about length of spore. Telia not seen; teliospores common in the amphisori, sometimes twice septate, oblong or lanceolate, 13–19 by 35–64 μ, rounded or narrowed at each end, slightly or not constricted at septum;


214

wall nearly colorless, 1–1.5 μ thick at sides, 2–4 μ above; pedicel colorless, one-third length of spore or less.

On Cyperaceae: **Carex exsiccata** Bailey, Ore.—**C. frankii** Kunth(*C. stenolepis* Torr.), Va., W.Va.—**C. lurida** Wahl., Pa., Va.—**C. scabrata** Schw., Pa., Wis.—**C. sprengelii** Dewey(*C. longirostris* Torr.), Pa.—**C. tuckermani** Dewey, Wis.—**C.** sp., La. **Range:** Isolated localities in the mountains of Pennsylvania, West Virginia and Virginia, the northern part of Wisconsin, and on the coasts of Louisiana and Oregon; also in northern Europe.

89. PUCCINIA KARELICA. Fig. 215.

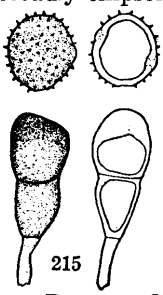
(N. A. F. 7: 369, 787, 840.)

(*Aecidium trientalis* Tranz.; Gobi & Tranz., Scripta Bot. Hort. Imp. Petrop. **3:** 116. 1891.)
Puccinia karelica Tranz., Trav. Mus. Bot. Acad. Sci. St.-Petersb. **2:** 16. 1905.
Dicaeoma trientalis A. & K., N. Am. Flora **7:** 369. 1920.

Pycnia not seen, probably rarely formed. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 13–16 by 15–21 μ; wall colorless, 1–1.5 μ thick; finely verrucose.

On Primulaceae: **Trientalis americana** Pursh, N.Y., Wis.; N.S.—**T. arctica** Fisch., Alas.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 16–19 by 20–24 μ; wall cinnamon-brown, 2–2.5 μ thick, echinulate, the pores 3–5, scattered. Telia chiefly hypophyllous, blackish; teliospores clavate-oblong, 13–21 by 26–48 μ, usually rounded above, rounded or narrowed below, slightly constricted at septum; wall chestnut-brown, 1–1.5 μ thick at sides, 7–12 μ above; pedicel colored, about one-half length of spore.


215

On Cyperaceae: **Carex canescens** L., N.Y., Vt.—**C. diandra** Schk.(*C. teretiuscula* Gooden.), N.Y.—**C. paupercula** Michx.(*C. paupercula irrigua* Fern., *C. magellanica* Am.auth.), Me., N.Y., Wis.; N.S.—**C. strictior** Dewey, Mich.

Range: Nova Scotia to northern New York and Wisconsin, and in southeastern Alaska; also in northern Europe and Japan.

The species occurs in cold bogs. It was cultured in 1903 and 1905 by Tranzschel (Centr. Bakt. II. **11:** 106. 1903; Trav. Mus. Bot. Acad. Sci. St.-Petersb. **2:** 14-17. 1904; same **2:** 50. 1905), by sowing teliospores from *Carex limosa* on *Trientalis europaea.*

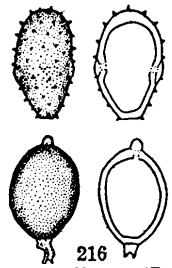
90. UROMYCES CALADII. Fig. 216.

(N. A. F. 7: 236, 753, 828.)

(*Aecidium caladii* Schw., Schr. Nat. Ges. Leipzig **1:** 69. 1822.)
Uredo caladii Schw., Schr. Nat. Ges. Leipzig **1:** 71. 1822.
Puccinia ari-triphylli Schw., Trans. Am. Phil. Soc. II. **4:** 297. 1832.
Uromyces peltandrae Howe, Bull. Torrey Club **5:** 3. 1874.
Uromyces arisaemae Cooke, Bull. Torrey Club **6:** 32. 1875.

Uromyces caladii (Schw.) Farl.; Ellis, N. Am. Fungi *232*. 1879.
Nigredo caladii Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia chiefly hypophyllous, systemic, preceding or accompanying the aecia. Aecia, chiefly hypophyllous, systemic, cupulate; aeciospores globoid or ellipsoid, 15–20 by 17–25 μ; wall pale-yellow, about 1.5 μ thick, finely verrucose. Uredia amphigenous, light cinnamon-brown; urediospores ellipsoid, obovoid or pyriform, 15–25 by 25–38 μ; wall pale cinnamon-brown, 1.5–3 μ thick at sides, 3–8 μ above, sparsely echinulate, the pores 4, equatorial. Telia amphigenous, light chestnut-brown; teliospores ellipsoid or obovoid, 17–25 by 23–40 μ; wall cinnamon-brown, 1.5–2 μ thick at sides, slightly thicker above and bearing a hyaline papilla; pedicel colorless, short.


216

On Araceae: **Arisaema stewardsonii** Britt., N.Y.—**A. triphyllum** (L.)Schott, Conn., Del., D.C., Fla., Ill., Ind., Iowa, Kans., Ky., Me., Mass., Mich., Minn., Miss., Mo., Neb., N.H., N.J., N.Y., N.C., N.D., Ohio, Pa., R.I., S.C., S.D., Tenn., Va., Vt., W.Va., Wis.; N.S., Ont., Queb.—**Muricauda dracontium** (L.)Small(*Arisaema d.* Schott), Ala., Ark., Del., Fla., Ill., Ind., Iowa, Kans., Ky., Mich., Miss., Mo., Neb., N.Y., N.C., Ohio, Okla., Pa., Tenn., Tex., W.Va.; Ont.—**Peltandra glauca** (Ell.)Feay(*P. sagittaefolia* Morong, not Raf.), Ga., N.Y., N.C.—**P. virginica** (L.)Kunth, Conn., Del., D.C., Fla., Ind., Md., Mass., Mich., N.J., N.Y., N.C., Pa., Va. **Range:** Nova Scotia to North Dakota, southward to Florida and Texas; also in Mexico, Bermuda, and on cultivated plants of *Peltandra virginica* in northern Europe.

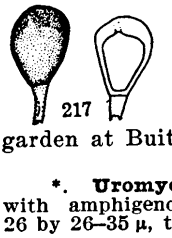
No cultures have been made, although attempted. The method generally pursued is probably not applicable with this species, due to its systemic nature. When the way in which infection takes place is ascertained, an explanation may be apparent why only aecia are observed on the plants cultivated in Europe. The somewhat larger urediospores on *Peltandra* have been taken by Sydow (Monog. Ured. **2**: 296. 1910) to warrant separation of the form on *Peltandra* as a distinct species. The aecia on *Peltandra* are not considered by him as part of the species, but to be heteroecious. Observations in America where the species is common on *Peltandra*, both in aecial and telia stages, do not lend support to this view.

91. UROMYCES PYRIFORMIS. Fig. 217.

(N. A. F. 7: 237, 753.)

Uromyces pyriformis Cooke; Peck, Ann. Rep. N. Y. State Mus. **29**: 69. 1878.
Nigredo pyriformis Arth., N. Am. Flora **7**: 237. 1912.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores obovoid or ellipsoid, 18–19 by 21–26 μ; wall light cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, or sometimes 3, equatorial. Telia amphigenous, blackish-brown; teliospores obovoid, 13–18 by 20–27 μ; wall light chestnut-brown, 1.5–2 μ thick at sides, 5–7 μ above; pedicel colored, about length of spore or shorter.


217

On Araceae: **Acorus calamus** L., Ill., Iowa, Me., Mich., N.Y., Va., Wis.; Ont. **Range:** Maine to Wisconsin, southward to Virginia and Iowa; also in Japan and in the botanic garden at Buitenzorg, Java.

*. **Uromyces commelinae** (Speg.) Cooke (*Uredo c., Nigredo c.* Arth.), with amphigenous, cinnamon-brown uredia, urediospores broadly ellipsoid, 20–26 by 26–35 μ, the wall chestnut-brown, 2–2.5 μ thick, and 2 equatorial pores; telio-

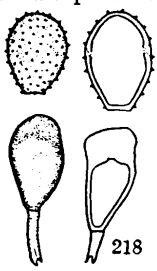
spores ellipsoid or obovoid, 21–24 by 29–35 μ, the wall mostly chestnut-brown, 1.5–2 μ thick at sides, 8–10 μ above, with nearly colorless pedicel, about length of spore; occurs on COMMELINACEAE: **Commelina angustifolia** Michx., southern Fla., and **C. erecta** L., south-central Texas; also in West Indies, Mexico, Central and South America, Africa, southern Asia, Formosa and Japan. (N. A. F. **7:** 237, 753, 828.)

92. UROMYCES PONTEDERIAE. Fig. 218.

(N. A. F. 7: 238, 753.)

Uromyces pontederiae Ger., Bull. Torrey Club **6:** 31. 1875.
Nigredo pontederiae Arth., N. Am. Flora **7:** 238. 1912.

Pycnia and aecia unknown. Uredia amphigenous, light cinnamon-brown; urediospores ellipsoid, 18–21 by 23–29 μ; wall yellowish-brown, 1–1.5 μ thick, echinulate, the pores 4, equatorial. Telia amphigenous, chocolate-brown; teliospores obovoid or broadly clavate, 13–18 by 21–29 μ; wall yellowish-brown, 1–1.5 μ thick at sides, 5–9 μ above; pedicel colored, length of spore or less.



218

ON PONTEDERIACEAE: **Pontederia cordata** L., Del., Fla., Ga., Mo., N.Y., Va. **Range:** Atlantic coast from southeastern New York to Florida, and in southeastern Missouri; also in South America.

93. PUCCINIA LITTORALIS.

Uredo junci Str., Ann. Wett. Ges. **2:** 105. 1812.
Puccinia littoralis Rostr., in Thümen, Myc. Univ. *327*. 1876.
Puccinia junci Wint., Hedw. **19:** 28. 1880. Not Desmaz., 1825.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous, cupulate; aeciospores globoid, 13–18 by 15–22 μ; wall colorless, 1 μ thick, finely verrucose.

ON CICHORIACEAE: **Sonchus** and **Cichorium** spp., in northern Europe, not found in America.

Uredia amphigenous, small, dark cinnamon-brown; urediospores broadly ellipsoid, 14–21 by 15–28 μ; wall pale cinnamon-brown, 1.5–2 μ thick, sparsely verrucose, the pores 2, rarely 3, equatorial. Telia amphigenous, blackish-brown; teliospores obovate-clavate, 12–24 by 35–55 μ, rounded or narrowed above, narrowed below, slightly or not constricted at septum; wall pale-brown, 1.5–2.5 μ thick at sides, 7–12 μ and darker above; pedicel colored, about once length of spore. Mesospores not rare.

ON JUNCACEAE: **Juncus** sp., in northern Europe, not found in America.

Cultures have been made in Europe with teliospores from *Juncus gerardii* and aeciospores from *Sonchus asper* and other species, and from *Cichorium intybus*, showing genetic connection (Tranzschel, Ann. Myc. **5:** 418. 1907; Mycol. Centr. **4:** 71. 1914; Treboux, Ann. Myc. **10:** 75, 304. 1912).

Uromyces junci. Fig. 219.

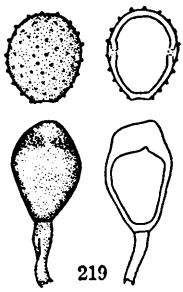
(N. A. F. 7: 238, 753, 828.)

Puccinia junci Desmaz., Pl. Crypt. *81*. 1825.
Uromyces junci (Desmaz.) L. Tul., Ann. Sci. Nat. IV. **2:** 146. 1854.
Nigredo junci Arth., N. Am. Flora **7:** 238. 1912.

Pycnia and aecia as in *Puccinia littoralis*.

ON AMBROSIACEAE: **Ambrosia coronopifolia** T.&G.(*A. psilostachya* Gray, not DC.), Calif., Colo., Neb., N.D.; on CARDUACEAE (tribe *Astereae*): **Aster**

lindleyanus T.&G., Sask.—**A. macrophyllus** L., Ont.—**Grindelia robusta** Nutt., Calif.; (tribe *Heliantheae*): **Helianthus annuus** L., Neb.—**H. decapetalus** L., Neb.—**H. maximiliani** Schrad., Neb., N.D.—**H. nuttallii** T.&G., Wyo.—**H. occidentalis** Ridd., Iowa.—**H. parishii** Gray, Calif.—**H. petiolaris** Nutt., Okla.—**H. rigidus** (Cass.)Desf.(*H. scaberrimus* Ell.), Neb., S.D.—**H. subrhomboideus** Rydb., Sask.—**H. subtuberosus** Bourg., Alta.—**H. trachelifolius** Mill., Kans.—**H. tuberosus** L., Neb., N.D.; Man.; (tribe *Helenieae*): **Eriophyllum staechadifolium** (DC.)Lag., Calif. (tribe *Senecioneae*): **Arnica cana** Greene, Calif.—**A. celsa** Nels., Colo.—**A. chamissonis** Less., Alta.—**A. cordifolia** Hook., Ore., S.D.—**A. mollis** Hook., Mont.—**A. stricta** Nels., Wyo.; (tribe *Cynareae*): **Cirsium flodmanii** (Rydb.)Arth.(*C. canescens* Gray, not Nutt.), Mont., Neb., N.D.; Man.—**C. foliosum** (Hook.)DC., Wyo.—**C. hookerianum** Nutt., Mont.—**C. megacephalum** (Gray)Cockerell, Sask.—**C. undulatum** (Nutt.)Spreng., Alta.


219

Uredia and urediospores as in *P. littoralis*. Telia and teliospores as in *P. littoralis*, except the spores 1-celled, 15–21 by 26–40 μ.

On Juncaceae: **Juncus ater** Rydb., Alta.—**J. balticus** Willd., Calif., Colo., Ida., Kans., Mont., Neb., Nev., N.D., Ore., Pa., S.D., Wash., Wyo.; Man., Sask.—**J. lescurii** Boland., Calif., Ore.—**J. mertensianus** Bong., Ida.—**J. mexicanus** Willd., Calif., Nev.—**J. patens** E.Mey., Calif.—**J. textilis** Buch., Calif.—**J. torreyi** Cov., Calif., Nev.—**J. xiphioides** E.Mey., Calif.

Range: Manitoba to Alberta, southward to Oklahoma and southern California, and sparingly from northern Ontario to Pennsylvania; also in Mexico, South America and Europe.

Successful cultures with teliospores from *Juncus balticus* were made in 1910 and 1912 by Arthur (Mycol. **1:** 22. 1912; same **7:** 76. 1915), when sown on *Cirsium flodmanii*, and also at the latter date on *Ambrosia artemisiaefolia* and *A. psilostachya*. The assignment of aecia on *Aster* and *Helianthus* is largely based upon locality and size of spores, and in part must be considered tentative.

Uromyces junci-effusi.

(N. A. F. 7: 239, 754, 814, 828.)

Puccinia junci Schw., Trans. Am. Phil. Soc. II. **4:** 295. 1832. Not *P. junci* Desmaz., 1825.
Uromyces effusus Arth., Jour. Myc. **13:** 193. 1907. Not *U. effusus* De-T., 1888.
Uromyces junci-effusi Syd., Monog. Ured. **2:** 290. 1910.
Nigredo junci-effusi Arth., N. Am. Flora **7:** 239. 1912.

Pycnia and aecia unknown. Uredia and urediospores as in *Puccinia littoralis*, 14–19 by 18–26 μ (on *J. effusus* and *J. filiformis*), or 16–24 by 21–29 μ (on other hosts), sparsely verrucose-echinulate, the pores 3 or 4, equatorial. Telia and teliospores as in *P. littoralis*, except the spores 1-celled, 13–23 by 24–40 μ.

On Juncaceae: **Juncus bolanderi** Engelm., Ore., Wash.—**J. effusus** L., Ala., Conn., Del., Ind., Md., Mass., Mo., N.J., N.Y., N.C., Ohio, Pa., S.C., Tenn., Va., W.Va.—**J. ensifolius** Wikstr., Calif., Ida., Mont., Ore., Utah, Wash.—**J. falcatus** E.Mey., Calif.—**J. filiformis** L., N.S.—**J. mertensianus** Bong., Ore.—**J. nevadensis** Wats., Calif.—**J. orthophyllus** Cov., Ore., Wash.—

J. oxymeris Engelm., Calif., Ore.—**J. phaeocephalus** Engelm., Calif.—**J. saximontanus** Nels., Utah.—**J. suksdorfii** Piper, Wash.—**J. xiphioides** E.Mey., Calif.; B.C. **Range:** British Columbia to Utah and southern California, and from Nova Scotia to Ohio, southward to South Carolina and Alabama.

Cultures have been attempted, but without success, although the aecia are quite likely to occur on cichoriaceous or carduaceous hosts, and to resemble those of *U. junci* and *U. silphii.*

Uromyces silphii.

(N. A. F. 7: 239, 754, 828.)

(*Aecidium compositarum silphii* Burr.; De-T., in Sacc., Syll. Fung. **7:** 798. 1888.)
Uromyces silphii [Burr.] Arth., Jour. Myc. **13:** 202. 1907.
Uromyces junci-tenuis Syd., Monog. Ured. **2:** 289. 1910.
Nigredo silphii Arth., N. Am. Flora **7:** 239. 1912.

Pycnia and aecia as in *Puccinia littoralis.*

On Carduaceae (tribe *Astereae*): **Aster macrophyllus** L., Wis.; (tribe *Heliantheae*): **Helianthus divaricatus** L., N.Y., Va.—**H. giganteus** L., N.Y.—**H. strumosus** L., Ill., Mo., Wis.—**Heliopsis helianthoides** (L.)Sweet(*H. laevis* Pers.), Ind., Mo.—**Silphium integrifolium** Michx., Ill., Mo., Wis.—**S. laciniatum** L., Ill., Iowa, Kans.—**S. perfoliatum** L., Ind., Iowa, Mo., Wis.—**S. terebinthinaceum** Jacq., Ill., Mich., Mo., Ohio, Wis.

Uredia as in *P. littoralis;* urediospores broadly ellipsoid, 13–19 by 15–23 μ; wall pale cinnamon-brown, about 1.5 μ thick, sparsely verrucose-echinulate, the pores 2, superequatorial. Telia and teliospores as in *P. littoralis,* except the spores 1-celled, 12–19 by 26–35 μ.

On Juncaceae: **Juncus acuminatus** Michx., Ala.—**J. dichotomus** Ell., Del., Fla., Ga., N.J., Tenn.—**J. dudleyi** Wieg., Colo., Conn., Ind., Mich., Neb., Pa., Tenn., Wash.—**J. georgianus** Cov., Ga.—**J. greenei** Oakes&Tuck., Conn.—**J. interior** Wieg., Colo., Ill., Iowa, Neb., N.M., S.D., Tex.—**J. longistylis** Torr., Colo., Ida., Mont., Neb., N.M., N.D., Wash., Wyo.; Man.—**J. macer** S.F.Gray(*J. tenuis* Auth., not Willd.), Conn., Del., Ill., Ind., Iowa, Kans., Ky., La., Me., Md., Mass., Mich., Minn., Mo., Neb., N.Y., N.C., N.D., Ohio, Pa., S.D., Tenn., Tex., Va., Wash., W.Va., Wis.; Ont.—**J. marginatus** Rostk., Neb.—**J. occidentalis** (Cov.)Wieg., Ore.—**J. setosus** (Cov.)Small, Neb.

Range: Maine to Washington and Oregon, southward to Florida and New Mexico, chiefly east of the Rocky Mountains; also in South America.

Cultures made in 1906 and 1907 by Arthur (Jour. Myc. **13:** 202. 1907; same **14:** 17. 1908), using teliospores from *Juncus tenuis,* gave infection on *Silphium perfoliatum.* The aecia of this species can not be separated from those of *U. junci* by structural characters. Both are smaller than in *Puccinia helianthi,* but do not differ materially from those of *P. extensicola.*

Puccinia silphii.

(N. A. F. 7: 581, 806.)

Puccinia silphii Schw., Trans. Am. Phil. Soc. II. **4:** 296. 1832.
Micropuccinia silphii A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, chocolate-brown, cinereous by germination; teliospores oblong,

10–16 by 30–48 μ, obtuse or narrowed above and below, slightly or not constricted at septum; wall chestnut-brown, 1–1.5 μ thick at sides, 4–10 μ above, smooth; pedicel nearly or quite colorless, once length of spore or less. Mesospores not rare.

On Carduaceae (tribe *Heliantheae*): **Silphium asperrimum** Hook., Tex. —**S. asteriscus** L., Ala.—**S. compositum** Michx., Ala.—**S. integrifolium** Michx., Ill., Ind., Kans., Miss., Mo., Neb., Wis.—**S. laciniatum** L., Ala., Iowa, Kans.—**S. perfoliatum** L., Ind., Iowa, Miss., Mo., Neb., N.D., Ohio, S.D., Wis. —**S. trifoliatum** L., N.C., W.Va. **Range:** Ohio to North Dakota, southward to North Carolina and Texas.

Cultures in 1905 and 1906 by Arthur (Jour. Myc. **12:** 21. 1906; same **13:** 198. 1907), using teliospores from *Silphium integrifolium* sown on three other species of *Silphium*, showed no marked tendency toward specialization. The species is clearly correlated with *Uromyces silphii*, as shown by the aecial hosts and the form and size of the teliospores.

The three macrocyclic species of *Uromyces* on *Juncus*, *U. junci*, *U. junci-effusi* and *U. silphii*, are closely related and often show intergrading forms. The known aecia of two of the species are morphologically indistinguishable. The teliospores of *U. silphii* are somewhat smaller than in the other two species, but not otherwise unlike. The most pronounced structural differences occur in the urediospores, in size of spore, number and position of the pores, and in the surface markings. The variation in the markings is one of degree. In *U. junci* they are like minute papillae, although slightly pointed, in *U. silphii* they are more pointed, and in *U. junci-effusi* even more pointed, and may be described as echinulate. It is significant that in *U. junci-effusi* the urediospores on hosts along the Pacific area are notably larger than those from the Atlantic area. It would do no violence to the situation to consider the three species of *Uromyces* as the variable forms of one polymorphic species, or as three varieties. To the third variety would be attached the microcyclic species, *Puccinia silphii*.

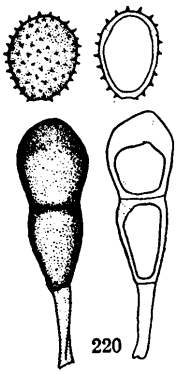
Although no species of *Puccinia* on *Juncus* has yet been found in America to correspond with the restricted *P. littoralis* of Europe, yet the occurrence of a microcyclic species correlated with one of the correlated species of *Uromyces* is of much significance.

It is furthermore to be noted that *Puccinia littoralis* and its correlated *Uromyces* species correspond closely with *P. extensicola* and its correlated species. The aecia of the two species are scarcely distinguishable, and the position of pores in the urediospores have a certain correspondence.

94. PUCCINIA OBSCURA. Fig. 220.

(N. A. F. **7:** 370, 787, 840.)

(*Aecidium compositarum bellidis* Dur. & Mont.; Durieu, Expl. Sci. Alger. Bot. **1:** 308. 1848.)
Puccinia obscura Schroet.; Pass., Nuovo Giorn. Bot. Ital. **9:** 256. 1877.
Dicaeoma obscurum Ktze., Rev. Gen. **3**[3]**:** 469. 1898.



220

Pycnia amphigenous. Aecia amphigenous, cupulate; aeciospores globoid, 15–19 by 16–22 μ; wall nearly or quite colorless, 1–1.5 μ thick, verrucose.

On Carduaceae (tribe *Astereae*): **Bellis perennis** L., in Europe, not found in America.

Uredia usually amphigenous, cinnamon-brown; urediospores ellipsoid or globoid, 16–24 by 24–30 μ; wall clear yellowish-brown, 1.5–2 μ thick, coarsely echinulate, the pores 2, superequatorial. Telia usually amphigenous, cinnamon- or chestnut-brown; teliospores ellipsoid or clavate, 14–20 by 32–45 μ (eastern hosts), 16–22 by 35–55 μ (western hosts), usually rounded above, narrowed below, somewhat constricted at septum; wall pale chestnut-brown, 1.5–2 μ thick at sides, 6–10 μ above; pedicel colored, as long as spore or less.

On Juncaceae: **Luzula carolinae** Wats., N.Y.; N.S., Ont.—**L. comosa** E.Mey., Calif., Ore., Wash.—**L. intermedia** (Thuill.)Nels.(*L. campestris* Am. auth.), Ida., Ind., Iowa, Me., Mass., Mich., N.Y., Vt., Wis.; N.S.—**L. parviflora** (Ehrh.)Desv., Ida., Ore., Wash.; B.C.

Range: Nova Scotia to northern Idaho, southward to Massachusetts and Iowa, and from British Columbia to northern California; also in Europe, Japan and northern Africa.

Reciprocal cultures were made in 1883 by Plowright (Journ. Linn. Soc. **20:** 511. 1884) with aeciospores from *Bellis perennis* and teliospores from *Luzula campestris*, inoculations being made in November and December in the open. Aeciospores from *B. silvestris* gave infection on *L. graeca*, as reported by Maire (Bull. Soc. Hist. Nat. Afrique Nord. **8:** 150. 1917).

95. PUCCINIA ATROPUNCTA. Fig. 221.

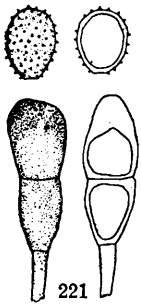
(N. A. F. **7:** 372, 788, 840.)

(*Aecidium dandelionis* Schw., Schr. Nat. Ges. Leipzig **1:** 66. 1822.)
Puccinia atropuncta P. & C.; Peck, Bot. Gaz. **4:** 171. 1879.
Puccinia zygadeni Trel., Prel. List Wis. Fungi 25. 1884.
Dicaeoma atropunctum Ktze., Rev. Gen. **3**[3]: 468. 1898.
Puccinia melanthii Bubák, Oesterr. Bot. Zeits. **50:** 318. 1900.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 13–18 by 16–18 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Cichoriaceae: **Cynthia dandelion** (L.)DC.(*Krigia d.* Nutt.), N.C.—**Nabalus trifoliolatus** Cass.(*Prenanthes t.* Fern.), Pa., Va.

Uredia chiefly amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 16–22 by 19–26 μ; wall yellowish-brown, 1–2 μ thick, echinulate, the pores 2, usually superequatorial Telia chiefly amphigenous, blackish-brown; teliospores oblong or oblong-clavate, 14–22 by 35–56 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall cinnamon-brown, 1–2 μ thick at sides, 7–12 μ and darker above; pedicel colored, about one-half length of spore.


221

On Melanthaceae: **Amianthium muscaetoxicum** (Walt.) Gray(*Chrosperma m.* Ktze.), Pa.—**Schoenocaulon dubium** (Michx.)Small(*S. gracile* Gray), Fla.—**Stenanthium gramineum** (Ker)Morong, Ga.—**Veratrum parviflorum** Michx.(*Melanthium p.* Wats.), N.C., Tenn.—**V. viride** Ait., Tenn., W.Va.—**V. woodii** Robb., Mo.—**Xerophyllum asphodeloides** (L.)Nutt., Miss.—**Zygadenus chloranthus** Richards.(*Anticlea c.* Rydb.), Iowa, N.D., Wis.; Ont., Sask.

Range: Locally from southwestern Ontario to Saskatchewan, southward to Florida and Mississippi.

Cultures were conducted in 1924 by Orton & Weiss (Mycol. **17:** 149. 1925) reciprocally with aeciospores from *Prenanthes trifoliolatus* and teliospores from *Amianthium muscaetoxicum*, the latter also successfully grown on *P. serpentaria* and *P. alba*.
A remarkable parallelism in development was brought out in this study. Morphologically the species is practically indistinguishable from *Puccinia extensicola hieraciata*, although all the spores may average slightly smaller than in the latter species. Both species have aecia on cichoriaceous hosts, but while the uredia and telia of the former are on Melanthaceae the latter are on species of *Carex*. The *Carex* form is a somewhat more northern one than the other. In spite of the morphologic paral-

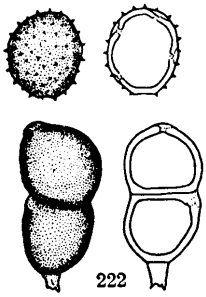
lelism there is almost no indication of a true correlation, *i.e.*, a phylogenetic connection, as indicated in the N. Am. Flora (**7**: 788. 1926).

96. PUCCINIA GRUMOSA. Fig. 222.

(N. A. F. 7: 372, 788.)

Puccinia grumosa Syd. & Holw.; Syd., Monog. Ured. **1**: 641. 1903.
Dicaeoma grumosum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia chiefly hypophyllous, loosely grouped. Aecia chiefly hypophyllous, in irregular groups, cupulate; aeciospores globoid or ellipsoid, 19–23 by 19–28 μ; wall pale-yellow, 1–2 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 18–26 by 22–32 μ; wall cinnamon-brown, 1–2 μ thick, echinulate, the pores 5–10, scattered. Telia amphigenous, long covered by gray epidermis, blackish when uncovered; teliospores ellipsoid or angularly irregular, 20–30 by 32–50 μ, rounded or truncate above, rounded or narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, slightly or not thickened above; pedicel slightly colored, fragile. Mesospores few.



222

On Melanthaceae: **Stenanthium occidentale** Gray, Cre.—**Zygadenus elegans** Pursh(*Anticlea e.* Rydb.), B.C.—**Z. coloradensis** Rydb., Colo.—**Z. gramineus** Rydb.(*Z. intermedius* Rydb.), Wyo. **Range:** Mountains in southern British Columbia, northern Oregon and northeastern Wyoming, only four American localities known; also in Asia.

Uromyces zygadeni.

(N. A. F. 7: 240, 754, 828.)

Uromyces zgyadeni Peck, Bot. Gaz. **6**: 239. 1881.
Nigredo zygadeni Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia, aecia and uredia as in *Puccinia grumosa.* Telia as in *P. grumosa,* except teliospores 1-celled, 19–26 by 25–33 μ; pedicel about as long as spore.

On Melanthaceae: **Zygadenus chloranthus** Richards.(*Anticlea c.* Rydb.), Iowa.—**Z. elegans** Pursh(*A. e.* Rydb.), Colo., Wyo.—**Z. falcatus** Rydb., Colo., Utah.—**Z. fremontii** Torr., Calif.—**Z. gramineus** Rydb.(*Z. intermedius* Rydb.), Mont., Wyo.; Alta.—**Z. nuttallii** Wats., Kans., Tex.—**Z. paniculatus** Wats., Nev., Utah.—**Z. venenosus** Wats., Mont., Wash., Wyo. **Range:** Western Iowa to southern Alberta, southward to central Texas and central California.

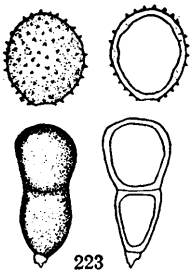
The correlation of the one- and two-celled forms was recorded in the N. Am. Flora **7**: 373. 1920.

97. PUCCINIA PORRI. Fig. 223.

(N. A. F. 7: 374, 788, 840.)

Uredo porri Sow., Engl. Fungi *pl. 411.* 1810.
Puccinia mixta Fckl., Jahrb. Nass. Ver. Nat. **23–24**: 58. 1870.
Puccinia porri (Sow.) Wint., in Rab., Krypt. Fl. **1**: 200. 1881.
Dicaeoma porri Ktze., Rev. Gen. **3**[3]: 470. 1898.

Pycnia amphigenous, among the aecia. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 18–20 by 19–26 μ; wall yellow, 1–2 μ thick,



223

finely verrucose. Uredia amphigenous, yellowish; urediospores broadly ellipsoid or globoid, 20–24 by 23–29 μ; wall yellow, 1–2 μ thick, echinulate, the pores 8–10, scattered, usually indistinct. Telia amphigenous, tardily naked, blackish, with few or many subepidermal paraphyses; teliospores ellipsoid or obovate, 17–21 by 32–37 μ, rounded or truncate above, usually narrowed below, somewhat constricted at septum; wall chestnut-brown, 1–2 μ thick at sides, slightly or not thicker above; pedicel nearly colorless, fragile, short. Mesospores often very numerous, 15–20 by 23–33 μ.

On Alliaceae: **Allium cepa** L., Conn.—**A. schoenoprasum** L., Conn., N.Y., Wash. **Range:** Found a few times in gardens; common in Europe, Asia and Japan on chives, garlic, leek, onion, and other kinds of *Allium*.

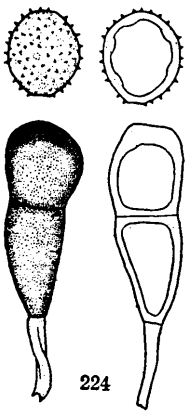
In a culture made in 1907 Tranzschel (Ann. Myc. **5:** 418. 1907) claims to have sown teliospores from *Allium schoenoprasum* upon the same host and produced uredia, without the appearance of pycnia or aecia. The possibility that the result might have been due to urediospores intermixed with the teliospores is not excluded, however. Schneider (Centr. Bakt. II. **32:** 453. 1912) used teliospores from *A. schoenoprasum* on same host and obtained aecia. Catherine von Tavel (Schweiz. Bot. Ges. **41:** 146. 1932) in 1931 sowed teliospores from *A. schoenoprasum* on three plants of the same host, obtaining on one plant rudimentary pycnia only, on one other pycnia with aecia, and on the third aecia without pycnia, and with no uredia on any of them. The description of pycnia and aecia given above is derived from No. 259 of Krieger's Fungi Saxonici, on *A. schoenoprasum*. Aecia have not been found in America.

98. PUCCINIA BLASDALEI. Fig. 224.

(N. A. F. 7: 373, 788.)

Puccinia blasdalei D. & H.; Diet., Erythea **1:** 248. 1893.
Dicaeoma allii Ktze., Rev. Gen. **3**[3]**:** 467. 1898.

Pycnia amphigenous. Aecia amphigenous, in small groups, cupulate; aeciospores globoid or oblong, 15–24 by 18–30 μ; wall nearly or quite colorless, 1.5–2.5 μ thick, finely verrucose. Uredia amphigenous, tardily naked, yellow; urediospores broadly ellipsoid or obovoid, 20–26 by 23–32 μ; wall yellow, 1–2.5 μ thick, echinulate, the pores 8–14, scattered, usually indistinct. Telia amphigenous, often confluent, tardily naked, blackish when uncovered, encircled by cinnamon-brown subepidermal paraphyses; teliospores clavate-oblong, 16–30 by 37–72 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall cinnamon-brown, 1.5–3 μ thick at sides, darker and 4–12 μ above; pedicel yellow, one-half length of spore or less. Mesospores often abundant, 16–23 by 29–50 μ.



224

On Alliaceae: **Allium acuminatum** Hook., Ida., Ore., Utah, Wash.—**A. attenuifolium** Kellogg, Calif., Ore.—**A. brandegei** Wats., Colo.—**A. cernuum** Roth, Colo., Wyo.—**A. hickmani** Eastw., Calif.—**A. precox** Brand., Calif.—**A. scaposum** Benth., Ariz.—**A. serratum** Wats., Calif.—**A. unifolium** Kellogg, Calif.—**A. textile** Nels.&Macb.(*A. reticulatum* Fraser, not Presl. ex G.Don), Alta. **Range:** Wyoming to southern Alberta, southward to southern Colorado and California; also in Europe, Asia and Japan.

Cultures were made in 1907 by Arthur, but not published, the original material and data being deposited in the Arthur Herbarium. Teliospores from *Allium brandegei* were sown May 18 on *A. cernuum*, giving rise to pycnia on June 3, and aecia June 7.

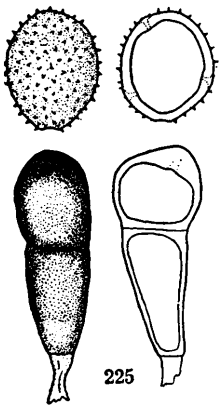
Puccinia allii of the mid-temperate regions of the Eastern Hemisphere, to which this species was referred in the N. Am. Flora, is scarcely to be distinguished morphologically. The chief differences are to be found in fewer mesospores, a more temperate habitat, and the absence of cupulate aecia. A culture made in 1908 by Tranzschel (Ann. Myc. **7:** 182. 1909) by sowing teliospores from *Allium paniculatum* upon the same host gave rise directly to uredia, from which he infers the species is a "Hemi-Puccinia." It is not possible to judge from the brief report whether the result might not have come from urediospores intermixed with the teliospores, as no mention is made of pycnia, and consequently his inference is not positively proved. Other cultures indicate a variable life history, some showing cupulate aecia, others uredinoid aecia and some neither. Some taxonomists make this species a synonym of *Puccinia porri*, and state that some forms show lability (*cf.*, Jørstad, Mag. Naturv. **70:** 340. 1932).

99. PUCCINIA GRANULISPORA. Fig. 225.

(N. A. F. 7: 375, 788, 840.)

Puccinia granulispora Ellis & Gall.; E. & E., Bull. Torrey Club **22:** 61. 1895.
Dicaeoma granulisporum Ktze., Rev. Gen. **3³:** 469. 1898.

Pycnia amphigenous, scattered or in groups. Aecia amphigenous, scattered or in groups, cupulate; aeciospores globoid or ellipsoid, 16–23 by 23–32 μ; wall nearly or quite colorless, 1.5–2 μ thick, finely verrucose. Uredia amphigenous, yellowish-brown; urediospores globoid or broadly ellipsoid, 23–32 by 28–39 μ; wall yellowish-brown, 1.5–2.5 μ thick, echinulate, the pores 8–15, scattered, usually distinct. Telia amphigenous, scattered or confluent, tardily naked, blackish, with subepidermal paraphyses, either sparse or abundant; teliospores clavate-obovate, 20–32 by 42–70 μ, obtuse or rounded above, narrowed below, somewhat constricted at septum; wall chestnut-brown, paler below, 1–2 μ thick at sides, 2.5–8 μ above; pedicel nearly or quite colorless, usually short, not half length of spore. Mesospores generally abundant, 18–25 by 30–50 μ.



225

On Alliaceae: **Allium cernuum** Roth, Ida., Mont., S.D.; Alta., B.C.—**A. nevii** Wats., Ore.—**A. recurvatum** Rydb., Mont.—**A. stellatum** Ker, Mont.—**A.** sp., Colo., Wash.; B.C. **Range:** Mountains from southern Alberta and British Columbia southward to western South Dakota and Oregon.

Uromyces bicolor.

(N. A. F. 7: 241, 754.)

Uromyces bicolor Ellis; Cov., Contr. U. S. Nat. Herb. **4:** 231. 1893.
Uromyces aterrimus D. & H.; Diet., Erythea **3:** 78. 1895.
Nigredo bicolor Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia, aecia and uredia as in *Puccinia granulispora.* Telia as in *P. granulispora,* except teliospores 1-celled, 24–29 by 28–34 μ.

On Alliaceae: **Allium canadense** L., Mass., Mo., N.Y., Tex.—**A. unifolium** Kellogg, Calif.—**A. validum** Wats., Calif., Ida.—**A.** sp., Me., Wyo. **Range:** Occurs locally across the continent from Maine to Idaho and northern Texas, most abundant in northern California.

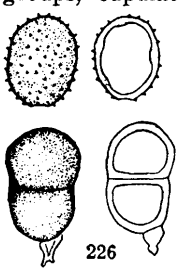
The correlation of one- and two-celled forms was recorded in the N. Am. Flora **7:** 375. 1920.

100. PUCCINIA MUTABILIS. Fig. 226.

(N. A. F. 7: 373, 788.)

Puccinia mutabilis Ellis & Gall., Jour. Myc. **5:** 67. 1889.
Dicaeoma mutabile Ktze., Rev. Gen. **3³:** 469. 1898.

Pycnia amphigenous, scattered or in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 15–23 by 18–27 μ; wall light-yellow, 1.5–2.5 μ thick, finely verrucose. Uredia amphigenous, orange-yellow; urediospores ellipsoid or obovate, 18–23 by 24–32 μ; wall yellow, 1–2 μ thick, echinulate, the pores 4–8, scattered, indistinct. Telia amphigenous, scattered, often confluent in lines, tardily naked, chocolate-brown; teliospores irregularly ellipsoid or oblong, 19–26 by 27–42 μ, usually rounded above and below, slightly constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, or slightly thicker above; pedicel nearly colorless, once length of spore, or more often much less. Mesospores few.


226

On Alliaceae: **Allium acuminatum** Hook., Utah.—**A. brevistylum** Wats., Wyo.—**A. geyeri** Wats., Ore., S.D., Wash.—**A. textile** Nels.&Macbr. (*A. reticulatum* Fraser, not Presl ex G.Don), Colo., Mont., Wash. **Range:** Mountains from western South Dakota to Washington, southward to Colorado and Utah.

The species has somewhat smaller spores, fewer pores in the urediospores, thinner-walled teliospores, and an absence of subepidermal paraphyses as compared with *P. blasdalei* or *P. granulispora.*

Uromyces aemulus.

(N. A. F. 7: 241, 754, 828.)

Uromyces aemulus Arth., Bull. Torrey Club **38:** 373. 1911.
Nigredo aemula Arth., N. Am. Flora **7:** 241. 1912.

Pycnia, aecia and uredia as in *Puccinia mutabilis.* Telia as in *P. mutabilis,* except teliospores 1-celled, often globoid, 18–24 by 24–30 μ.

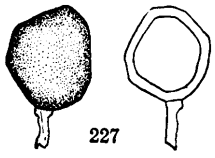
On Alliaceae: **Allium acuminatum** Hook., Colo., Utah.—**A. brevistylum** Wats., Colo., Wyo.—**A. campanulatum** Wats., Calif.—**A. validum** Wats., Nev., Ore. **Range:** Mountains from northern Wyoming to southern Oregon and northern California, southward to northern Colorado.

The correlation of the one- and two-celled forms was recorded in the N. Am. Flora **7:** 373. 1920.

101. UROMYCES AUREUS. Fig. 227.

(N. A. F. 7: 442.)

Uromyces aureus D. & H.; Diet., Hedw. **32:** 30. Feb., 1893.
Uromyces chlorogali D. & H.; Diet., Erythea **1:** 248. Dec., 1893.
Puccioniola aurea Arth., N. Am. Flora **7:** 442. 1921.


227

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores irregularly and angularly globoid or obovoid, 21–29 by 26–40 μ; wall nearly or quite colorless, 2.5–3 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, closely associated with the aecia, long covered by gray epidermis, chocolate-brown when naked; teliospores angularly globoid or ellipsoid, 19–32 by 26–39 μ;

wall dark cinnamon-brown, uniformly 2–3 μ thick, smooth; pedicel colorless, as long as spore or less, fragile.

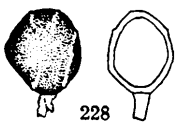
On Alliaceae: **Allium validum** Wats., Calif.; on Liliaceae: **Chlorogalum pomeridianum** Kunth, Calif. **Range:** Central California.

102. UROMYCES BRODIAEAE. Fig. 228.

(N. A. F. 7: 441, 795.)

Uromyces brodiaeae Ellis & Hark., Bull. Calif. Acad. **1:** 28. 1884.
Pucciniola brodiaeae Arth., N. Am. Flora **7:** 441. 1921.

Pycnia amphigenous, among the aecia. Aecia amphigenous, in groups, cupulate; aeciospores globoid or broadly ellipsoid, 16–26 by 19–27 μ; wall nearly or quite colorless, 2–3 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, chestnut-brown; teliospores globoid or obovoid, sometimes angular, and with a few longitudinal ridges, 15–24 by 20–28 μ; wall dark cinnamon-brown, uniformly 1.5–2 μ thick, smooth; pedicel colored, length of spore or less, fragile.


228

On Alliaceae: **Brodiaea douglasii** Wats. (*Triteleia grandiflora* Lindl.), Ore.—**B. ixioides** Wats. (*T. i.* Greene), Calif.—**B. lactea** (Lindl.) Wats. (*Hesperochordon l.* Lindl.), Wash.—**B. laxa** (Benth.) Wats. (*T. l.*), Calif. **Range:** Southern Washington to central California.

103. UROMYCES SCILLARUM. Fig. 229.

Uredo scillarum Grev.; Smith, Engl. Fl. **5:** 376. 1826.
Uromyces scillarum (Grev.) Wint.; Rab., Krypt. Fl. **1:** 142. 1881.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, in groups, chocolate-brown; teliospores globoid or obovoid, 17–21 by 23–32 μ; wall cinnamon-brown, uniformly 1.5–2 μ thick, smooth or with a few partly anastomosing ridges; pedicel colorless, length of spore or less, fragile.


229

On Liliaceae: **Scilla hispanica** Mill. (*S. campanulata* Ait.), Calif. **Range:** Collected at Berkeley, California, in March, 1931, by W. C. Blasdale; also in Europe and northern Africa.

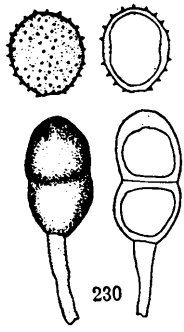
The teliospores of this rust differ from those of most other species by the absence of an evident germ-pore, and by germinating well in a nutrient fluid such as a decoction of prunes or horse dung (Schneider, Centr. Bakt. **72:** 254. 1927).

104. PUCCINIA ASPARAGI. Fig. 230.

(N. A. F. 7: 376, 788, 840.)

Puccinia asparagi DC., Fl. Fr. **2:** 595. 1805.
Dicaeoma asparagi Ktze., Rev. Gen. **3³:** 467. 1898.

Pycnia caulicolous. Aecia caulicolous, in groups or scattered, cupulate; aeciospores globoid, 13–21 by 17–26 μ; wall nearly colorless, 1 μ thick, finely verrucose. Uredia caulicolous, cinnamon-brown; urediospores globoid or ellipsoid, 18–25 by 22–30 μ; wall golden-yellow, 1.5–2 μ thick, echinulate, the pores usually 4, equatorial. Telia caulicolous, chocolate-brown; teliospores oblong or ellipsoid, 18–25 by 30–48 μ, rounded at both ends, slightly constricted at septum; wall chestnut-brown, 2–3 μ thick at sides, 4–8 μ above; pedicel somewhat



230

colored, one-half to twice length of spore. Mesospores often numerous, 19–23 by 29–35 μ.

On Alliaceae: **Allium cepa** L., Iowa, Neb.—**A. cepa bulbifera** Bailey, Wis.; on Convallariaceae: **Asparagus officinalis** L., common. **Range.** In both Canada and the United States wherever asparagus is grown; also in Europe and Africa.

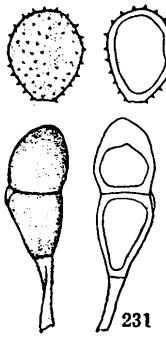
Teliospores taken from asparagus were used by John L. Sheldon in 1900 and 1901 to grow the rust on seedlings of *Allium cepa,* producing aecia, followed sparingly by uredia and a few telia. The results were not published, but specimens and notes are in the Arthur Herbarium. Aecial collections have been made from the field, showing that *Allium cepa* is a possible but not a congenial host for the rust.

105. PUCCINIA SMILACIS. Fig. 231.

(N. A. F. 7: 377, 788, 840.)

Uredo smilacis Schw., Schr. Nat. Ges. Leipzig **1**: 70. 1822.
Puccinia smilacis Schw., Schr. Nat. Ges. Leipzig **1**: 72. 1822.
Dicaeoma smilacis Ktze., Rev. Gen. **3**[3]: 470. 1898.

Pycnia and aecia unknown. Uredia hypophyllous, cinnamon-brown; urediospores ellipsoid, 17–24 by 23–32 μ; wall yellowish-brown, 1.5–2.5 μ thick, echinulate, the pores usually 3, equatorial. Telia hypophyllous, blackish; teliospores oblong or ellipsoid, 17–23 by 30–51 μ, rounded or acute above, usually narrowed below, somewhat constricted at septum; wall cinnamon-brown, 1–2.5 μ thick at sides, 5–10 μ above; pedicel about once length of spore.



231

On Smilaceae: **Smilax bona-nox** L., Ark., Fla., Ill., Ind., La., Miss., Okla., S.C., Tenn., Tex.—**S. glauca** Walt., Ala., Ark., Del., D.C., Fla., Ga., Ind., Ky., Miss., Mo., N.J., N.Y., N.C., Ohio, S.C., Tenn., Tex., Va., W.Va.—**S. havanensis** Jacq., Fla.—**S. herbacea** L.(*Nemexia h.* Small), D.C., Ky.—**S. hispida** Muhl., D.C., Neb., Tenn.—**S. laurifolia** L., N.J.—**S. pseudo-china** L., S.C., Tex.—**S. rotundifolia** L., Ark., Del., D.C., La., Md., N.Y., N.C., Okla., Tenn., Va.—**S. tamnifolia** Michx.(*Nemexia t.* Small), Tex. **Range:** Southern New York to Ohio and Nebraska, southward to Florida and Texas; also reported from the West Indies and Mexico.

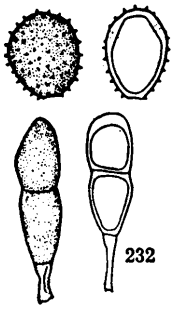
There are reasons to think that *Aecidium smilacis* Schw., which has usually been considered to be the aecial stage of this species, is genetically connected with some grass rust and that the true aecial stage of *P. smilacis* may occur on *Apocynum.*

106. PUCCINIA ALETRIDIS. Fig. 232.

(N. A. F. 7: 377, 788, 840.)

Puccinia aletridis B. & C., Grev. **3**: 52. 1874.
Dicaeoma aletridis Ktze., Rev. Gen. **3**[3]: 467. 1898.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 15–22 by 20–28 μ; wall cinnamon-brown, 1.5 μ thick,



232

echinulate, the pores 2, superequatorial. Telia amphigenous, dark cinnamon-brown; teliospores oblong or clavate-oblong, 14–20 by 30–50 μ, obtuse or acute above, usually narrowed below, slightly constricted at septum; wall light golden-brown, 1–1.5 μ thick at sides, 3–10 μ above; pedicel nearly or quite colorless, one-half to once length of spore.

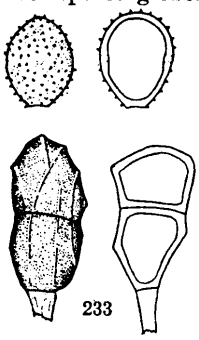
On Amaryllidaceae: **Aletris aurea** Walt., Fla., Miss., S.C., Tex.—**A. farinosa** L., Del., Ind., Mass., N.J., R.I., Tenn., Wis.—**A. lutea** Small, Fla. **Range:** Coastal states of the Atlantic Ocean and Gulf of Mexico from Massachusetts to Texas, and in Wisconsin and northern Indiana.

107. PUCCINIA COOPERIAE. Fig. 233.

(N. A. F. 7: 378.)

Puccinia cooperiae Long, Bull. Torrey Club **29:** 110. 1902.
Dicaeoma cooperiae Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid or ellipsoid, 17–22 by 20–28 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 17–25 by 22–32 μ; wall nearly colorless, 1–2 μ thick, echinulate, the pores 3 or 4, equatorial, obscure. Telia amphigenous, chestnut-brown; teliospores ellipsoid or oblong, usually angular, 19–28 by 32–48 μ, usually rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, with few longitudinal lines formed by the angles; pedicel nearly or quite colorless, often inserted obliquely, short, fragile.



233

On Amaryllidaceae: **Cooperia drummondii** Herb., Tex.—**C. pedunculata** Herb., Tex. **Range:** Central Texas.

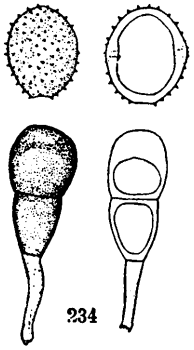
108. PUCCINIA IRIDIS. Fig. 234.

(N. A. F. 7: 379, 789, 840.)

Uredo iridis DC.; Poir., in Lam. Enc. **8:** 224. 1808.
Puccinia iridis (DC.) Wallr.; Rab., Deuts. Krypt.-Fl. **1:** 23. 1844.
Dicaeoma iridis Ktze., Rev. Gen. **3**[3]: 469. 1898.

Pycnia and aecia occur in Siberia on *Valeriana officinalis*, but have not been recognized in America.

Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 19–27 by 24–32 μ; wall light cinnamon-brown, 2–3.5 μ thick, echinulate, the pores 3 or 4, usually equatorial. Telia amphigenous, chestnut-brown; teliospores oblong, 13–22 by 34–55 μ, rounded or truncate above, narrowed below, somewhat constricted at septum; wall golden-brown, 1.5–2.5 μ thick at sides, 5–10 μ above; pedicel colored, as long as spore or less.



234

On Iridaceae: **Iris douglasiana** Herb., Calif.—**I. fulva** Ker (*I. cuprea* Pursh), La.—**I. kimballiae** Small, La.—**I. longipetala** Herb., Calif.—**I. miraculosa** Small, La.—**I. missouriensis** Nutt., Ariz., Calif., Colo., Ida., N.M., Wash.—**I. tenax** Dougl., Ore.—**I. tuberosa** L., Calif.—**I. versicolor**

L., Conn., Del., Ind., Iowa, La., Me., Mass., Mich., N.H., N.Y., Pa., Vt., Wis.; N.S., Ont., Queb.—**I. violipurpurea** Small, La.—**I. xiphium** L., Calif.

Range: Nova Scotia to Washington, southward to Louisiana and Arizona; also in Europe, Asia and Japan.

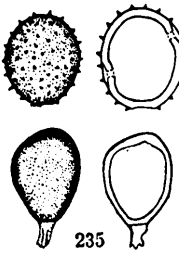
Cultures were repeatedly attempted on various hosts by Tranzschel (Beitr. Biol. Ured. I, page 15. 1904; same III, page 19. 1909) in 1904 and 1906, using teliospores from cultivated iris, but with no infection. Again in 1917 (Notulae Syst. Inst. Crypt. Horti Bot. Petrop. **2:** 83. 1923) teliospores from *Iris sibirica* were sown on *Valeriana officinalis*, with development of aecia, but no pycnia were seen. The aecia resemble those of *Uromyces valerianae* Fckl., a species which does not occur in America. The results need confirmation. East of the Rocky Mountains *Puccinia iridis* usually produces only uredia.

109. UROMYCES PROBUS. Fig. 235.

(N. A. F. 7: 243, 829.)

Uromyces probus Arth., Bull. Torrey Club **38:** 376. 1911.
Nigredo proba Arth., N. Am. Flora **7:** 243. 1912.

Pycnia not seen. Aecia amphigenous, cupulate; aeciospores broadly ellipsoid, 18–21 by 23–26 μ; wall colorless, 1.5 μ thick, finely verrucose. Uredia amphigenous, light cinnamon-brown; urediospores broadly ellipsoid, 19–23 by 26–31 μ; wall golden-yellow, 2–3 μ thick, echinulate, the pores 5 or 6, scattered. Telia usually amphigenous, chocolate-brown; teliospores broadly ellipsoid or obovate-ellipsoid, 16–21 by 23–29 μ; wall dark cinnamon-brown, about 1.5 μ thick at sides, 2–3 μ above; pedicel nearly colorless, usually shorter than spore.


235

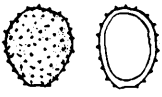
On Iridaceae: **Olsynium grandiflorum** (Dougl.)Raf. (*Sisyrinchium g.*), Ida., Utah, Wash. **Range:** Northeastern Washington to central Utah.

110. UROMYCES HOUSTONIATUS. Fig. 236.

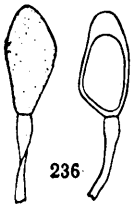
(N. A. F. 7: 242, 755, 829.)

(*Caeoma* (*Aecidium*) *houstoniatum* Schw., Trans. Am. Phil. Soc. II. **4:** 293. 1832.)
Uromyces murrillii Ricker, Mycol. **1:** 237, hyponym. 1909.
Uromyces houstoniatus [Schw.] Sheldon, Torreya **9:** 55. 1909.
Nigredo houstoniata Sheldon, Torreya **9:** 55. 1909.

Pycnia hypophyllous, systemic. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 13–18 by 16–19 μ; wall colorless, 1 μ thick, finely verrucose.



On Rubiaceae: **Houstonia angustifolia** Michx., Kans., Tex. —**H. coerulea** L., Conn., Del., Mass., Mo., Pa., W.Va.—**H. longifolia** Gaertn., N.Y., Pa., W.Va., Wis.; Sask.—**H. minima** Beck, Tex.—**H. purpurea** L., Tenn., W.Va.


236

Uredia amphigenous, pale cinnamon-brown; urediospores broadly ellipsoid, 16–19 by 23–26 μ; wall pale golden-brown, 1.5–2 μ thick, echinulate, the pores 3, rarely 4, equatorial. Telia amphigenous, cinnamon-brown, or paler from germination of the spores; teliospores narrowly ellipsoid or oblong, 12–17 by 28–34 μ, obtuse or acute at both ends; wall pale-yellow, 1 μ thick at sides, 4–9 μ above; pedicel colorless, one to one and a half times length of spore.

On Iridaceae: **Sisyrinchium angustifolium** Mill., Me.—**S. graminoides** Bickn. (*S. gramineum* Curtis, not Lam.), W.Va.

Range: East of the Rocky Mountains from Maine to Saskatchewan, southward to Tennessee and Texas.

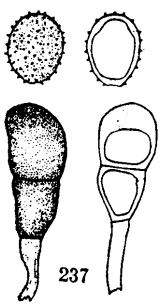
Cultures with aeciospores were made in 1906–8 and with teliospores in 1907 by Sheldon (Torreya **9:** 54. 1909), and also with aeciospores in 1908 by Arthur (Mycol. **1:** 238. 1909). Unlike most heteroecious rusts the teliospores germinate in the sorus immediately upon maturity.

111. PUCCINIA CYPRIPEDII. Fig. 237.

(N. A. F. 7: 381, 789.)

Puccinia cypripedii A. & H.; Arth., Bull. Iowa Agric. Coll. Dep. Bot. **1884:** 156. 1884.
Dicaeoma cypripedii Arth., N. Am. Flora **7:** 381. 1920.

Pycnia and aecia unknown. Uredia hypophyllous, cinnamon-brown; urediospores ellipsoid or obovoid, 15–19 by 18–23 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, superequatorial. Telia amphigenous, chocolate-brown; teliospores oblong or oblong-clavate, 14–23 by 31–45 μ, rounded or flattened above, narrowed below, somewhat constricted at septum; wall cinnamon-brown, 1.5 μ thick at sides, darker and 7–12 μ above; pedicel colored, about one-half length of spore.


237

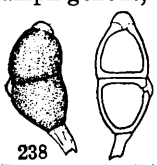
On Orchidaceae: **Cypripedium parviflorum** Salisb. (not *C. pubescens* Willd.), Iowa; Sask.—**Limodorum tuberosum** L. (*Calopogon pulchellus* R.Br.), Ind., N.J. **Range:** Local and infrequent in northern United States, and in Saskatchewan.

112. PUCCINIA ASARINA. Fig. 238.

(N. A. F. 7: 525, 846.)

Puccinia asarina Kunze; Kunze & Schmidt, Myk. Hefte **1:** 70. 1817.
Micropuccinia asarina A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, cinnamon-brown; teliospores oblong, 16–21 by 30–40 μ, rounded or narrowed above and below, constricted at septum; wall golden-brown, uniformly 1–2 μ thick, with a hyaline papilla over the pores; pedicel colorless, short, fragile.


238

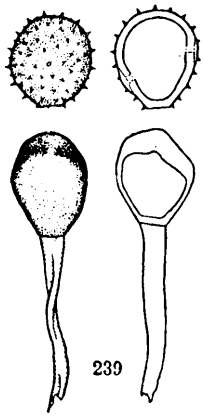
On Aristolochiaceae: **Asarum caudatum** Lindl., Calif., Ida., Ore., Wash.; B.C.—**A. lemmoni** Wats., Calif. **Range:** Idaho to British Columbia, southward to central California; also in Siberia and Japan.

113. UROMYCES INTRICATUS. Fig. 239.

(N. A. F. 7: 244, 757, 829.)

Uromyces intricatus Cooke, Grev. **7:** 3. 1878.
Uromyces chorizanthis Ellis & Hark., Bull. Calif. Acad. **1:** 28. 1884.
Nigredo intricata Arth., N. Am. Flora **7:** 244. 1912.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 16–22 by 19–24 μ; wall nearly or quite colorless, 1 μ thick,



239

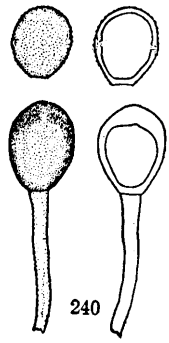
finely verrucose. Uredia chiefly epiphyllous, light chestnut-brown; urediospores broadly ellipsoid or obovoid, 20–25 by 26–33 μ; wall dark golden-brown, 1.5–2.5 μ thick, echinulate, the pores 3–6 or rarely more, scattered. Telia amphigenous, chocolate-brown; teliospores obovoid or globoid, 20–27 by 24–35 μ, usually narrowed below, obtuse or truncate above; wall cinnamon-brown, 1.5–2 μ thick at sides, 5–9 μ above; pedicel colorless, two to three times length of spore.

On Polygonaceae: **Chorizanthe pungens** Benth., Calif.—**C. robusta** Parry, Calif.—**Eriogonum biumbellatum** Rydb., Utah.—**E. campanulatum** Nutt., Colo., Utah, Wyo.—**E. cernuum** Nutt., Calif.—**E. compositum** Dougl., Ida., Ore., Wash.—**E. croceum** Small, Ida., Ore.—**E. dichotomum** Dougl., Wash.—**E. divergens** Small, Ariz.—**E. dumosum** Greene, Calif.—**E. effusum** Nutt., Colo., Ida., Wyo.—**E. elongatum** Benth., Calif.—**E. fasciculatum** Benth., Ariz., Calif.—**E. flavum** Nutt., Colo., Mont., N.D.—**E. gracile** Benth., Calif.—**E. heracleoides** Nutt., Ida., Nev., Utah, Wash.—**E. jamesii** Benth., N.M.—**E. kennedyi** Porter, Nev.—**E. latifolium** Smith, Calif.—**E. lonchophyllum** T.&G., Colo.—**E. medium** Rydb., Utah.—**E. microthecum** Nutt., Mont., Ore., Utah, Wyo.—**E. multiceps** Nees, Mont., Neb., N.D.—**E. nudum** Dougl., Calif.—**E. oredense** Nels., Wyo.—**E. ovale** Small, Mont.—**E. ovalifolium** Nutt., Wyo.—**E. parviflorum** Smith, Calif.—**E. pauciflorum** Greene, Colo.—**E. piperi** Greene, Ida., Mont.—**E. polyanthum** Benth., Ariz., Nev.—**E. proliferum** T.&G., Nev.—**E. racemosum** Nutt., Ariz., Colo., N.M., Utah.—**E. saxatile** Wats., Calif.—**E. scoparium** Small, Colo.—**E. subalpinum** Greene, Colo., Mont.—**E. sulphureum** Greene, Ore.—**E. umbellatum** Torr., Calif., Colo., Mont., Ore., Utah, Wyo.—**E. ursinum** Wats., Calif.—**E. vimineum** Dougl., Calif., Ore.—**E. virgatum** Benth., Calif., Colo., Ore., Wyo.—**E. wrightii** Torr., Ariz., Calif.—**Oxytheca dendroidea** Nutt., Calif. **Range:** Western North Dakota to Washington, southward to New Mexico and southern California.

114. UROMYCES POLYGONI. Fig. 240.

(N. A. F. 7: 243, 757, 829.)

Puccinia polygoni Pers., Neues Mag. Bot. **1:** 119. 1794.
Puccinia polygoni-aviculariae Pers., Syn. Fung. 227. 1801.
Uromyces polygoni (Pers.) Fckl., Jahrb. Nass. Ver. Nat. **23–24:** 64. 1870.
Nigredo polygoni Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.



240

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 15–18 by 16–19 μ; wall nearly or quite colorless, 1 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 15–22 by 19–27 μ; wall golden-brown, 1.5–2 μ thick, finely verrucose, the pores 4, equatorial. Telia amphigenous, chocolate-brown; teliospores broadly ellipsoid or obovate-ellipsoid, 16–24 by 23–32 μ, usually rounded above, slightly narrowed below; wall cinnamon-brown, 2–3 μ thick at sides, 4–7 μ above; pedicel colorless, once to twice length of spore.

On Polygonaceae: **Polygonum aviculare** L., Alas., Calif., Conn., Del., Ida., Ill., Ind., Iowa, Kans., Me., Mass.,

Mich., Minn., Mo., Neb., N.H., N.J., N.Y., N.D., Ore., Pa., R.I., S.D., Utah, Vt., Wash., Wis., Wyo.; Ont., Queb.—**P. buxiforme** Small, Calif., Colo.—**P. erectum** L., Calif., Conn., Del., Ill., Ind., Iowa, Ky., Miss., Mo., Neb., N.J., N.Y., N.C., Pa., S.D., W.Va., Wis.—**P. fowleri** B.L.Rob., Me.; Newf.—**P. glaucum** Nutt.(*P. maritimum* Auth., not L.), La., Mass.—**P. ramosissimum** Michx., Ill., Iowa, Kans., Minn., Mo., Mont., Neb.—**P. sawatchense** Small, Colo.—**P. spergulariaeforme** Meissn., B.C. **Range**: Newfoundland to southeastern Alaska, southward to North Carolina and southern California; also in Europe, Asia, Japan, Australia, New Zealand, and Africa.

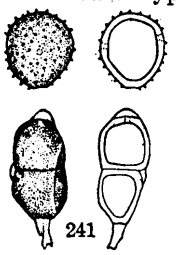
115. PUCCINIA SEPTENTRIONALIS. Fig. 241.

(N. A. F. 7: 384, 789.)

(*Caeoma thalictri* Sommerf., Suppl. Fl. Lapp. 230. 1826.)
(*Aecidium sommerfeltii* Johans., Oefv. Sv. Vet.-Akad. Förh. **41**[9]: 161. 1885.)
Puccinia septentrionalis Juel, Oefv. Sv. Vet.-Akad. Förh. **52**: 383. 1895.
Dicaeoma sommerfeltii Arth., N. Am. Flora **7**: 384. 1920.

Pycnia amphigenous. Aecia amphigenous, in groups, cupulate; aeciospores globoid or ellipsoid, 15–17 by 17–22 μ; wall colorless, about 1 μ thick, minutely verrucose, appearing smooth.

On Ranunculaceae: **Thalictrum alpinum** L., Alas.


241

Uredia hypophyllous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 19–21 by 23–26 μ; wall dark cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 2–4, equatorial or slightly superequatorial, indistinct. Telia hypophyllous, dark chestnut-brown; teliospores ellipsoid or oblong, often irregular, 15–23 by 26–40 μ, somewhat narrowed at both ends, slightly constricted at septum; wall light chestnut-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pores, the pore in upper cell apical, in lower cell at septum or somewhat depressed, smooth or with a few faint longitudinal striae; pedicel colorless, short, fragile.

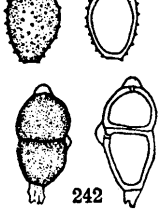
On Polygonaceae: **Bistorta vivipara** (L.)S.F.Gray(*Polygonum v.*), Alas.; Newf. **Range**: Boreal stations in Newfoundland and Alaska; also in Iceland and northern Europe.

A culture was made in 1895 by Juel (Oefv. Sv. Vet.-Akad. Förh. **52**: 381. 1895), by using aeciospores upon both *Polygonum viviparum* and *P. bistorta.*

116. PUCCINIA PARCA. Fig. 242.

(N. A. F. 7: 385.)

Puccinia parca Arth., Bull. Torrey Club **46**: 117. 1919.
Dicaeoma parcum Arth., N. Am. Flora **7**: 385. 1920.


242

Pycnia and aecia unknown. Uredia hypophyllous, brownish-yellow; urediospores narrowly ellipsoid or obovoid, 13–16 by 19–26 μ; wall light brownish-yellow, 1 μ thick or less, echinulate, the pores 2–4, equatorial or superequatorial. Telia hypophyllous, dark cinnamon-brown; teliospores oblong or ellipsoid, 15–19 by 29–42 μ; wall cinnamon-brown, uniformly 1–2 μ thick, with a hyaline papilla over the pores, the pore in upper cell apical, in lower cell near septum, smooth; pedicel colorless, short, fragile. Mesospores sometimes present.

On Polygonaceae: **Polygonum scandens** L.(*Bilderdykia s.* Greene, *Tiniaria s.* Small), N.J., N.Y., N.C. **Range:** Long Island, New York to western North Carolina.

117. PUCCINIA POLYGONI-AMPHIBII. Fig. 243.

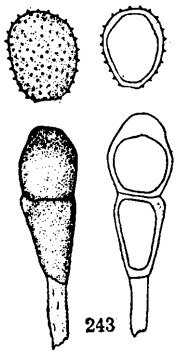
(N. A. F. 7: 381, 789, 840.)

Puccinia polygoni-amphibii Pers., Syn. Fung. 227. 1801.
Puccinia polygoni A. & S., Consp. Fung. 132. 1805. Not *P. polygoni* Pers., 1794.
Puccinia polygoni-convolvuli Hedw. f.; Poir., in Lam. Encyc. **8:** 251. 1808.
(*Aecidium geranii-maculati* Schw., Schr. Nat. Ges. Leipzig **1:** 67. 1822.)
Dicaeoma polygoni-amphibii Arth., Proc. Ind. Acad. Sci. **1898:** 184. 1899.
(*Aecidium sanguinolentum* Lindr., Bot. Notiser **1900:** 241. 1900.)

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or broadly ellipsoid, 13–18 by 16–22 μ; wall colorless, 0.5–1 μ thick, very finely verrucose.

On Geraniaceae: hosts and range under the several varieties.

Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 15–22 by 19–29 μ; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, sometimes 3, superequatorial, or on *Polygonum virginianum* subequatorial. Telia amphigenous, long covered by epidermis and dark grayish-brown, or early naked and shiny blackish-brown; teliospores oblong or clavate, 14–23 by 30–35 μ, rounded or truncate above, narrowed below, slightly constricted at septum; wall cinnamon-brown, 1–2 μ thick at sides, much darker and 5–10 μ above; pedicel nearly or quite colorless, about half length of spore.



243

On Polygonaceae: hosts and range under the several varieties.

The species as represented in America is separable into three fairly distinct varieties, chiefly on morphologic characters, varying with the different groups of hosts.

(1). **Puccinia polygoni-amphibii persicariae** (Str.) n. comb. (*Uredo polygoni persicariae* Str., *Puccinia persicariae* Mart.). Pycnia and aecia as above; on Geraniaceae: **Geranium columbianum** L., Conn.—**G. incisum** Nutt., Mont.—**G. maculatum** L., Conn., D.C., Ind., Iowa, Mich., Minn., Miss., Mo., N.Y., N.C., Pa., Va., W.Va., Wis.; Ont. Urediospore-pores strongly superequatorial; telia somewhat punctiform, in close groups, long covered by epidermis; teliospores obtuse or obliquely pointed; on Polygonaceae: **Polygonum coccineum** Muhl.(*Persicaria c.* Greene), Me., Utah, Wis.; Ont., Queb.—**P. hartwrightii** Gray(*P. amphibium* Am.auth., not L., *Pers. h.* Greene), Calif., Colo., Conn., Ida., Ill., Iowa, Mich., Minn., Mont., Neb., N.Y., N.D., Okla., Ore., S.D., Utah, Vt., Wash., Wis., Wyo.; Alta., B.C., Man., N.S.—**P. hirsutum** Walt.(*Pers. h.* Small), Fla.—**P. hydropiper** L.(*Pers. h.* Opiz), S.C.—**P. hydropiperoides** Michx.(*Pers. h.* Small), Calif., Fla., Ill., Ind., Ky., Miss., Mo., N.Y., W.Va.; Ont.—**P. incarnatum** Ell.(*Pers. i.* Small), Calif., Mo., N.Y.—**P. lapathifolium** L.(*Pers. l.* S.F.Gray), Ark., Calif., Ind., Mo., Ohio; Ont.—**P. muhlenbergii** (Meissn.)Wats.(*Pers. m.* Small), Calif., Colo., Ida., Ind., Iowa, Kans.,

Me., Md., Mass., Mich., Miss., Mo., Mont., Neb., N.Y., N.D., Ohio, Ore., Pa., S.D., Vt., Wash., Wis., Wyo.; Ont., Queb.—**P. opelousanum** Ridd.(*Pers. o.* Small), La.—**P. pennsylvanicum** L.(*Pers. p.* Small), Ala., Ark., Del., Fla., Ill., Ind., Ky., Miss., N.Y., S.C., Tenn., Tex.; Queb.—**P. persicaria** L.(*Pers. p.* Small), Del., Ga., La., Miss., Ore., Pa.—**P. portoricensis** Bert.(*Pers. p.* Small), Tex.—**P. punctatum** Ell.(*P. acre* H.B.K., *Pers. p.* Small), Ala., Ark., Calif., Fla., Ill., Ind., Kans., Ky., La., Mich., Miss., Mo., N.Y., Ohio, Okla., S.C., Tenn., Tex., Va., W.Va.—**P. setaceum** Baldw.(*Pers. s.* Small), Ala., La., Mo. **Range:** Nova Scotia to Alberta, southward east of the Rocky Mountains to Florida and Texas, and from British Columbia and western Idaho southward to southern California; also in Bermuda, West Indies, Mexico, Central America, Europe, Asia, Africa, Japan and Hawaii.

Cultures were made in 1903 by Tranzschel (Centr. Bakt. II. **11:** 106. 1903; Neue Fälle Het. Ured. 15–17. 1904) by sowing teliospores from *Polygonum amphibium* on *Geranium palustre* and *G. pratense.* The connection was confirmed and extended by Bubák (Ann. Myc. **2:** 361. 1904), Klebahn (Zeits. Pflanzenkr. **15:** 70. 1905; **22:** 327. 1912), Treboux (Ann. Myc. **10:** 305, 557. 1912) and Gina Jacob (Centr. Bakt. **44:** 619. 1915). In 1904 aeciospores from *Geranium maculatum* were sown on *Polygonum emersum* by Arthur (Jour. Myc. **11:** 59. 1905), and in the following year the reverse culture was made (Jour. Myc. **12:** 18. 1906). Treboux (Centr. Bakt. **44:** 635. 1912) failed to infect *Geranium maculatum,* grown in Switzerland, with teliospores from *P. amphibium,* producing only yellow flecks, and concluded that the American and European forms are biologically distinct.

(2). **Puccinia polygoni-amphibii convolvuli** (A.&S.) n. comb. (*Uredo betae convolvuli* A.&S., *P. polygoni* A.&S.). Pycnia and aecia as above; on GERANIACEAE: **Geranium pusillum** in Europe, unknown in America. Urediospores as in *P. polyg.-amph. persicariae;* telia mostly caulicolous, large, early naked, blackish-brown; teliospores rounded or obtuse; on POLYGONACEAE: **Polygonella articulata** (L.)Meissn.(*Gonopyrum a.* Fisch.&Mey.), Fla.—**Polygonum convolvulus** L.(*Bilderdykia c.* Dumort.), Conn., Del., Ill., Ind., Iowa, Kans., Ky., Md., Mich., Minn., Mo., Neb., N.J., N.Y., N.D., Ohio, Pa., S.D., Tenn., W.Va., Wis.; Ont.—**P. cristatum** Engelm.&Gray(*B. c.* Greene), Miss., N.C., Pa., Tex., Va.—**P. dumetorum** L.(*Tiniaria d.* Opiz), W.Va.—**P. scandens** L.(*B. s.* Greene, *T. s.* Small), Ind., Ky., Miss., Neb., N.Y.,. Va., W.Va., Wis. **Range:** New York to North Dakota, southward to Florida and Texas; also in Europe.

In 1904 Tranzschel (Neue Fälle Het. Ured. 17. 1904) made successful cultures by sowing teliospores from *Polygonum convolvulus* on *Geranium pusillum,* and the connection was confirmed and extended by Klebahn (Zeits. Pflanzenkr. **22:** 328. 1912) and Gina Jacob (Centr. Bakt. **44:** 636. 1912). A negative result was obtained by Arthur (Jour. Myc. **12:** 18. 1906) by applying teliospores from *P. emersum* on *Geranium pusillum* and *G. robertianum.* No aecia have been found on *G. pusillum* or *G. robertianum* in America. The American and European forms may be biologically distinct.

(3). **Puccinia polygoni-amphibii tovariae** n. nom. Pycnia and aecia unknown. Urediospore-pores subequatorial; telia and teliospores as in *P. polyg.-amph. persicariae,* except telia more scattered; on POLYGONACEAE: **Polygonum pennsylvanicum** L.(*Persicaria p.* Small), La.—**P. virginianum** L.(*Tovaria v.* Raf.), Conn., Ill., Ind., La., Mass., Mo., N.Y., N.C., Ohio, W.Va. **Range:** Massachusetts to Illinois, southward to North Carolina and Louisiana.

Reciprocal cultures were made in 1932 by Mains (Mycol. 25 : 415. 1933) between *P. virginianum* and *Geranium maculatum*.

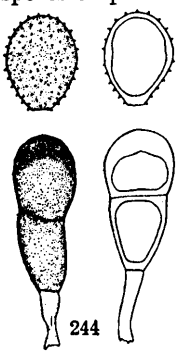
Puccinia morthieri Körn., a microcyclic species occurring on *Geranium palustre* and *G. sylvaticum* in Europe, is considered by Tranzschel (Neue Fälle Het. Ured. 15. 1904) to be correlated with *P. polygoni-amphibii*. It has not been found in America.

118. PUCCINIA PUNCTIFORMIS. Fig. 244.

(N. A. F. 7: 386, 789.)

Puccinia punctiformis D. & H.; Diet., Erythea **2**: 128. 1894.
Dicaeoma punctiforme Arth., N. Am. Flora **7**: 386. 1920.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 18–26 by 26–37 μ; wall pale cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 4, nearly equatorial. Telia amphigenous, blackish-brown; teliospores oblong or obovate-oblong, 16–23 by 34–51 μ, rounded above, narrowed below, slightly constricted at septum; wall dark cinnamon-brown, 1–2 μ thick at sides, darker and 5–9 μ above, smooth; pedicel nearly or quite colorless, one-half length of spore.


244

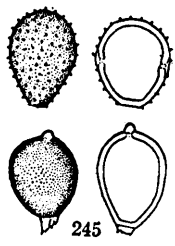
On Polygonaceae: **Rumex altissimus** Wood, Kans., Wis.—**R. hymenosepalus** Torr., Calif.—**R. occidentalis** Wats., Calif.—**R. salicifolius** Weinm., Calif. **Range:** Southern Wisconsin and central California; also in Mexico, Central America, eastern Siberia and Japan.

119. UROMYCES BETAE. Fig. 245.

(N. A. F. 7: 245, 758.)

Uredo betae Pers., Syn. Fung. 220. 1801.
Uromyces betae (Pers.) Lév., Ann. Sci. Nat. III. **8**: 375. 1847.
(*Aecidium betae* Kühn, Zeits. Landw. Centr.-Ver. Sachs. **26**: 41. 1869.)
Nigredo betae Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 19–24 by 23–26 μ; wall colorless, 1.5–2 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 19–23 by 26–33 μ; wall golden-brown, about 2 μ thick, echinulate, the pores 3 or 4, equatorial. Telia amphigenous, chestnut-brown; teliospores broadly ellipsoid or obovate, 18–21 by 26–30 μ; wall dark golden-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pore; pedicel colorless, shorter than the spore.


245

On Chenopodiaceae: **Beta cicla** L., Calif., Ore.—**B. vulgaris** L., Calif. **Range:** Oregon to southern California; also in Europe, southern Africa, Australia and New Zealand.

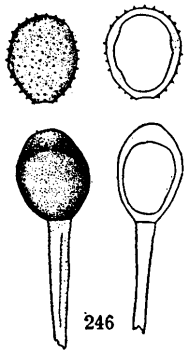
120. UROMYCES CHENOPODII. Fig. 246.

(N. A. F. 7: 758.)

(*Aecidium chenopodii-fruticosi* DC., Fl. Fr. **6**: 92. 1815.)
(*Caeoma chenopodiatum* Link, in Willd., Sp. Pl. **6**²: 45. 1825.)
(*Uredo chenopodii* Spreng., Syst. Veg. **4**: 574. 1827.)
Uredo chenopodii Duby, Bot. Gall. **2**: 899. 1830.
Uromyces giganteus Speg., Dec. Myc. Ital. *30*. 1879.
(*Aecidium suaedae* Thüm., Flora **63**: 479. 1880.)

Uromyces chenopodii (Duby) Schroet., in Kunze, Fungi Sel. *214*. 1880.
Uromyces suaedae Jacz., Bull. Soc. Myc. Fr. **9**: 47. 1893.
Nigredo chenopodii-fruticosi Arth., N. Am. Flora **7**: 758. 1926.

Pycnia amphigenous, in groups. Aecia amphigenous, surrounding the pycnia, cupulate; aeciospores broadly ellipsoid, 18–20 by 24–27 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia amphigenous, early naked, chestnut-brown; urediospores ellipsoid or obovoid, 18–22 by 26–32 μ; wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores obscure, apparently 6–8, scattered. Telia amphigenous, on stems often producing fusiform swellings, blackish-brown; teliospores globoid or obovoid, 23–26 by 27–35 μ, rounded above, rounded or narrowed below; wall chestnut-brown, 1.5–2 μ thick at sides, 3–6 μ above; pedicel colorless, twice length of spore or longer.


246

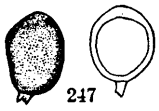
On Chenopodiaceae: **Suaeda brevifolia** (Standl.) Eastw.(*Dondia b.*), Calif.—**S. californica** Wats.(*D. c.* Wats.), Ariz., Ida.—**S. ramosissima** (Standl.)I.M.Johnst. (*D. r.*), Calif.—**S. suffrutescens** Wats.(*D. s.* Heller), Tex.—**S. taxifolia** Standl.(*D. t.* Standl.), Calif.—**S. torreyana** Wats.(*D. t.* Standl.), Calif., Wyo. **Range:** Wyoming to Idaho, southward to western Texas and southern California; also in Europe and northern Africa.

121. UROMYCES SHEARIANUS. Fig. 247.

(N. A. F. 7: 443, 795.)

(*Aecidium atriplicis* Shear, Bull. Torrey Club **29**: 453. 1902.)
Uromyces atriplicis Arth., Bull. Torrey Club **45**: 141. 1918. Not *U. atriplicis* McA., 1906.
Uromyces shearianus Arth., Bull. Torrey Club **46**: 120. 1919.
Puccinia atriplicis Arth., N. Am. Flora **7**: 443. 1921.

Pycnia chiefly hypophyllous, scattered. Aecia chiefly hypophyllous, scattered, cupulate; aeciospores angular-globoid or oblong, variable in size, 15–22 by 17–35 μ; wall colorless, 1–1.5 μ thick. Uredia wanting. Telia chiefly hypophyllous, cinnamon-brown; teliospores globoid or obovoid, 18–23 by 23–31 μ, rounded at both ends, or narrowed below; wall cinnamon-brown, 1.5–2 μ thick at sides, 4–5 μ above, smooth; pedicel colorless, short, fragile.


247

On Chenopodiaceae: **Atriplex californica** Moq., Calif.—**A. canescens** (Pursh)Nutt., N.M.—**A. confertifolia** (Torr.)Wats., Colo., Utah, Wyo.—**A. leucophylla** Dietr., Calif.—**A. polycarpa** Wats., Ariz. **Range:** Wyoming, southward to New Mexico and southern California.

*. **Puccinia guillemineae** D. & H., (*Dicaeoma g.* Arth.), with pycnia unknown; aecia epiphyllous, in small groups or scattered, aeciospores globoid, 12–17 by 17–21 μ, the wall yellowish, 1 μ thick, minutely verrucose; uredia epiphyllous, yellowish-brown, urediospores ellipsoid or globoid, 16–19 by 19–23 μ, the wall golden-brown, 1–2 μ thick, finely verrucose, the pores 3 or 4, equatorial; telia epiphyllous, blackish-brown, teliospores ellipsoid, 19–24 by 29–39 μ, rounded at both ends, slightly constricted at septum, the wall 1.5–2.5 μ thick at sides, 5–9 μ above, smooth, with colorless pedicel twice to thrice length of spore; occurs on Amaranthaceae: **Brayulinea densa** (Willd.)Small, in southern Arizona; also in Mexico. (N. A. F. **7**: 386, 789, 841.)

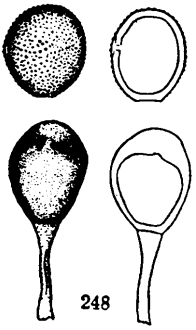
122. UROMYCES SILENES. Fig. 248.

(N. A. F. 7: 247, 759, 829.)

Caeoma silenes Schl., Fl. Berol. **2**: 128. 1824.
Uromyces inaequialtus Lasch, in Rab., Fungi Eur. *94*. 1859.

Uromyces silenes (Schl.) Fckl., Jahr. Nass. Ver. Nat. **23–24:** 61. 1870.
Uromyces pulchellus E. & E., Bull. Torrey Club **22:** 57. 1895.
Nigredo silenes Arth., N. Am. Flora **7:** 247. 1912.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 15–19 by 18–23 μ; wall nearly or quite colorless, 1.5–2 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 18–23 by 22–27 μ; wall cinnamon-brown, 1.5–2.5 μ thick, moderately verrucose, the pores 3, nearly equatorial. Telia amphigenous, dark chocolate-brown; teliospores ellipsoid or obovoid, 12–23 by 25–32 μ; wall light chocolate-brown, 1.5–2.5 μ thick at sides, paler and 5–9 μ above, smooth; pedicel colored, once to twice length of spore.


248

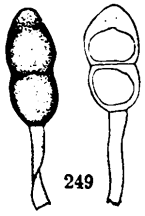
On Caryophyllaceae: **Arenaria glabrescens** (Wats.) Howell, Utah.—**Silene douglasii** Hook., Calif.—**S. lemmonii** Wats., Calif.—**S. multicaulis** Nutt., Mont., Wash.—**S. nivea** (Nutt.)Otth, Iowa, Kans.—**S. noctiflora** L., Pa.—**S. occidentalis** Wats., Calif. **Range:** Sparingly from northern Pennsylvania to Washington and northern California; also in Europe and western Asia.

123. PUCCINIA ARENARIAE. Fig. 249.

(N. A. F. 7: 526, 527, 553, 802, 846.)

Uredo arenariae Schum., Enum. Pl. Saell. **2:** 232. 1803.
Puccinia dianthi DC., Fl. Fr. **2:** 220. 1805.
Puccinia moehringiae Fckl., Jahrb. Nass. Ver. Nat. **23–24:** 51. 1870.
Puccinia arenariae (Schum.) Wint., in Rab., Krypt.-Fl. **1:** 167. 1881.
Puccinia hysteriiformis Peck, Bot. Gaz. **6:** 276. 1881.
Puccinia glaucis Arth., Bull. Torrey Club **37:** 571. 1910.
Micropuccinia arenariae A. & J.: Arth., Bull. Torrey Club **48:** 40. 1921.
Micropuccinia hysteriiformis A. & J., N. Am. Flora **7:** 527. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, cinnamon-brown becoming blackish-brown; teliospores oblong or linear-oblong, 13–20 by 32–50 μ, rounded or obtuse above, rounded or narrowed below, slightly constricted at septum; wall cinnamon-brown, 1–2 μ thick at sides, 5–10 μ above, smooth; pedicel colorless, or tinted next to spore, once to twice length of spore.


249

On Caryophyllaceae: **Arenaria congesta** Nutt., Mont.—**A. douglasii** Fenzl, Calif.—**A. stricta** Michx., N.Y., Wis.—**A. uintahensis** Nels., Utah.—**Cerastium alpinum** L. Greenl.—**C. strictum** L., Colo., Mont.—**Dianthus barbatus** L., Conn., Mass., Miss., N.Y., Pa.—**D. deltoides** L., N.Y.—**Honkenya peploides** (L.)Ehrh.(*Arenaria p.*), N.S.—**Merckia physodes** Fisch.(*A. p.* Fisch.), N.W.Terr.—**Moehringia lateriflora** (L.)Fenzl(*A. l.*), Alas., Me., Mont.; Sask.—**Spergula arvensis** L., Me., N.Y.—**Stellaria borealis** Bigel.(*Alsine b.* Britt.), Mont., Wash.—**S. laeta** Richards.(*A. l.* Rydb.), Mont., Wyo.—**S. longipes** Goldie(*A. l.* Cov.), Alas.; Alta.; Greenl. **Range:** Western Greenland to northern border of North West Territory, southward to northern Mississippi, Colorado and northern California; also in Europe, Asia, Japan and South America.

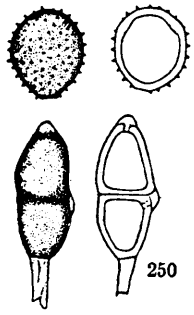
The species is usually leptosporic, but rarely so when the spores are shorter and broader, as in the form designated as *P. hysteriiformis*.

124. PUCCINIA CALTHAE. Fig. 250.

(N. A. F. 7: 389, 789, 841.)

(*Aecidium calthae* Grev., Fl. Edin. 446. 1824.)
Puccinia calthae [Grev.] Link, in Willd., Sp. Pl. 6^2: 79. 1825.
Puccinia elongata Schroet., Beitr. Biol. Pfl. **3**: 61. 1879.
Dicaeoma calthae Ktze., Rev. Gen. 3^3: 468. 1898.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 14–20 by 20–26 μ; wall colorless, about 1 μ thick, finely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid or obovoid, 20–26 by 26–32 μ; wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 2, rarely 3, superequatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 15–22 by 32–50 μ, rounded or narrowed at both ends, slightly or not constricted at septum; wall cinnamon-brown, 1.5–2 μ thick at sides, slightly thicker above, with a hyaline papilla over the pores, the upper pore apical, the lower at septum, smooth; pedicel nearly or quite colorless, short, fragile.


250

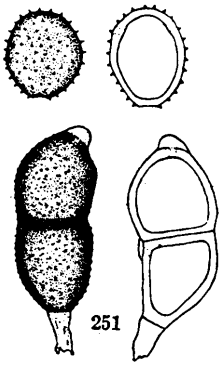
On Ranunculaceae: **Caltha palustris** L., Ind., Iowa, Mich., N.J., N.Y., N.D., S.D., Wis.; Man., Ont. **Range:** New York to Manitoba, southward to New Jersey and Iowa; also in Europe, Japan and Siberia.

125. PUCCINIA AREOLATA. Fig. 251.

(N. A. F. 7: 390, 789, 841.)

Puccinia areolata D. & H.; Diet., Bot. Gaz. **19**: 304. 1894.
Dicaeoma areolatum Ktze., Rev. Gen. 3^3: 467. 1898.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 18–24 by 21–26 μ; wall colorless, about 1 μ thick, minutely verrucose. Uredia hypophyllous, cinnamon-brown; urediospores globoid or obovoid, 20–25 by 25–32 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, superequatorial. Telia hypophyllous, chocolate-brown; teliospores oblong or clavate, 20–34 by 45–80 μ, obtuse above, obtuse or narrowed below, slightly constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pores, the upper pore apical, the lower at septum, smooth or minutely rugose; pedicel colorless, short, fragile.


251

On Ranunculaceae: **Caltha biflora** DC., Alas., Wash.—**C. howellii** Greene, Calif.—**C. leptosepala** DC., B.C., Sask.—**C. rotundifolia** (Huth)Greene, Colo. **Range:** Central Saskatchewan to southeastern Alaska, southward to Colorado and northern California.

Puccinia gemella.

(N. A. F. 7: 529, 802.)

Puccinia gemella D. & H.; Syd., Monog. Ured. **1**: 541. 1903.
Micropuccinia gemella A. & J., N. Am. Flora **7**: 529. 1922.

Pycnia, aecia and uredia wanting. Telia as in *Puccinia areolata*, or paler if germinating; teliospores fusiform-oblong, 20–26 by 40–58 μ, otherwise as in *P. areolata*.

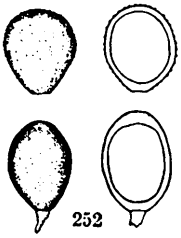
On Ranunculaceae: **Caltha biflora** DC., Calif., Ore., Wash.—**C. howellii** Greene, Calif.—**C. leptosepala** DC., Alas., Ida., Wash. **Range:** Idaho to southeastern Alaska, southward to northern California.

126. UROMYCES LYCOCTONI. Fig. 252.

(N. A. F. 7: 760.)

(*Aecidium bifrons* DC., Fl. Fr. **2:** 246. 1805.)
Uredo lycoctoni Kalchb., Mitth. Acad. Wiss. III. 1865.
Uromyces aconiti Fckl., Jahrb. Nass. Ver. Nat. **23–24:** 61. 1870.
Uromyces aconiti-lycoctoni Wint., in Rab., Krypt-Fl. **1:** 153. 1881.
Uromyces lycoctoni (Kalchb.) Trotter, Flora Ital. Crypt. **1:** 64. 1908.
Nigredo bifrons Arth., N. Am. Flora **7:** 760. 1926.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores ellipsoid, 16–21 by 23–34 μ; wall colorless, 1.5–2 μ thick, finely verrucose. Uredia not formed; urediospores in the telial sori globoid or ellipsoid, 17–23 by 22–29 μ; wall nearly colorless, 1–2 μ thick, minutely and striately verrucose, the pores 5–7, scattered, very obscure. Telia epiphyllous, chocolate-brown; teliospores ellipsoid or obovoid, 18–27 by 23–35 μ; wall cinnamon-brown, 1.5–2 μ thick at sides, 3–4 μ above, smooth; pedicel colorless, length of spore or less, fragile.


252

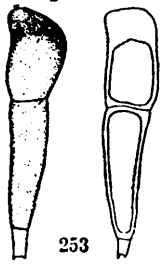
On Ranunculaceae: **Aconitum columbianum** Nutt., Calif., Colo., Utah, Wyo. **Range:** Northern Wyoming and Colorado to northern California; also in Europe.

127. PUCCINIA GIGANTISPORA. Fig. 253.

(N. A. F. 7: 457, 458, 797, 798, 844.)

Puccinia gigantispora Bubák, Sitz. Böhm. Ges. Wiss. **1901**[2]: 9. 1901.
Allodus gigantispora Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.
Allodus opposita Orton, Mem. N. Y. Bot. Gard. **6:** 185. 1916.
Puccinia opposita Arth., Bull. Torrey Club **48:** 33. 1921.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 16–23 by 19–26 μ; wall colorless, 1.5–2 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, at first closely associated with aecia, long covered by epidemis, with few subepidermal paraphyses, when naked blackish; teliospores cylindric, the cells rarely subequal, the lower often twice length of upper, 13–19 by 40–87 μ, obtuse or truncate above, narrowed below, slightly or much constricted at septum; wall pale-brownish, 1–1.5 μ thick at sides, chestnut-brown and 3–12 μ above, smooth, often with one to three longitudinal ridges; pedicel colored, short.


253

On Ranunculaceae: **Anemone cylindrica** Gray, Colo.; Alta., B.C., Sask.—**A. globosa** Nutt., Colo., Ida., Mont., Wyo.; Alta., B.C. **Range:** Saskatchewan to British Columbia, southward to Colorado.

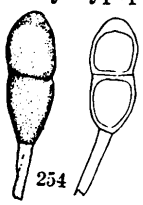
*. **Puccinia stromatica** B. & C., with pycnia, aecia and uredia unknown, possibly wanting; telia caulicolous, in groups, crowded into crust-like masses, 1–5 cm. long, chocolate-brown, teliospores oblong or ellipsoid, 16–21 by 26–32 μ, rounded at both ends, slightly constricted at septum, the wall chestnut-brown, uniformly 1.5–2.5 μ thick, or slightly thicker above, smooth, with nearly colorless pedicel twice length of spore; occurs on Ranunculaceae: **Clematis** sp. in Alabama, but only once collected. (N. A. F. **7:** 592.)

128. PUCCINIA THLASPEOS. Fig. 254.

(N. A. F. 7: 532.)

Puccinia thlaspeos Schub.; Fic. & Schub., Fl. Dresd. **2:** 254. 1823.
Micropuccinia thlaspeos A. & J., N. Am. Flora **7:** 532. 1922.

Pycnia not seen, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, systemic, light chestnut-brown, cinereous by germination; teliospores oblong or clavate-oblong, 14–18 by 32–45 μ, rounded above, rounded or narrowed below, slightly constricted at septum; wall golden-brown, 1–1.5 μ thick at sides, 5–8 μ above, smooth; pedicel colorless, once to once and a half length of spore.


254

On Brassicaceae (*Cruciferae*): **Thlaspi glaucum** Nels., Colo., Utah.—**T. nuttallii** Rydb., Colo.—**T. purpurascens** Rydb. (*T. alpestre* Am.auth.), Ida. **Range:** Idaho to Colorado and central Utah; also in Europe.

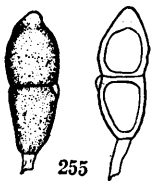
This species closely resembles *Puccinia holboellii*, a microcyclic form of *P. monoica*, differing chiefly in the considerably smaller size of the teliospores. The presence of the species in Europe, where *P. monoica* is not known, makes it inexpedient to associate it with *P. holboellii* as a divergent form, although strongly suggested by the habit and morphology.

129. PUCCINIA DENTARIAE. Fig. 255.

(N. A. F. 7: 531.)

Uredo dentariae A. & S., Consp. Fung. 129. 1805.
Puccinia dentariae (A. & S.) Fckl., Jahrb. Nass. Ver. Nat. **25–26:** 295. 1871.
Micropuccinia dentariae A. & J., N. Am. Flora **7:** 531. 1922.

Pycnia not seen, probably not formed. Aecia and uredia wanting. Telia amphigenous, gregarious on hypertrophied areas, chestnut-brown; teliospores clavate or cylindric, 15–18 by 32–50 μ, rounded or somewhat narrowed above and below, somewhat constricted at septum; wall dark cinnamon-brown, 1.5–3 μ thick at sides, 4–6 μ above, smooth both when wet and dry in American collections, minutely striate when dry in European collections; pedicel colorless, short, fragile.


255

On Brassicaceae (*Cruciferae*): **Dentaria tenella** Pursh, Ore. **Range:** Western Oregon; also in Europe.

130. PUCCINIA sp. unknown.

Endophyllum sempervivi.

(N. A. F. 7: 700.)

Uredo sempervivi A. & S., Consp. Fung. 126. 1805.
Endophyllum persoonii Lév., Mém. Soc. Linn. Paris **4:** 208. 1825.
Endophyllum sempervivi (A. & S.) de Bary, Ann. Sci. Nat. IV. **20:** 86. 1863.

Pycnia chiefly epiphyllous, few. Aecia and uredia wanting. Telia amphigenous, aecidioid, systemic, irregularly scattered, yellowish, pulverulent, the peridial cells readily falling apart; teliospores catenulate, 1-celled, globoid or somewhat ellipsoid, 18–28 by 18–35 μ; wall pale brownish-yellow, uniformly 3–4 μ thick, verrucose.

On Crassulaceae: **Sempervivum punctatum** C.Sm., N.J., N.Y. **Range:** Vicinity of Long Island, N. Y.; also in Europe.

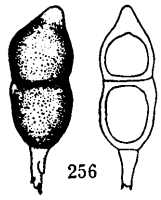
Although introduced into America a quarter of a century or more ago, the species is comparatively rare, even in the limited area here recorded. The infected plants have a striking appearance, being yellowish and drawn. It may occur on any species of *Sempervivum*. The correlated macrocyclic species is not definitely known, although the aecial form belonging to some undetermined species on grass has been found on *S. tectorum* in southern France. The assignment to *Puccinia longissima* in the North American Flora, page 700, was an error.

131. PUCCINIA LAURENTIANA. Fig. 256.

(N. A. F. 7: 534.)

Puccinia laurentiana Trel., Harriman Alas. Exp. Crypt. 38. 1904.
Micropuccinia laurentiana A. & J., N. Am. Flora **7:** 534. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, chestnut-brown; teliospores oblong, 18–20 by 40–50 μ, rounded or obtuse above and below, strongly constricted at septum; wall chestnut-brown, 3–3.5 μ thick at sides, slightly thicker above, with colorless apex, smooth; pedicel colorless, once to once and a half length of spore, fragile.


256

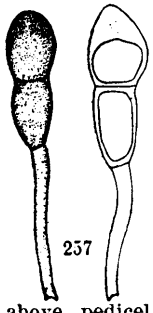
On Saxifragaceae: **Ocrearia nudicaulis** (D.Don)Small (*Saxifraga n.*), Alas. **Range:** Known only from one collection, on St. Lawrence Island, Bering Sea, Alaska.

132. PUCCINIA WALDSTEINIAE. Fig. 257.

(N. A. F. 7: 540, 803.)

Puccinia waldsteiniae Curt.; Peck, Ann. Rep. N. Y. State Mus. **25:** 120. 1873.
Micropuccinia waldsteiniae A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, in groups, chocolate-brown; teliospores oblong or clavate-oblong, 13–18 by 40–55 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall cinnamon-brown, 1–1.5 μ thick at sides, 5–12 μ and much darker above, smooth; pedicel cinnamon-brown, twice length of spore.


257

On Rosaceae: **Waldsteinia fragarioides** (Michx.)Tratt., N.Y., Vt., Wis.; Ont.—**W. idahoensis** Piper, Ida. **Range:** Sparingly from Vermont to Idaho; also in Japan.

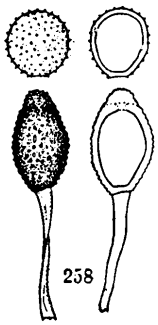
*. **Uromyces krameriae** Long, is reported only from vicinity of Denton, in northern Texas. Only telia are known, which are amphigenous, chestnut-brown, teliospores ellipsoid or globoid, 21–23 by 23–29 μ, wall cinnamon-brown, 2.5–3 μ thick at sides, paler and 6–9 μ above, pedicel colorless, once to twice length of spore; occurs on Krameriaceae: **Krameria glandulosa** Rose&Painter(*K. parvifolia* Gray, not Benth.), Texas. (N. A. F. **7:** 587.)

133. UROMYCES HEDYSARI-PANICULATI. Fig. 258.

(N. A. F. 7: 248, 761, 829.)

Puccinia hedysari-paniculati Schw., Schr. Nat. Ges. Leipzig **1:** 74. 1822.
Uromyces desmodii Cooke, Hedw. **17:** 39. 1878.
Uromyces hedysari-paniculati (Schw.) Farl.; Ellis, N. Am. Fungi *246*. 1879.
Nigredo hedysari-paniculati Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia epiphyllous. Aecia hypophyllous, in small groups, cupulate; aeciospores globoid, 13–16 by 14–17 μ; wall colorless, 1 μ thick, minutely verrucose. Uredia chiefly hypophyllous, cinnamon-brown, with few inconspicuous nearly colorless paraphyses; urediospores ellipsoid or obovate-ellipsoid, 17–24 by 19–26 μ; wall golden-brown, 1.5 μ thick, echinulate, the pores 3–5, scattered. Telia



chiefly hypophyllous, blackish-brown; teliospores obovoid or ellipsoid, 15–20 by 19–29 μ, obtuse or rounded at both ends; wall chestnut- or chocolate-brown, 2.5–3 μ thick at sides, 4–7 μ above, verrucose; pedicel nearly or quite colorless, about twice length of spore.

On Fabaceae: (*Leguminosae*): **Desmodium bracteosum** Hemsl.(*Meibomia b.* Ktze.), Ill., S.C.—**D. canadense** DC.(*M. c.* Ktze.), Iowa, Ky., Mich., Miss., N.J., N.Y.—**D. canescens** (L.) DC.(*M. c.* Ktze.), Ark., Conn., D.C., Ga., Ill., Ind., Kans., Ky., La., Miss., Mo., N.C., Ohio, S.C., Tenn., W.Va.—**D. dillenii** Darl. (*M. d.* Ktze.), Ala., Ark., Del., Ga., Ill., Ind., Iowa, La., Miss., Mo., Neb., N.Y., N.C., Pa., Tenn., W.Va., Wis.; Ont.—**D. grandiflorum** (Walt.)DC.(*D. acuminatum* DC., *M. g.* Ktze.), Kans.—**D. illinoense** Gray (*M. i.* Ktze.), Ill., Kans.—**D. laevigatum** (Nutt.)DC.(*M. l.* Ktze.), Del., Fla., Ind., Ky., N.C.—**D. longifolium** T.&G.(*M. l.* Vail), Miss.—**D. marylandicum** (L.)Boott(*M. m.* Ktze.), Ala., Del., Mich., Miss., N.Y., Tenn., Tex., Va.—**D. michauxii** (Vail)Dan.(*D. rotundifolium* DC., *M. m.*), Ala., Ill., Ind., N.J., N.Y., S.C., Vt., Va.—**D. obtusum** (Muhl.)DC.(*D. ciliare* DC., *M. o.* Vail), Del., Miss., N.J., N.Y., N.C., S.C., Tenn., Tex.—**D. paniculatum** (L.)DC.(*M. p.* Ktze.), Ala., Ark., Del., D.C., Ga., Ill., Ind., Kans., Ky., La., Mich., Miss., Mo., N.J., N.Y., N.C., Ohio, Okla., Pa., S.C., Tex., Va., W.Va.—**D. pauciflorum** (Nutt.) DC.(*M. p.* Ktze.), Ark., Mo.—**D. rhombifolium** (Ell.)DC.(*M. r.* Vail), Ala., Ga.—**D. rigidum** (Ell.)DC.(*M. r.* Ktze.), D.C., Mass., Miss., N.Y., Tenn.—**D. scorpiurum** (Sw.)Desv.(*M. s.* Ktze.), Fla.—**D. sessilifolium** T.&G.(*M. s.* Ktze.), Iowa, Kans., Okla., Tex.—**D. strictum** (Pursh)DC.(*M. s.* Ktze.), Ala., Del., N.C., S.C.—**D. viridiflorum** (L.)Beck(*M. v.* Ktze.), Fla., Ind., Ky., Mo., N.J., Ohio. **Range:** New York to Minnesota, southward to Florida and Texas; also in South America.

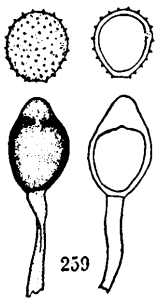
The description of the aecia is based on one collection on *D. rigidum* from Tennessee. Only three other collections of aecia on *Desmodium* are known for North America, one each from Wisconsin and Minnesota on *D. grandiflorum* and one on *D. dillenii* from Alabama, all three of which are now considered to be *Aecidium onobrychidis* Burr., and are placed under *Puccinia andropogonis*, page 122. *Aecidium desmodii* P. Henn., entered as a synonym in the N. Am. Flora **7:** 248, is a common species in South America, now believed to be heteroecious (Jackson, Mycol. **23:** 345. 1931), but apparently does not belong with this species or with *P. andropogonis*.

134. UROMYCES LESPEDEZAE-PROCUMBENTIS. Fig. 259.

(N. A. F. 7: 247, 760, 829.)

Puccinia lespedezae-procumbentis Schw., Schr. Nat. Ges. Leipzig **1:** 73. 1822.
Uromyces lespedezae-procumbentis (Schw.) Curt., Cat. Pl. N. Car. 123. 1867.
Uromyces lespedezae Peck; Coult., Bot. Bull. (Bot. Gaz.) **1:** 20. 1878.
(*Aecidium leucostictum* B. & C.; Burr., Bull. Ill. Lab. Nat. Hist. **2:** 226. 1885.)
Nigredo lespedezae-procumbentis Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 11–15 by 13–16 μ; wall colorless, 1 μ thick, minutely verrucose. Uredia hypophyllous, cinnamon-brown, with peripheral incurved paraphyses; urediospores ellipsoid or obovate-ellipsoid, 13–18 by 16–23 μ; wall pale golden-brown, 1–1.5 μ thick, echinulate, the pores 3 or 4, nearly equatorial. Telia amphigenous, blackish-brown, with paraphyses similar to those in the uredia usually present, but less abundant; teliospores obovoid, 12–16 by 18–32 μ, rounded or narrowed above and below; wall dark chestnut-brown, 1.5 μ



259

thick at sides, 5–10 μ and paler above, smooth; pedicel colorless, once to once and a half length of spore.

On Fabaceae (*Leguminosae*): **Lespedeza capitata** Michx., Ala., Conn., Ill., Ind., Iowa, Kans., Mass., Mich., Minn., Miss., Neb., N.J., N.Y., N.C., Vt., Wis.; Ont.—**L. frutescens** (L.)Britt., Ala., Ark., Del., Ga., Ky., Mass., Mo., N.Y., N.C., Pa., S.C., Tenn., Tex., Va., W.Va.—**L. hirta** (L.)Hornem.(*L. polystachya* Michx.), Ala., Ark., Del., Fla., Ill., Ind., Ky., Mass., Mich., Miss., N.J., N.Y., N.C., Ohio, Pa., S.C., Tenn., Va., W.Va. —**L. leptostachya** Engelm., Iowa.—**L. nuttallii** Darl., Ky., N.Y. —**L. procumbens** Michx., Ala., Ark., Ga., Ill., Ind., Ky., Md., Mass., Miss., Mo., N.J., N.Y., N.C., Pa., R.I., Tenn., Tex., Va., W.Va.—**L. repens** (L.)Bart., Ala., D.C., Ill., Md., Miss., Mo., N.C., S.C., Tenn., W.Va.—**L. stuvei** Nutt., Ala., Ark., Md., Mass., Mo., N.Y., N.C., Tenn.—**L. texana** Britt., Tex.—**L. violacea** (L.) Pers., Ark., Conn., Ill., Iowa, La., Mass., Miss., Mo., N.Y., Ohio, Pa., S.C., Va., W.Va., Wis.—**L. virginica** (L.)Britt.(*L. angustifolia* Ell.), Ala., Ark., Conn., Del., D.C., Ga., Ill., Ind., Iowa, Ky., La., Md., Minn., Mo., N.Y., Okla., Pa., S.C., Tex., Va. **Range:** Vermont to Minnesota, southward to Florida and Texas; also in eastern Asia and Japan.

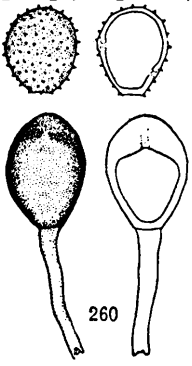
A culture was made by Arthur (Jour. Myc. **10:** 14. 1904) in 1903 by sowing teliospores from *Lespedeza capitata* upon the same species of host, resulting in abundant aecia.

135. UROMYCES FABAE. Fig. 260.

(N. A. F. 7: 251, 761, 830.)

Uredo fabae Pers., Neues Mag. Bot. **1:** 93. 1794.
Uredo viciae-fabae Pers., Syn. Fung. 221. 1801.
Uredo viciae Rebent., Prodr. Fl. Neom. 355. 1804.
Uromyces fabae (Pers.) de Bary, Ann. Sci. Nat. IV. **20:** 80. 1863.
(*Aecidium album* G. W. Clint., Ann. Rep. N. Y. State Mus. **26:** 78. 1874.)
Nigredo fabae Arth., N. Am. Flora **7:** 251. 1912.

Pycnia chiefly epiphyllous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores broadly ellipsoid, 15–21 by 18–26 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 17–25 by 22–30 μ; wall light golden-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, scattered or nearly equatorial. Telia amphigenous, blackish-brown; teliospores obovoid, 18–25 by 25–39 μ; wall dark chestnut-brown, 1.5–2.5 μ thick at sides, 6–10 μ above, smooth; pedicel colored next to spore, firm, once to twice length of spore.



260

On Fabaceae (*Leguminosae*): **Lathyrus arizonicus** Britt., Ariz., Colo., N.M.—**L. bijugatus** T.G.White, Wash. —**L. bolanderi** Wats., Calif.—**L. coriaceus** T.G.White, Utah.—**L. decaphyllus** Pursh(*L. polymorphus* Nutt.), Colo., N.M., Utah.—**L. laetivirens** Greene, Colo.—**L. leucanthus** Rydb., Colo., Ida., N.M.—**L. littoralis** Dougl., Calif.—**L. myrtifolius** Muhl., Ill., Iowa; Ont.—**L. nuttallii** Wats., Ore.—**L. obovatus** (Torr.)T.G.White, Ore., Wash.—**L. ochroleucus** Hook., Ill., Mich., N.Y., S.D., Utah, Wis.; Alta. (55° N. Lat.), Man., Ont.—**L. oregonensis** T.G.White, Ore.—**L. palustris** L.,

Mich., Wash., Wis.—**L. pauciflorus** Fern., Ida., Mont., Ore.—**L. polyphyllus** Nutt., Ore., Wash.—**L. stipulaceus** (Pursh)Butters&St.John(*L. ornatus* Nutt.), Colo., Kans., Neb.—**L. strictus** Nutt., Calif.—**L. sulphureus** Brewer, Calif., Ore., Wash.—**L. torreyi** Gray, Calif.—**L. utahensis** Jones, Colo., Utah.—**L. venosus** Muhl., Ind., Iowa, Mich., Minn., N.D., S.D., Wis.; Alta.—**L. violaceus** Greene, Calif.—**L. watsonii** T.G.White, Calif.—**Pisum sativum** L., Minn.; Man.—**Vicia americana** Muhl., Ariz., Ida., Iowa, Mo., Mont., N.M., N.Y., Ohio, Ore., S.D., Wash., Wyo.; B.C., Man., Sask.—**V. angustifolia** (L.)Richard., B.C.—**V. californica** Greene, Calif.—**V. caroliniana** Walt., Wis.—**V. cracca** L., Conn.; N.S., Queb.—**V. dissitifolia** (Nutt.)Rydb., Colo.—**V. faba** L.(*Faba vulgaris* Moench), Calif., La., N.C., Pa.—**V. melilotoides** W.&S., Ariz.—**V. oregana** Nutt.(*V. truncata* Nutt.), Ore.; Alta.—**V. sativa** L., Mont., Wash.—**V. sparsifolia** Nutt.(*V. linearis* Greene), Ariz., Kans., Minn., Ore., Wyo.; Alta. **Range:** Nova Scotia to northern Alberta, southward to Arizona; also in Mexico, Central and South America, Europe, northern Africa Asia, Japan, Australia and New Zealand; a cosmopolitan species.

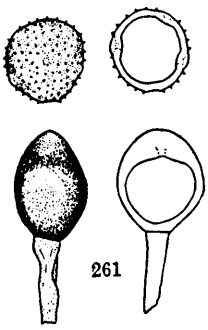
The first successful culture experiments ever made, introducing modern methods, were carried out in 1862 by de Bary (Ann. Sci. Nat. Bot. IV. **20:** 74. 1863), who sowed teliospores from *Faba vulgaris* on seedlings of that species and *Pisum sativum*, and produced aecia on both hosts. The experiment has often been repeated, both in Europe and America.

136. UROMYCES LUPINI. Fig. 261.

(N. A. F. 7: 252, 762, 830.)

Uredo lupini B. & C., Proc. Am. Acad. **4:** 126. 1858.
Uromyces lupini B. & C., Proc. Am. Acad. **4:** 126. 1858.
Nigredo lupini Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia chiefly epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 18–24 by 21–29 μ; wall nearly or quite colorless, 1.5–2 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 19–24 by 24–32 μ; wall dark-yellow, 2–3 μ thick, echinulate, the pores 6–8, scattered. Telia amphigenous, chocolate-brown; teliospores globoid or ellipsoid, 18–26 by 26–39 μ; wall chestnut-brown, 2–3 μ thick at sides, 7–12 μ above, smooth; pedicel colored, once or twice length of spore.



261

On Fabaceae (*Leguminosae*): **Lupinus aduncus** Greene, Colo.—**L. albifrons** Benth., Calif.—**L. amplus** Greene, Colo.—**L. argenteus** Pursh (*L. decumbens* Torr.), Colo., Neb., Wyo.—**L. bridgesii** (Wats.)Greene, Calif.—**L. chamissonis** Eschsch., Calif.—**L. douglasii** J.Ag., Calif.—**L. formosus** Greene, Calif.—**L. holosericeus** Nutt., Mont.—**L. latifolius** J. Ag., Calif.—**L. laxiflorus** Dougl., Ore., Wyo.—**L. leucophyllus** Dougl., Mont., Wash.—**L. parviflorus** Nutt., Wyo.—**L. polyphyllus** Lindl., Ore., Wash.—**L. rivularis** Dougl., Calif., Ore.—**L. sericeus** Pursh, Ida.—**L. suksdorfii** B.L.Rob., Wash.—**L. sulphureus** Dougl., Wash. **Range:** Montana to Washington, southward to western Nebraska and southern California; also in Mexico.

*. **Uromyces indigoferae** D. & H. (*Nigredo i.* Arth.), with pycnia and aecia unknown; uredia amphigenous, urediospores globoid, 15–19 by 19–25 μ, the wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3, equatorial; telia amphigenous,

blackish-brown, teliospores globoid, 17–23 by 22–29 μ, the wall chestnut-brown, 2.5–3.5 μ thick at sides, 7–10 μ above, smooth, with colorless pedicel, once to twice length of spore; occurs on FABACEAE (*Leguminosae*) : **Indigofera leptosepala** Nutt., in northern Texas, and **I. miniata** Ort., in southern Florida; also in Mexico and Central America. (N. A. F. **7:** 250, 761, 830.)

*. **Uromyces dolicholi** Arth. (*Nigredo d.* Arth.), with pycnia and aecia unknown; uredia amphigenous, urediospores globoid, 18–21 μ in diameter, the wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3, occasionally 4, equatorial; telia amphigenous, cinnamon-brown, teliospores oblong, 10–15 by 26–32 μ, narrowed at both ends, the wall golden-brown, 1 μ thick at sides, 3–6 μ above, smooth, with nearly colorless pedicel, half length of spore; occurs on FABACEAE (*Leguminosae*) : **Cajanus flavus** DC. (*C. indicus* Spreng., *Cajan cajan* Millsp.), in southern Florida, and **Dolicholus texanus** (T.&G.) Vail ((*Rhynchosia t.*), in southern Texas; also in West Indies and South America. (N. A. F. **7:** 258, 765.)

*. **Puccinia arachidis** Speg. (*Bullaria a.* Arth. & Mains), with pycnia and aecia unknown; uredia chiefly hypophyllous, dark cinnamon-brown, urediospores ellipsoid or obovoid, 16–22 by 23–29 μ, the wall cinnamon-brown, 1–2 μ thick, the pores 2, nearly equatorial; telia chiefly hypophyllous, chestnut-brown, teliospores oblong, often with 3 or 4 cells, 14–16 by 38–42 μ, germinating at maturity, the wall chestnut-brown, smooth, with colorless pedicel, once length of spore; occurs sporadically in southern Georgia and Florida, only as uredia, on FABACEAE (*Leguminosae*) : **Arachis hypogaea** L.; also in West Indies and South America. (N. A. F. **7:** 484.)

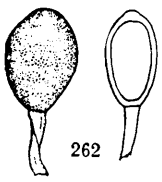
*. **Puccinia offuscata** Arth. (*Uredo zorniae* Diet., not *P. z.* McA., *Bullaria z.* Arth.), with pycnia and aecia unknown; uredia amphigenous, dark cinnamon-brown, with inconspicuous paraphyses, urediospores ellipsoid or obovoid, 18–23 by 23–29 μ, the wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 3 or 4, equatorial; telia hypophyllous, dark cinnamon-brown, teliospores oblong-clavate or oblong-ellipsoid, 13–18 by 32–53 μ, rounded above, narrowed below, slightly constricted at septum, germinating at maturity, the wall light golden-brown, 1–2 μ thick at sides, slightly thicker above, smooth, with colorless pedicel, one-half length of spore; occurs on FABACEAE (*Leguminosae*) : **Zornia bracteata** (Walt.) Gmel. (*Z. tetraphylla* Michx.), in southern Florida; also in West Indies and South America. (N. A. F. **7:** 484.)

137. UROMYCES PSORALEAE. Fig. 262.

(N. A. F. 7: 446, 447, 796, 843.)

(*Aecidium psoraleae* Peck; Parry, Am. Nat. **8:** 215. 1874.)
Uromyces psoraleae Peck, Bot. Gaz. **6:** 239. 1881.
Uromyces argophyllae Seym., Proc. Bost. Soc. Nat. Hist. **24:** 185. 1889.
Puccinia psoraleae Arth., N. Am. Flora **7:** 446. 1921.
Puccinia argophyllae Arth., N. Am. Flora **7:** 447. 1921.

Pycnia hypophyllous, preceding or scattered among the aecia. Aecia hypophyllous, systemic, cupulate; aeciospores globoid or ellipsoid, 15–23 by 18–29 μ; wall nearly or quite colorless, 1–1.5 μ thick, minutely verrucose. Uredia wanting. Telia amphigenous, dark chestnut-brown; teliospores obovoid or oblong, 13–26 by 26–42 μ; wall dark cinnamon-brown, uniformly 1.5–2.5 μ thick, sometimes with a hyaline papilla over the pore, smooth; pedicel colorless, as long as spore or more often short, fragile.


262

ON FABACEAE (*Leguminosae*): Hosts and localities given under the varieties.

Separable into two varieties, chiefly distinguished by the form and size of the teliospores, and by the hosts.

(1). **Uromyces psoraleae typica** n. nom. Teliospores broadly obovoid, 21–26 by 26–42 μ; on FABACEAE: **Psoralea lanceolata** Pursh, Ariz., Colo., Ida., Kans., Mont., Neb., N.M., S.D., Utah, Wyo.—**P. micrantha** Gray, Ariz., N.M., Utah.—**P. purshii** Vail (*Psoralidium p.* Rydb.), Utah, Wyo. **Range:** Southwestern South Dakota to Idaho, southward to Colorado and Utah.

(2). **Uromyces psoraleae argophyllae** (Seym.) n. comb. Teliospores narrowly obovoid or oblong, 13–21 by 26–39 μ; on FABACEAE: **Psoralea argophylla** Pursh, Iowa, Kans., Minn., Neb., N.D., S.D.—**P. bigelovii** (Rydb.) Tidest.(*P. obtusiloba* Vail, not T.&G.), Ariz.—**P. collina** Rydb., Neb.—**P. cuspidata** Pursh, Colo., S.D.—**P. floribunda** Nutt., Colo., Kans., Ill., Mont., Neb., S.D., Tex., Wyo.—**P. linearifolia** T.&G., S.D.—**P. mephitica** Wats., Colo.—**P. tenuiflora** Pursh, Ariz., Colo., Ill., Kans., Mont., Neb., Okla., Wyo. **Range:** Minnesota to Montana, southward to Texas and Arizona.

Uromyces abbreviatus.

(N. A. F. 7: 517, 802.)

Uromyces abbreviatus Arth., Bull. Torrey Club **42:** 587. 1915.
Teleutospora abbreviata Arth. & Bisby, N. Am. Flora **7:** 517. 1922.

Pycnia as in *Uromyces psoraleae.* Aecia and uredia wanting. Telia and teliospores as in *U. psoraleae typica.*

ON FABACEAE (*Leguminosae*): **Psoralea physodes** Dougl.(*Hoite p.* Rydb.), Calif., Wash.; B.C.—**P. purshii** Vail(*Psoralidium p.* Rydb.), Nev. **Range:** British Columbia to northern Nevada and central California.

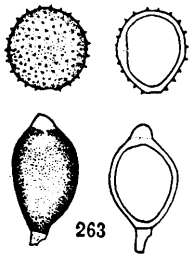
A microcyclic species correlated with *Uromyces psoraleae typica,* as pointed out in the N. Am. Flora **7:** 517. 1922.

138. UROMYCES GERANII. Fig. 263.

(N. A. F. 7: 765.)

Uredo geranii DC., Syn. Pl. 47. 1806.
Uromyces geranii (DC.) Fries, Summa Veg. Scand. 514. 1849.
Uromyces puccinioides Rab., Bot. Zeit. **9:** 627. 1851.
(*Aecidium violaceum* Trel., Harriman Alaska Exp. Crypt. 37. 1904.)
Nigredo geranii Arth., N. Am. Flora **7:** 765. 1926.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores ellipsoid, 20–24 by 26–30 μ; wall nearly or quite colorless, 2–2.5 μ thick, finely verrucose. Uredia hypophyllous, cinnamon-brown; urediospores globoid or ellipsoid, 22–24 by 24–30 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, with 1 pore, usually in the equator. Telia hypophyllous, chestnut-brown; teliospores ellipsoid or obovoid, 18–24 by 26–38 μ; wall chestnut-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pore, smooth; pedical colorless, short, fragile.


263

ON GERANIACEAE: **Geranium erianthum** DC., Alas. **Range:** Southeastern to southwestern Alaska; also in Europe and Japan.

*. **Puccinia oxalidis** (Lév.) Diet. & Ellis (*Dicaeoma o.* Ktze.), with pycnia epiphyllous, in groups, with paraphyses; aecia hypophyllous, in groups, cornutiform, aeciospores globoid, 11–15 by 13–18 μ, the wall colorless, 1–2 μ thick, finely verrucose; occurs on BERBERIDACEAE: **Mahonia repens** (Lindl.)Don(*Berberis r., Odostemon aquifolium* Rydb.), in southern New Mexico; uredia hypophyllous, yellowish-white, at first waxy, urediospores globoid, 16–19 by 17–24 μ, the wall 0.8–1 μ thick, minutely echinulate; telia hypophyllous, pale brownish-yellow, teliospores oblong, 13–20 by 18–28 μ, the wall nearly or quite colorless, uniformly 0.5–0.8 μ thick, with very short pedicel; occurs on OXALIDACEAE: **Oxalis martiana** Zucc., in southern Florida, and **O. violacea** L., in southern Louisiana, New Mexico and Texas; also in Mexico. (N. A. F. **7:** 391, 841.)

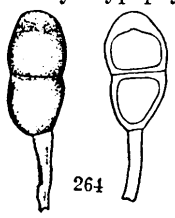
The connection of the two stages was established in 1917 by Long (Bot. Gaz. **65:** 475. 1918), who made reciprocal cultures with spores from *Oxalis violacea* and *Mahonia repens.*

139. PUCCINIA PYROLAE. Fig. 264.

(N. A. F. 7: 540, 803.)

Puccinia pyrolae Cooke, Proc. Portl. Soc. Nat. Hist. **1:** 183. 1862.
Puccinia polygalae Paz.; Rab.-Wint.-Paz., Fungi Eur. *4029.* 1895.
Micropuccinia pyrolae A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chocolate-brown; teliospores oblong or clavate-oblong, 16–26 by 30–42 μ, rounded or obtuse above, rounded or narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, 5–9 μ above, smooth; pedicel nearly or quite colorless, as long as spore.


264

On Polygalaceae: **Polygala paucifolia** Willd., Conn., Me., Mich., Minn., N.H., N.Y., Wis.; Ont. **Range:** Maine and Connecticut, westward to Minnesota.

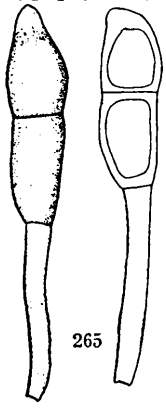
*. **Puccinia arechavaletae** Speg. (*Uromyces pervius* Speg., *Micropuccinia a.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia chiefly hypophyllous, chestnut-brown, cinereous by germination, teliospores variable, globoid, ellipsoid or oblong, 15–26 by 20–35 μ, not constricted at septum, the wall usually golden-brown, 1.5–3 μ thick at sides, 3–7 μ above, smooth, with colorless pedicel, one-half to three times length of spore; mesospores very abundant, often exclusively present; occurs on Sapindaceae: **Cardiospermum corindum** L., and **C. halicacabum** L., both in southernmost Florida and Texas; also in West Indies, Mexico, Central and South America. (N. A. F. **7:** 541, 803, 846.)

140. PUCCINIA MALVACEARUM. Fig. 265.

(N. A. F. 7: 542, 803, 847.)

Puccinia malvacearum Bert.; Mont., in Gay, Fl. Chil. **8:** 43. 1852.
Micropuccinia malvacearum A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, light chestnut-brown, cinereous by germination; teliospores oblong or fusiform-oblong, 16–26 by 40–70 μ, slightly or not constricted at septum; wall cinnamon-brown, variable in thickness, 1.5–4 μ thick at sides, 5–10 μ above, smooth; pedicel colorless, once and a half to twice length of spore.


265

On Malvaceae: **Althaea ficifolia** (L.)Cav., Colo., N.Y., Ore.; Ont.—**A. rosea** (L.)Cav., Ariz., Calif., Colo., Del., Ill., Ind., Me., Mass., Mich., Miss., Mont., Neb., N.H., N.J., N.Y., Ohio, Ore., Pa., Tenn., Utah, Vt., Va., Wash., W.Va., Wis.; Ont.—**Lavatera arborea** L., Calif.—**L. assurgentiflora** Kellogg, Calif.—**L. cretica** L.(*L. sylvestris* Brot.), Calif.—**L. maritima** Gouan, Calif.—**L. plebeia** Sims, Calif.—**Malva borealis** Wallm., Calif.—**M. moschata** L., Calif.; Ont.—**M. oxyloba** Boiss., Calif.—**M. parviflora** L., Calif.—**M. pusilla** Smith, Colo.—**M. rotundifolia** L., Colo., Conn., Del., Ind., Mich., N.J., N.Y., Ore., Pa., Utah, Va., Wash., W.Va., Wis.; Ont.—**M. sylvestris** L., Calif., Colo., Ore., W.Va—**M. verticillata** L.(*M. crispa* L.), Calif. **Range:** Maine to Washington, southward to Tennessee and central Califor-

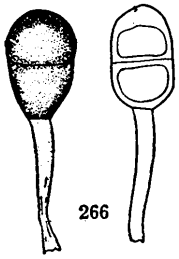
nia; also in West Indies, Mexico, South America, Europe, southern Africa, Australia, and almost wherever hollyhocks are grown.

141. PUCCINIA LOBATA. Fig. 266.

(N. A. F. 7: 545, 847.)

Puccinia lobata B. & C., Grev. **3**: 54. 1874.
Micropuccinia lobata A. & J., N. Am. Flora **7**: 545. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, blackish, cinereous by germination; teliospores oblong or obovate, 16–22 by 30–45 μ, not constricted at septum; wall chestnut-brown, 1.5–3.5 μ thick at sides, 5–10 μ above, smooth; pedicel colorless, twice to thrice length of spore.


266

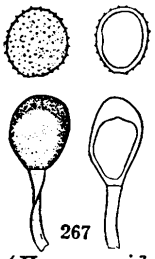
On Malvaceae: **Althaea rosea** (L.)Cav., Ariz., N.M., Tex.—**Sida hederacea** (Dougl.)Torr.(*Disella h.* Greene), Ariz., Calif., N.M., Tex., Utah.—**S. lepidota** Gray(*D. l.* Greene), N.M., Tex.—**Sphaeralcea orcuttii** Rose, Calif. **Range:** Western Texas to central and southern California; also in Mexico.

142. UROMYCES HYPERICI. Fig. 267.

(N. A. F. 7: 261, 768, 831.)

(*Aecidium hyperici-frondosi* Schw., Schr. Nat. Ges. Leipzig **1**: 68. 1822.)
Uredo hyperici Spreng., Syst. Veg. **4**: 572. 1827.
Uromyces triquetrus Cooke, Proc. Portland Soc. Nat. Hist. **1**: 184. 1862.
Uromyces hyperici (Spreng.) Curt., Cat. Pl. N. Car. 123. 1867.
Uromyces hyperici-frondosi Arth., Bull. Minn. Acad. Nat. Sci. **2**²: 15. 1883.
Nigredo hyperici-frondosi Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, small, cupulate; aeciospores globoid, 14–23 by 16–26 μ; wall colorless, 1.5 μ thick, minutely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores ellipsoid or globoid, 13–21 by 19–27 μ; wall pale cinnamon-brown, 1–1.5 μ thick, minutely echinulate, the pores 3, equatorial. Telia chiefly hypophyllous, blackish-brown; teliospores obovoid or globoid, 12–18 by 16–32 μ; wall chestnut-brown, 1–1.5 μ thick at sides, 7–10 μ above, smooth; pedicel colored, about length of spore.


267

On Hypericaceae: **Ascyrum hypericoides** L., Miss., N.J., Tex.—**Hypericum anagalloides** C.&S., Calif.—**H. ascyron** L. (*H. pyramidatum* Ait.), Iowa, Minn., Mo., Wis.—**H. boreale** (Britt.)Bickn., Me., Pa.—**H. canadense** L., Me.—**H. ellipticum** Hook., Md., N.H., N.Y.—**H. galioides** Lam., La.—**H. kalmianum** L., Ill.; Ont.—**H. majus** (Gray)Britt.(*H. canadense majus* Gray), Kans., Me., Mass., Vt., Wis.—**H. mutilum** L., Ala., Conn., Del., D.C., Ill., Ind., Me., Md., Mass., Miss., N.H., N.Y., N.C., Ohio, Pa., S.C., Tenn., Vt., Va., W.Va.—**H. opacum** T.&G., Fla.—**H. perforatum** L., Me., N.Y.—**H. prolificum** L., Ind., N.C., Pa., Tex., Wis.; Ont.—**H. punctatum** Lam.(*H. corymbosum* Muhl.), Conn., Mass., Mo., N.Y., Wis.—**H. scouleri** Hook., Ore.—**Triadenum petiolatum** (Walt.)Britt.(*Elodea p.* Pursh), Ill., Mo. —**T. virginicum** (L.)Raf.(*E. v.* Nutt.), Ala., Fla., Del., Ga., Ill., Ind., Me.,

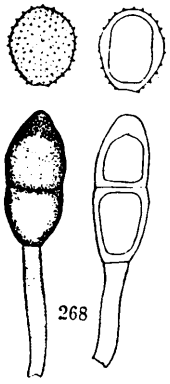
Mass., Mich., Mo., Neb., N.J., N.Y., Wis.; N.S., Ont., Queb. **Range:** Nova Scotia to Minnesota, southward to Florida and Texas; also occasionally in Mexico, South America and Formosa.

143. PUCCINIA OENOTHERAE. Fig. 268.

(N. A. F. 7: 394, 790, 841.)

Puccinia oenotherae Vize, Grev. **5:** 109. 1877.
Puccinia boisduvaliae Peck, Bot. Gaz. **7:** 45. 1882.
Puccinia clarkiae Peck, Bull. Torrey Club **11:** 49. 1884.
Puccinia heteranthae E. & E., Erythea **1:** 204. 1893.
Puccinia eulobi D. & H.; Diet., Erythea **1:** 249. 1893.
(*Aecidium clarkiae* D. & H.; Diet., Erythea **2:** 129. 1894.)
Puccinia sphaerostigmatis Diet. & Neg., Bot. Jahr. **22:** 353. 1896.
Puccinia zauschneriae Syd., Monogr. Ured. **1:** 435. 1903.

Pycnia usually scattered among the aecia. Aecia chiefly hypophyllous, systemic, cupulate; aeciospores globoid, 13–18 by 18–23 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores obovoid or globoid, 18–23 by 21–27 μ, usually flattened laterally; wall cinnamon-brown, 1.5–3 μ thick, echinulate, the pores 2, equatorial, covered by swollen cuticle. Telia amphigenous, chocolate- or blackish-brown; teliospores ellipsoid or oblong, 16–26 by 27–55 μ, rounded above and below, slightly constricted at septum; wall chestnut-brown, 1–3 μ thick at sides, 3–13 μ above, smooth, the pore of upper cell apical, of lower cell at septum; pedicel nearly or quite colorless, sometimes twice length of spore, or short and fragile.



268

On Onagraceae: **Boisduvalia densiflora** (Lindl.)Wats., Calif., Wash.—**B. parviflora** Heller, Ida.—**B. salicina** (Nutt.)Rydb., Ida., Ore., Wash.—**B. sparsiflora** Heller, Calif.—**B. stricta** (Gray)Greene(*B. torreyi* Wats.), Ore.—**Chylismia cardiophylla** (Torr.)Small(*Oenothera c.* Torr.), Calif.—**C. hirta** Nels., Nev.—**Clarkia amoena** (Lehm.)Nels.&Macbr.(*Godetia a.* G. Don), Calif., Ore.—**C. biloba** (Durand)Nels.&Macbr.(*G. b.* Wats.), Calif.—**C. elegans** Dougl., Calif.—**C. epilobioides** (Nutt.)Nels.&Macbr.(*G. e.* Wats.), Nev., Wash.—**C. pulchella** Pursh, Ida., Ore., Wash.—**C. rhomboidea** Dougl., Calif., Wash.—**C. superba** Nels.&Macbr.(*G. grandiflora* Lindl.), Calif.—**Epilobium minutum** Lindl., Calif.; B.C.—**Eulobus californicus** Nutt., Calif.—**Oenothera strigosa** (Rydb.)Mack.&Bush, Mont., Wash.—**Sphaerostigma alyssoides** (H. &A.)Walp.(*Oenothera a.*), Calif., Ida.—**S. andinum** (Nutt.)Walp., Ida., Wash. —**S. bistorta** (Nutt.)Walp., Calif.—**S. boothii** (Dougl.)Walp., Ore., Wash.—**S. contortum** (Dougl.)Walp., Calif., Wash.—**S. decorticans** (H.&A.)Small, Calif.—**S. dentatum** (Cav.)Walp., Ore.—**S. hirtellum** (Greene)Small, Calif.—**S. micranthum** (Hornem.)Walp., Calif.—**S. pubens** (Wats.)Rydb., Calif.—**S. spirale** (Lehm.)Walp., Calif.—**S. utahensis** Small, Utah.—**S. veitchianum** (Hook.)Small, Calif.—**S. viridescens** (Lehm.)Walp., Calif.—**Zauschneria californica** Presl, Calif.—**Z. garrettii** Nels., Utah. **Range:** Montana to British Columbia, southward to western Wyoming and southern California.

(1). **Puccinia oenotherae heteranthae** (E.&E.) n. comb., with pycnia, aecia, uredia, urediospores and telia as in *Puccinia oenotherae*, except pycnia more abundant and telia more pulverulent; teliospores obovoid or ellipsoid,

19–26 by 30–45 μ, wall 2–3 μ thick at sides, 4–7 μ and lighter above, the pore of upper cell more or less depressed, of lower cell at septum, with colorless pedicel, short, fragile; occurs on ONAGRACEAE: **Taraxia brevifolia** Nutt., Mont. —**T. graciliflora** (H.&A.)Raim., Calif.—**T. longiflora** Nutt., Nev.—**T. ovata** (Nutt.)Small(*Oenothera o.*), Calif.—**T. subacaulis** (Pursh)Rydb. (*O. heteranthа* Nutt.), Colo., Ida., Mont., Nev., Utah, Wyo. **Range:** Montana to Idaho, southward to Utah and central California.

Uromyces plumbarius.

(N. A. F. 7: 262, 768, 832.)

Uromyces plumbarius Peck, Bot. Gaz. **4:** 127. 1879.
(*Aecidium gaurinum* Peck, Bot. Gaz. **4:** 218. 1879.)
Uromyces oenotherae Burr., Bot. Gaz. **9:** 187. 1884.
Uromyces fremontii Syd., Ann. Myc. **4:** 29. 1906.
Nigredo plumbaria Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia as in *Puccinia oenotherae;* aeciospores globoid, 12–16 by 14–18 μ; wall as in *P. oenotherae.* Uredia, telia and their spores as in *P. oenotherae,* except teliospores one-celled, obovate, 15–23 by 22–35 μ, rounded or narrowed above and below; wall cinnamon-brown, 2–2.5 μ thick at sides, 5–10 μ above, smooth; pedicel nearly or quite colorless, sometimes one and a half length of spore, usually broken away, fragile.

ON ONAGRACEAE: **Gaura angustifolia** Michx., Miss.—**G. biennis** L., Ill., Ind., Md., N.Y., Ohio, Tex., Va., Wis.—**G. coccinea** Nutt.(*G. marginata* Lehm.), Colo., Kans., Mont., Neb., Nev., N.M., N.D., S.D., Tex., Wyo.; Alta., Sask.—**G. glabra** Lehm., Colo., Mont.—**G. induta** W. & S., N.M., Okla.—**G. neomexicana** Woot., Colo.—**G. parviflora** Dougl., Kans., Neb.—**G. sinuata** Nutt., Okla., Tex.—**G. villosa** Torr., Kans.—**Oenothera biennis** L.(*Onagra b.* Scop.), Ill., Ind., Iowa, Me., Mass., Mo., Neb., N.H., N.J., Ohio, Okla., Pa., R.I., S.D., Tex., Va., W.Va., Wis.—**O. brachycarpa** Gray(*Lavauxia b.* Britt.), Neb.—**O. fremontii** Wats.(*Megapterium f.* Britt.), Kans.—**O. laciniata** Hill(*O. sinuata* L., *Raimannia l.* Rose), Ala., Del., Kans., Miss., Neb., N.J., N.C., S.C., Okla., Tex.—**O. linifolia** Nutt.(*Kneiffia l.* Spach), Ill., Mo., Tex.—**O. muricata** L., N.Y.—**O. rhombipetala** Nutt.(*R. r.* Rose), Wis.—**Pachylophus caespitosus** (Nutt.)Raim.(*O. c.*), Colo., Nev., Utah, Wyo.—**P. macroglottis** Rydb.(*P. hirsutus* Rydb.), Colo., Ida., Wyo.—**P. marginatus** (Nutt.)Rydb.(*O. m.*), Ida., Ore., Utah.—**P. montanus** (Nutt.)Nels.(*O. m.*), Ida., Mont., Ore., Utah, Wyo.—**Taraxia ovata** (Nutt.)Small(*O. o.*) Calif.—**T. tanacetifolia** (T.&G.)Piper(*O. t.*), Nev. **Range:** Maine to Washington, southward to South Carolina and Arizona.

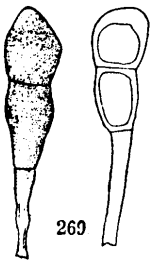
The correlation of this species with *Puccinia heteranthae* (*P. oenotherae heteranthae*) was recorded by Orton (Mycol. **4:** 203. 1912).

144. PUCCINIA JUSSIAEAE. Fig. 269.

(N. A. F. 7: 461, 798, 844.)

(*Aecidium jussiaeae* Speg., Anal. Soc. Ci. Argent. **9:** 174. 1880.)
Puccinia jussiaeae Speg., Anal. Soc. Ci. Argent. **12:** 68. 1881.
(*Aecidium ludwigiae* E. & E., Proc. Acad. Phila. **1893:** 155. 1893.)
Puccinia nesaeae E. & E., Bull. Torrey Club **22:** 363, excl. synonymy, 1895.
Allodus jussiaeae Arth. & Orton, N. Am. Flora **7:** 461. 1921.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 13–19 by 15–21 μ; wall nearly or quite colorless, 1–1.5 μ


269

thick, minutely verrucose. Uredia wanting. Telia chiefly hypophyllous, at first in and around the aecia, cinnamon-brown; teliospores oblong or cylindric, 15–21 by 35–58 μ, rounded or obtuse above, usually narrowed below, somewhat constricted at septum; wall cinnamon-brown, 1.5–2 μ thick at sides, 7–12 μ and slightly paler above, smooth; pedicel somewhat colored, about as long as spore.

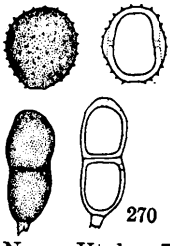
On Onagraceae: **Isnardia palustris** L.(*Ludwigia p.* Ell.), Fla., La., Ohio, Tex.—**I. repens** (Sw.)DC.(*L. natans* Ell.), Calif.—**Jussiaea decurrens** (Walt.)DC., Miss.—**Ludwigia alternifolia** L., Fla., Md.—**L. glandulosa** Walt., Md.—**L. hirtella** Raf., Miss.—**L. polycarpa** Short&Peter, Iowa, Mo., Wis.—**L. sphaerocarpa** Ell., Del., Fla.—**L. virgata** Michx., Fla. **Range:** Delaware to Iowa, southward to Florida and Louisiana; also in West Indies and South America.

145. PUCCINIA GLABELLA. Fig. 270.

(N. A. F. 7: 394.)

Puccinia glabella Holw., N. Am. Ured. **1:** 76. 1907.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid, slightly flattened laterally, 18–24 by 21–26 μ; wall cinnamon-brown, 2–3 μ thick, echinulate, the pores 2, equatorial, covered by swollen cuticle. Telia amphigenous, at first covered by gray epidermis, dark cinnamon-brown when naked; teliospores oblong, 14–19 by 24–34 μ, usually rounded above and below, slightly constricted at septum; wall cinnamon-brown, 1–2 μ thick at sides, paler and 2–3.5 μ above, smooth, the pore of upper cell apical, of lower cell at septum, or both somewhat depressed; pedicel colorless, short, fragile.


270

On Onagraceae: **Boisduvalia glabella** (Nutt.)Walp., Ore., Nev., Utah. **Range:** Semiarid region of northwestern Utah, southeastern Oregon and adjacent northern Nevada. Only three collections known.

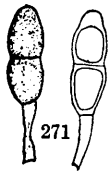
The species stands intermediate between *Puccinia oenotherae* and *P. vagans*. The pulverulent telia and small teliospores, inclined to be ellipsoid, with short pedicels, ally it with *P. vagans* while other characters, especially the smooth usually oblong teliospores, with the pore generally placed apically, favor *P. oenotherae*.

146. PUCCINIA CIRCAEA. Fig. 271.

(N. A. F. 7: 548, 803, 847.)

Puccinia circaeae Pers., Neues Mag. Bot. **1:** 119. 1794. Syn. Fung. 228. 1801. *Micropuccinia circaeae* A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, in groups, dark cinnamon-brown, cinereous by germination; teliospores oblong, 10–16 by 24–39 μ, obtuse above and below, slightly constricted at septum; wall golden-brown or much paler, 1–1.5 μ thick at sides, 3-9 μ above, smooth; pedicel colorless, about length of spore.


271

On Onagraceae: **Ciracaea alpina** L., Alas., Colo., Mich., Minn., Mont., N.H., N.Y., Pa., Vt., Wash., W.Va., Wis.; Newf.;

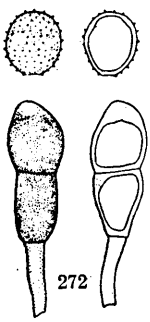
N.S., Ont., Sask.—**C. intermedia** Ehrh., Tenn.—**C. lutetiana** L., Conn., Ind., Iowa, Kans., Ky., Me., Md., Mass., Mich., Minn., Miss., Mo., Neb., N.J., N.Y., N.C., N.D., Ohio, Pa., Tenn., Va., W.Va., Wis.; N.S., Ont., Queb.—**C. pacifica** Asch.&Magn., Alas., Calif., Colo., Ida., Mont., Ore., Utah, Wash.; B.C. **Range:** Newfoundland to southern Alaska, southward to North Carolina and central California; also in Europe, Asia and Japan.

147. PUCCINIA PROSERPINACAE. Fig. 272.

(N. A. F. 7: 396, 790, 841.)

(*Aecidium proserpinacae* B. & C.; Berk., Grev. **3**: 60. 1874.)
Puccinia proserpinacae [B. & C.] Farl., Proc. Am. Acad. **18**: 80. 1883.
Dicaeoma proserpinacae Ktze., Rev. Gen. **3**^{3}: 470. 1898.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, cupulate; aeciospores globoid or ellipsoid, 15–19 by 18–23 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia hypophyllous, brownish, uredio-



272

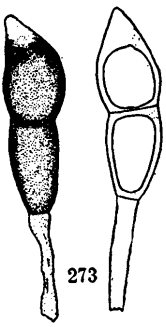
spores globoid or ellipsoid, 18–24 by 21–29 μ; wall cinnamon-brown, 1–2 μ thick, echinulate, the pores 2, equatorial or super-equatorial. Telia amphigenous, cinnamon-brown; teliospores oblong, 13–20 by 35–58 μ, rounded or obtuse above, rounded or narrowed below, considerably or slightly constricted at septum; wall cinnamon-brown, 1–1.5 μ thick at sides, 5–8 μ and paler above, smooth; pedicel colorless, length of spore or less.

On Haloragidaceae: **Proserpinaca palustris** L., Conn., Ill., Ind., Mass., N.Y., Wis.—**P. pectinata** Lam., Mass.—**P. platycarpa** Small, Fla. **Range:** Massachusetts to Wisconsin, southward to Florida.

148. PUCCINIA PORPHYROGENITA. Fig. 273.

(N. A. F. 7: 553, 804.)

Puccinia acuminata Peck, Ann. Rep. N. Y. State Mus. **23**: 57. 1873. Not *P. acuminata* Fckl., 1870.
Puccinia porphyrogenita Curt.; Thüm., Myc. Univ. *545*. 1876.
Micropuccinia porphyrogenita A. & J.; Arth., Bull. Torrey Club **48**: 41. 1921.



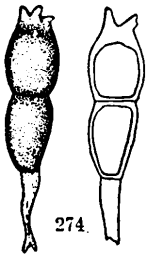
273

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, in groups, chocolate-brown; teliospores oblong or clavate-oblong, 16–23 by 45–64 μ acute or acuminate above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–3 μ thick at sides, 7–20 μ above, smooth; pedicel yellowish-brown, about as long as spore.

On Cornaceae: **Cornus canadensis** L. (*Chamaepericliminum c.* Asch.&Graebn.), Alas., Ida., Me., Minn., Mont., N.H., N.Y., Ore., Wash.; Newf.; B.C., N.S., Sask. **Range:** Newfoundland to southern Alaska, southward to northern New York and northern Oregon; also in Japan.

149. PUCCINIA VOLKARTIANA. Fig. 274.

Puccinia volkartiana Fisch., Ured. Schweiz 381. 1904.



274

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, in groups, pulvinate, blackish; teliospores oblong or clavate, 12–16 by 30–55 μ, rounded or usually with 2–5 digitate projections above, narrowed below, slightly constricted at septum; wall light chestnut-brown, 1.5–2 μ thick at sides, thickened 5–10 μ above; pedicel tinted, short.

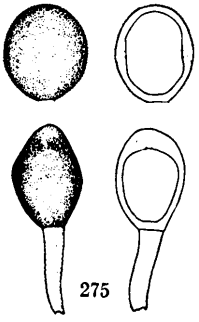
On Primulaceae: **Androsace chamaejasme** Host, Alas. **Range:** Known from one collection, central Alaska; also in Europe.

150. UROMYCES LIMONII. Fig. 275.

(N. A. F. 7: 263, 768.)

Puccinia limonii DC., Fl. Fr. **2:** 595. 1805.
Uredo statices Desmaz., Pl. Crypt. *128*. 1826.
Uromyces limonii (DC.) Lév., Dict. d'Hist. Nat., Art. Ured. 19. 1840.
Uromyces statices B. & C., Proc. Am. Acad. **4:** 126. 1858.
Nigredo limonii Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 18–23 by 20–28 μ; wall pale-yellow, 1–1.5 μ thick, minutely verrucose. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 23–27 by 27–34 μ; wall cinnamon-brown, 1.5–2.5 μ thick, closely and finely verrucose, the pores 2 or 3, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid or obovate, 19–24 by 27–35 μ; wall chestnut-brown, 1.5–2.5 μ thick at sides, 5–10 μ above; pedicel nearly or quite colorless, once to twice length of spore.



275

On Plumbaginaceae (*Armeriaceae*): **Limonium californicum** (Boiss.)Small, Calif.—**L. carolinianum** (Walt.) Britt., Me., Mass., Miss., N.J., N.Y.; N.B.; N.S.—**L. limbatum** Small, N.M., Tex. **Range:** Alkaline areas in border states from Nova Scotia to New Mexico, and along the coast of California; also in Europe, northern Africa and Siberia.

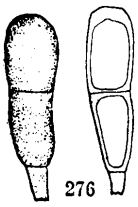
(1). **Uromyces limonii armeriae** (Schl.) n. comb. (*Caeoma armeriae* Schl., *Uromyces a.* Lév., *Nigredo a.* Arth.), with pycnia, aecia, uredia and telia as in *Uromyces limonii*, except urediospore-wall 2.5–3 μ thick, and teliospores broader, with short, fragile pedicels; occurs on Plumbaginaceae (*Armeriaceae*): **Armeria vulgaris** Willd.(*Statice armeria* L.), along the coast of California; also in Europe. (N. A. F. 7: 768.)

151. PUCCINIA HALENIAE. Fig. 276.

(N. A. F. 7: 554, 804.)

Puccinia haleniae A. & H.; Arth., Bull. Geol. Nat. Hist. Surv. Minn. **3:** 30. 1887.
Micropuccinia haleniae A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly epiphyllous, long covered by epidermis, chocolate-brown when naked, shining, with abundant subepidermal paraphyses; teliospores cylindric, 8–16 by 32–58 μ, truncate or obtuse above, rounded or narrowed below, not constricted


276

at septum; wall dark cinnamon-brown, pale below, 1–1.5 μ thick at sides, 2.5–4 μ above, smooth; pedicel colored, short, persistent.

On Gentianaceae: **Gentiana calycosa** Griseb.(*Dasystephana c.* Rydb.), Wyo.—**Halenia deflexa** (J.E.Sm.) Griseb., Mich., Minn., Wis. **Range:** Northern Michigan to western Wyoming; also in Japan.

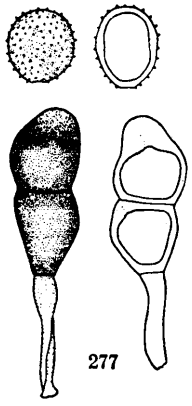
*. **Puccinia dichondrae** Mont. (*Micropuccinia d.* A. & J.), with pycnia unknown; aecia (only known in South America and New Zealand) chiefly hypophyllous, cupulate, aeciospores globoid, 20–24 by 22–26 μ, wall colorless, 3 μ thick, coarsely verrucose; uredia wanting; telia hypophyllous, chestnut-brown, teliospores oblong or clavate-oblong, 14–20 by 28–45 μ, rounded or obtuse above, rounded or narrowed below, somewhat constricted at septum, the wall cinnamon-brown, 1.5–2 μ thick at sides, 4–7 μ and paler above, smooth, with colorless pedicel, once length of spore; occurs on Convolvulaceae: **Dichondra caroliniensis** Michx., along coastal areas of North Carolina, Mississippi, Louisiana, Texas and **D. repens** Forst., in southern California; also in Bermuda, West Indies, Central and South America, New Zealand and Australia. (N. A. F. **7:** 556, 804, 847.)

152. PUCCINIA LITHOSPERMI. Fig. 277.

(N. A. F. 7: 402, 791, 842.)

Puccinia lithospermi E. & K., Jour. Myc. **1:** 2. 1885.
Dicaeoma lithospermi Ktze., Rev. Gen. **3³:** 469. 1898.
Puccinia enecta Speg., Anal. Mus. Nac. Buenos Aires III. **1:** 62. 1902.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 13–16 by 16–21 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia amphigenous, dark-brown; urediospores globoid or obovoid, 18–21 by 21–26 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores usually 2, rarely 3, equatorial. Telia amphigenous, blackish-brown; teliospores oblong, 18–23 by 42–56 μ, rounded or obtuse above and rounded or narrowed below, considerably constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 7–15 μ above, smooth; pedicel colored next to spore, colorless below, as long as spore or longer, persistent.


277

On Convolvulaceae: **Evolvulus nuttallianus** R.&S.(*E. pilosus* Nutt., *E. argenteus* Pursh), Colo., Kans., Neb., Tex.—**E. sericeus** Sw., Tex. **Range:** Nebraska and Colorado, southward to Texas; also in West Indies, Mexico, South America, southwest Africa and Japan.

The type collection of *Puccinia enecta* has not been seen by the writer, but the explicit description given by Spegazzini of the telial form leaves no doubt of the identity of his material. The assumption in the N. Am. Flora **7:** 791, that *Puccinia tuyutensis* is identical with the North American species, was an error.

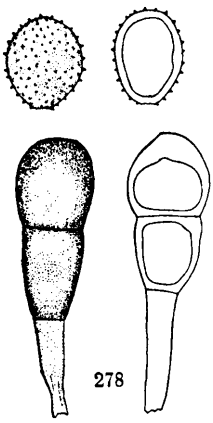
A successful culture was made in 1910 by Arthur (Mycol. **4:** 28. 1912) at Lafayette, Ind., with teliospores on *Evolvulus pilosus*, received from Texas, sown on the same species of host, and obtaining both pycnia and aecia.

153. PUCCINIA CONVOLVULI. Fig. 278.

(N. A. F. 7: 401, 791, 842.)

Uredo betae convolvuli Pers., Syn. Fung. 221. 1801.
Puccinia convolvuli (Pers.) Cast., Obs. **1:** 16. 1842.
Dicaeoma convolvuli Ktze., Rev. Gen. **3³:** 468. 1898.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 15–20 by 18–25 μ; wall nearly or quite color-


278

less, 1–1.5 μ thick, minutely verrucose. Uredia amphigenous, cinnamon-brown; urediospores broadly ellipsoid or obovoid, 18–26 by 23–33 μ; wall cinnamon-brown, 2–2.5 μ thick, echinulate, the pores 3, nearly or quite equatorial. Telia chiefly amphigenous, blackish-brown; teliospores oblong or obovate-oblong, 23–31 by 42–55 μ, rounded or obtuse above, obtuse or narrowed below, somewhat constricted at septum; wall chestnut-brown, 2–3 μ thick at sides, 5–13 μ above, smooth; pedicel cinnamon-brown, nearly as long as spore, persistent.

On Convolvulaceae: **Convolvulus arvensis** L., Ind., Mass.—**C. atriplicifolius** (Hallier f.)House, Ore.—**C. californicus** Choisy, Calif.—**C. interior** House(*C. repens* Auth., not L.), Neb., N.J., Tenn.—**C. malacophyllus** Greene(*C. villosus* Gray, not Pers.), Calif.—**C. occidentalis** Gray, Calif.—**C. polymorphus** Greene, Calif., Ore.—**C. purpuratus** Greene(*C. luteolus* Gray, not Spreng.), Calif.—**C. sepium** L., Ala., Conn., Del., D.C., Ill., Ind., Iowa, Kans., Md., Mass., Mich., Minn., Miss., Mo., Mont., Neb., N.J., N.Y., N.D., Ohio, Pa., Tenn., Vt., Va., W.Va., Wis.; Queb.—**C. soldanella** L., Calif. **Range:** Massachusetts to Oregon, southward to Alabama and southern California; also in South America, Europe, Japan and northern Africa.

*. **Puccinia crassipes** B. & C. (*Allodus c.* Arth.), with pycnia not seen; aecia in groups, cupulate, aeciospores globoid, 16–22 by 19–26 μ, the wall 1–1.5 μ thick, finely verrucose; uredia wanting; telia amphigenous, usually grouped about the aecia, chocolate-brown, teliospores ellipsoid, 24–32 by 39–61 μ, usually rounded at both ends, not or only slightly constricted at septum, the wall dark chestnut-brown, 3–4 μ thick at sides, 6–9 μ and lighter above, strongly verrucose, with pedicel colored next to spore and once and a half length of spore; occurs in coastal areas on Convolvulaceae: **Ipomoea trichocarpa** Ell.(*I. carolina* Pursh, not L.), Georgia, Florida, Louisiana, South Carolina, Texas.—**I. trifida** (H.B.K.)G.Don, Texas.—**I. triloba** L., Florida; also in Mexico, Central and South America, and West Indies. (N.A.F. **7**: 466, 798, 844.)

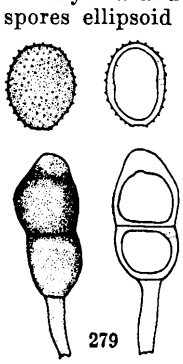
This is one of the few species in the eupuccinia section having prominently verrucose teliospores.

154. PUCCINIA GILIAE. Fig. 279.

(N. A. F. 7: 403, 791.)

Pucciana giliae Hark., Bull. Calif. Acad. **1**: 34. 1884.
Dicaeoma giliae Ktze., Rev. Gen. **3**[3]: 469. 1898.

Pycnia and aecia unknown. Uredia amphigenous, chestnut-brown; urediospores ellipsoid or obovoid, 16–23 by 21–26 μ; wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, cinnamon- or chestnut-brown; teliospores oblong or obovate-oblong, 18–23 by 35–58 μ, rounded or obtuse above, rounded or narrowed below, sightly constricted at septum, upper cell darker; wall cinnamon-brown, 1.5–2.5 μ thick at sides, 7–10 μ and paler above, smooth; pedicel more or less colored, length of spore or more.


279

On Polemoniaceae: **Collomia grandiflora** (Gray)Dougl. (*Gilia g.*), Calif., Wash.—**Gilia calcaria** Jones (*G. pinnatifida* Nutt.), Colo.—**G. capitata** Hook., Calif., Ore.—**G. filifolia** Nutt., Ariz.—**G. gilioides** (Benth.)Greene(*Collomia g.*), Calif.—**Linanthus bigelovii** (Gray)Greene(*Gilia b.*), Ariz.—

L. ciliatus (Benth.)Greene(*Gilia c.*), Calif.—**Navarrettia atractyloides** H.&A., Calif.—**N. intertexta** (Benth.)Hook., Ore. **Range:** Washington to eastern Colorado, southward to Arizona and southern California.

Puccinia douglasii.

(N. A. F. 7: 469, 799, 844.)

Puccinia douglasii E. & E., Proc. Am. Acad. Sci. Phila. **1893:** 152. 1893.
Puccinia richardsoni Syd., Monog. Ured. **1:** 317. 1902.
Allodus douglasii Orton, Mem. N. Y. Bot. Garden **6:** 198. 1916.

Pycnia amphigenous, scattered among the aecia. Aecia hypophyllous, systemic, short, cupulate; aeciospores globoid, 13–19 by 18–21 μ; wall colorless, about 1 μ thick, minutely verrucose. Uredia wanting. Telia and teliospores as in *Puccinia giliae.*

On Polemoniaceae: **Phlox alyssifolia** Greene, Mont.—**P. canescens** T. &G., Utah.—**P. depressa** (Nels.)Rydb., Colo., Utah.—**P. diapensioides** Rydb., Mont.—**P. diffusa** Benth., Ore., Utah, Wash.—**P. glabrata** (E.Nels.)Brand, Wyo.—**P. hoodii** Richards., Mont.; Alta., Sask.—**P. nana** Nutt., N.M.—**P. rigida** Benth., Utah, Wash.—**P. scleranthifolia** Rydb., Neb.—**P. subulata** L., N.J., Pa. **Range:** Wisconsin to Alberta and Washington, southward to New Mexico, and two localities not far apart in New Jersey and Pennsylvania.

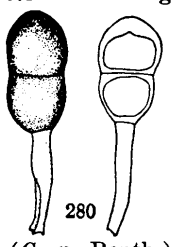
The host of the type collection for *Puccinia douglasii*, stated to be *Phlox douglasii* is now considered to be *P. diffusa*, and that of *P. richardsoni* is changed from *Phlox richardsoni* to *P. diapensioides*, while *Phlox amoena* (*P. procumbens*) credited to Pennsylvania has been found to be the cultivated *P. subulata.*

155. PUCCINIA YOSEMITANA. Fig. 280.

(N. A. F. 7: 470, 799.)

Puccinia yosemitana Blasd., Univ. Calif. Publ. Bot. **7:** 150. 1919.
Allodus yosemitana Arth. & Orton, N. Am. Flora **7:** 470. 1921.

Pycnia unknown. Aecia hypophyllous, systemic, loosely scattered, cylindric, 0.8–1 mm. long; aeciospores globoid or ellipsoid, 16–19 by 16–23 μ; wall colorless, 1 μ or less thick, finely verrucose. Uredia wanting. Telia hypophyllous, blackish; teliospores ellipsoid or oblong, 21–26 by 32–39 μ, rounded at both ends or narrowed below, slightly or not constricted at septum; wall chestnut-brown, 1 μ thick at sides, 3–6 μ above; pedicel nearly or quite colorless, about as long as spore.


280

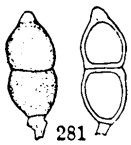
On Polemoniaceae: **Leptodactylon hookeri** (Dougl.) Nutt.(*Gilia pungens h.* Gray), Calif.—**L. pungens** (Torr.)Nutt. (*G. p.* Benth.), Colo. **Range:** Limited areas in southern Colorado and east-central California.

156. PUCCINIA POLEMONII. Fig. 281.

(N. A. F. 7: 556, 804.)

Puccinia polemonii D. & H.; Diet., Bot. Gaz. **18:** 255. 1893.
Micropuccinia polemonii A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, cinnamon-brown, pulvinate and cinereous by germination, or



281

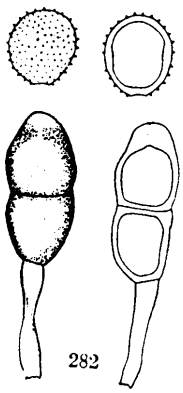
pulverulent and darker; teliospores oblong, 13–18 by 26–42 μ, obtuse or narrowed above and below, much constricted at septum; wall cinnamon-brown or almost colorless, 1–1.5 μ thick at sides, 4–6 μ above, smooth; pedicel colorless, as long as spore or less, fragile.

On Polemoniaceae: **Polemonium intermedium** (Brand) Rydb., Ida.—**P. occidentale** Greene, Calif.—**P. reptans** L., Ind. **Range:** One collection each from northern Idaho, central California and southern Indiana; also in northern Norway and Finland, and in northeastern Asia and Japan.

157. PUCCINIA CRYPTANTHES. Fig. 282.

(N. A. F. 7: 404, 791.)

Puccinia cryptanthes D. & H.; Diet., Erythea **1:** 249. 1893.
Dicaeoma cryptanthes Arth., N. Am. Flora **7:** 404. 1920.



282

Pycnia and aecia unknown. Uredia caulicolous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 19–26 by 23–29 μ; wall golden-brown, 2–2.5 μ thick, echinulate, the pores 2, nearly equatorial. Telia caulicolous and hypophyllous, blackish-brown; teliospores oblong or ellispoid, 16–29 by 32–58 μ, rounded at both ends or narrowed below, slightly constricted at septum; wall chestnut-brown, 1–2 μ thick at sides, 5–10 μ above, smooth; pedicel colorless, as long as spore.

On Boraginaceae: **Cryptantha ambigua** (Gray)Greene (*Krynitzkia a.*), Calif.—**C. flaccida** (Dougl.)Greene(*K. oxycarya* Gray), Calif.—**C. microstachys** Greene(*K. m.* Greene), Calif.—**C. torreyana** (Gray)Greene(*K. t.*), Calif., Wash. **Range:** Southern Washington to central California.

*. **Puccinia urbaniana** P. Henn. (*Micropuccinia u.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia chiefly hypophyllous, blackish-brown, cinereous by germination, teliospores ellipsoid or obovoid-ellipsoid, 14–22 by 28–45 μ, rounded above, narrowed below, slightly constricted at septum, the wall cinnamon-brown, 1–2 μ thick at sides, 4–7 μ above, smooth, with colored pedicel, once length of spore or less, fragile; mesospores common; occurs on Verbenaceae: **Stachytarpheta jamaicensis** Vahl(*S. dichotoma* Vahl, *Valerianodes j.* Ktze.), in southern Florida; also in Bahamas, West Indies, Central and South America. (N. A. F. **7:** 558, 804, 847.)

*. **Puccinia lantanae** Farl. (*Micropuccinia l.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia chiefly hypophyllous, blackish, cinereous by germination, teliospores ellipsoid, 15–20 by 24–40 μ, rounded at both ends, or narrowed below, slightly constricted at septum, the wall chestnut-brown, 1.5–2.5 μ thick at sides, 3–5 μ above, smooth, with nearly or quite colorless pedicel, once to twice length of spore, mesospores usually predominating; occurs on Verbenaceae: **Goniostachyum citrosum** Small, and **Lantana involucrata** L.(*L. odorata* L.), in southern Florida; also in Bermuda, West Indies, Mexico, Central and South America. (N. A. F. **7:** 559, 804, 847.)

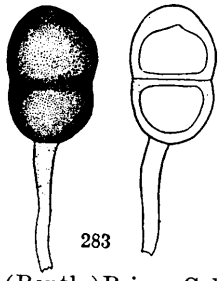
*. **Puccinia hyptidis** (Curt.) Tr. & Earle (*Uredo h., Dicaeoma h.* Arth.), with pycnia amphigenous, in groups; aecia amphigenous, without peridium, aeciospores globoid, 26–32 by 29–33 μ, the wall colorless, 2.5–3 μ thick, coarsely verrucose; uredia hypophyllous, cinnamon-brown, urediospores globoid, 22–27 μ in diameter, the wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 2, equatorial; telia hypophyllous, pale cinnamon-brown, cinereous by germination, teliospores fusiform or lance-oblong, 15–19 by 45–70 μ, obtuse or narrowed at both ends, somewhat constricted at septum, the wall nearly or quite colorless, uniformly 1 μ thick, with colorless pedicel, one half to once length of spore; occurs on Lamiaceae (*Labiatae*): **Hyptis radiata** Willd., in southern South Carolina, Florida and Mississippi; also in West Indies. (N. A. F. **7:** 408, 842.)

158. PUCCINIA MELLIFERA. Fig. 283.

(N. A. F. 7: 470, 799.)

Puccinia mellifera D. & H.; Diet., Erythea **1:** 25. 1893.
Allodus mellifera Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia not seen. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 19–23 by 22–32 μ; wall light cinnamon-brown when mature, 3–4 μ thick, often appearing thicker, minutely verrucose, with visible pores. Uredia wanting. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 25–31 by 40–48 μ, rounded above and below, slightly constricted at septum; wall dark chestnut-brown, 3–5 μ thick at sides, 7–9 μ above, smooth; pedicel colorless, about twice length of spore, delicate. Mesospores common.


283

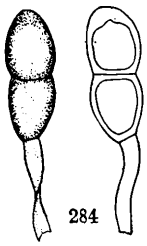
On Lamiaceae (*Labiatae*): **Audibertiella humilis** (Benth.)Briq.(*Audibertia h., Salvia sonomensis* Greene), Calif.—**A. incana** (Benth.)Briq., Nev.—**A. grandiflora** (Benth.)Briq., Calif.—**A. nivea** (Benth.)Briq., Calif.—**A. palmeri** (Gray) Briq., Calif.—**A. polystachya** (Benth.)Briq., Calif.—**A. stachyoides** (Benth.) Briq.(*Salvia mellifera* Greene, *Ramona s.* Briq.), Calif. **Range:** Southern California and Nevada.

159. PUCCINIA HYSSOPI. Fig. 284.

(N. A. F. 7: 561.)

Puccinia hyssopi Schw., Trans. Am. Phil. Soc. II. **4:** 296. 1832.
Micropuccinia hyssopi A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, chestnut-brown; teliospores oblong, 13–21 by 34–50 μ, obtuse above, often narrowed below, slightly constricted at septum; wall light chestnut-brown, 1.5–2 μ thick at sides, 6–12 μ above, smooth; pedicel colored, about length of spore.


284

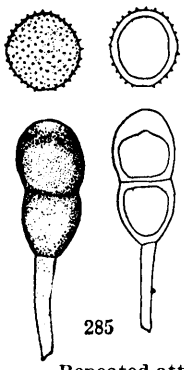
On Lamiaceae (*Labiatae*): **Lophanthus nepetoides** (L.) Benth.(*Agastache n.* Ktze., *Hyssopus n.*), Ill., Ind., Iowa, N.Y., Ohio.—**L. scrophulariaefolia** (Willd.)Benth.(*A. s.* Ktze.), Minn., Pa., W.Va. **Range:** New York to eastern Minnesota, southward to West Virginia and Illinois.

160. PUCCINIA ANTIRRHINI. Fig. 285.

(N. A. F. 7: 594, 809, 848.)

Puccinia antirrhini D. & H.; Diet., Hedw. **36:** 298. 1897.
Puccinia adenostegiae Arth., Bull. Torrey Club **29:** 231. 1902.
Puccinia cordylanthi Blasd., Univ. Calif. Publ. Bot. **7:** 134. 1918.

Pycnia and aecia unknown. Uredia chiefly hypophyllous, light chestnut-brown; urediospores globoid or obovoid, 16–24 by 21–30 μ; wall light chestnut-brown, 1.5–2.5 μ thick, echinulate, the pores 2, sometimes 3, equatorial. Telia chiefly hypophyllous, blackish-brown; teliospores oblong or ellipsoid, 18–29 by 30–55 μ, obtuse or rounded above, rounded or narrowed below, somewhat constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, 7–10 μ above, smooth; pedicel nearly or quite colorless, once length of spore or less.



285

ON SCROPHULARIACEAE: **Antirrhinum majus** L., Calif., Colo., Conn., Fla., Ill., Ind., Iowa, Kans., Me., Mass., Mich., Mo., Neb., N.J., N.Y., Ohio, Ore., Pa., S.D., Tex., Utah, Wash., Wis., Wyo.; Alta., B.C., Man., Ont., Sask.—**A. nuttallianum** Benth., Calif.—**A. virga** Gray, Calif.—**Cordylanthus filifolius** Nutt.(*Adenostegia f.* Abrams), Calif.—**C. pilosus** Gray(*A. p.* Greene), Calif.—**C. rigidus** (Benth.)Jepson (*A. r.*), Calif. **Range:** California on native plants, and throughout southern Canada and the United States where *A. majus* is cultivated in the open or under glass; also in Bermuda.

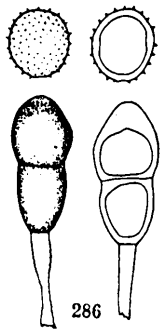
Repeated attempts have been made by Mains (Phytop. **14:** 284. 1924) and Hockey (Ann. Rep. Quebec Soc. Protect. Pl. **13:** 54. 1921) to infect *Antirrhinum* plants by using teliospores, always with negative results. The species is considered to be heteroecious, but without suggestion as to the alternate host.

161. PUCCINIA COLLINSIAE. Fig. 286.

(N. A. F. 7: 594, 637.)

(*Aecidium collinsiae* E. & E., Bull. Washb. Lab. Nat. Hist. **1:** 4. 1884.)
Puccinia collinsiae [E. & E.] P. Henn., Hedw. **37:** 269. 1898.

Pycnia hypophyllous, scattered. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 14–18 by 16–20 μ; wall colorless, 1 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid, 16–23 by 21–26 μ; wall cinnamon-brown, 2–2.5 μ thick, echinulate, the pores 2, sometimes 3, equatorial. Telia amphigenous, dark chestnut-brown; teliospores oblong or obovate-ellipsoid, 19–23 by 31–42 μ, rounded at both ends or narrowed below, slightly constricted at septum; wall chestnut-brown, 2–2.5 μ thick at sides, 7–10 μ above, smooth; pedicel colorless, about length of spore.



286

ON SCROPHULARIACEAE: **Collinsia bicolor** Benth., Calif.—**C. parviflora** Dougl., Ore., Wash.—**C. rattani** Gray, Wash.—**C.** sp., Calif.—**Tonella collinsioides** Nutt.(*T. tenella* Benth.), Wash. **Range:** Southern Washington to central California.

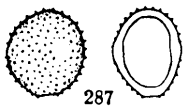
It has not been positively shown that the single collection from Potter Valley, California, described by Hennings, is the same as the more northern collections passing under the name of *Aecidium collinsiae.*

162. PUCCINIA CASTILLEJAE. Fig. 287.

(N. A. F. 7: 595.)

Uredo castillejae D. & H.; Diet., Erythea **1:** 247. 1893.
Puccinia castillejae (D. & H.) Arth.; Blasd., Univ. Calif. Publ. Bot. **7:** 133. 1919.

Pycnia and aecia unknown. Uredia amphigenous, light cinnamon-brown; urediospores globoid or ellipsoid, 16–24 by 20–29 μ; wall golden-brown, 2–3 μ thick, the pores 2 or 3, equatorial. Telia not seen; teliospores in uredia ellipsoid, 18–23 by 23–29 μ, rounded at both ends, slightly or not constricted at septum; wall dark golden-brown, 2–3 μ thick at sides, 5–7 μ above, smooth; pedicel colorless, short, fragile.



287

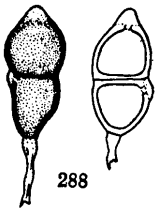
On Scrophulariaceae: **Castilleja exilis** Nels.(*C. e.minor* Gray), Utah.—**C. foliolosa** H.&A., Calif.—**C. stenantha** Gray, Calif. **Range:** Southern Utah to central and southern California.

163. PUCCINIA VERONICARUM. Fig. 288.

(N. A. F. 7: 566.)

Puccinia veronicarum DC., Fl. Fr. **2:** 594. 1805.
Micropuccinia veronicarum A. & J., N. Am. Flora **7:** 566. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, pulverulent, chestnut-brown in resting form, pulvinate and cinnamon-brown becoming cinereous in germinating form; teliospores oblong or ellipsoid, 16–19 by 32–45 μ, rounded or narrowed at both ends, slightly constricted at septum; wall light chestnut-brown, 2–3 μ thick in resting form, cinnamon-brown or paler, 1.5–2 μ thick in germinating form, paler and thickened 5–9 μ above, smooth; pedicel short, fragile in resting form or long, persistent in germinating form.


288

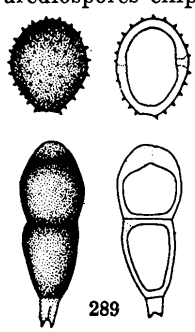
On Scrophulariaceae: **Veronica virginica** L.(*Leptandra v.* Nutt.), Iowa, Wis. **Range:** Southern Wisconsin to central Iowa; also in Europe, Siberia and Japan.

164. PUCCINIA PACIFICA. Fig. 289.

(N. A. F. 7: 596.)

Puccinia pacifica Blasd.; Arth., Bull. Torrey Club **48:** 31. 1921.

Pycnia and aecia unknown. Uredia amphigenous, dark chestnut-brown; urediospores ellipsoid or obovate, 22–26 by 26–32 μ; wall chestnut-brown, 2–3 μ thick, echinulate, the pores 2, equatorial. Telia like the uredia, but somewhat darker; teliospores oblong or obovate-oblong, 20–24 by 38–48 μ, rounded or obtuse at both ends or narrowed below, slightly constricted at septum; wall chestnut-brown, 1–1.5 μ thick at sides, 3–7 μ above, smooth; pedicel colorless, once or twice length of spore when unbroken, fragile.


289

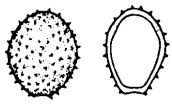
On Plantaginaceae: **Plantago decipiens** Barn.(*P. maritima* Auth., not L.), Calif. **Range:** San Mateo County, west-central California.

165. PUCCINIA PUNCTATA. Fig. 290.

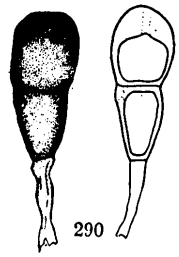
(N. A. F. 7: 417, 418, 792, 842.)

Puccinia punctata Link, Ges. Nat. Freunde Berlin Mag. **7:** 30. 1815.
Puccinia galii Schw., Schr. Nat. Ges. Leipzig **1:** 73. 1822.
(*Aecidium friesii* Bubák, Sitz-ber. Böhm. Ges. Wiss. **1898**[28]**:** 16. 1898.)
Dicaeoma punctatum Arth., Proc. Ind. Acad. Sci. **1903:** 150. 1904.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 14–21 by 19–24 μ; wall colorless, about 1 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or obovoid, 16–23 by 23–30 μ; wall light cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, superequatorial. Telia chiefly epiphyllous, chocolate-



brown; teliospores oblong or clavate-oblong, 16–26 by 37–56 μ, rounded or obtuse above, narrowed below, somewhat constricted at septum; wall chestnut-brown, 1–2 μ thick at sides, 7–15 μ above, smooth; pedicel nearly or quite colorless, once length of spore or less, fragile.



290

On Rubiaceae: **Galium aparine** L., Ore., Wash.—**G. asperrimum** Gray, Ariz., N.M., Ore., Wash.—**G. asprellum** Michx., Conn., Ill., Iowa, Minn., N.Y., Wis.; N.S., Ont.—**G. buxifolium** Greene, Calif.—**G. californicum** H.&A., Calif.—**G. concinnum** T.&G., Ill., Ind., Iowa, Mich., Miss., Mo., Wis.—**G. pilosum** Ait.(*G. purpureum* Walt.), N.C.—**G. tinctorium** L., Ind., Wis.—**G. trifidum** L., Wis.—**G. triflorum** Michx., Calif., Ida., Mont., N.D., Ore., Utah, Wash. **Range:** Nova Scotia to North Dakota, southward to North Carolina and southern Mississippi, and from western Montana to Washington, southward to California and New Mexico; also in Mexico, Central and South America, Europe, Asia, Japan, South Africa, Australia and New Zealand.

(1). **Puccinia punctata troglodytes** (Lindr.) n. comb. (*P. troglodytes* Lindr., *Dicaeoma t.* Jacks.), with pycnia and aecia unknown; uredia and urediospores as in *Puccinia punctata*, except the pores equatorial; telia and teliospores as in *P. punctata*, except teliospores smaller, 14–19 by 27–40 μ, the wall 1–1.5 μ thick at sides, 6–12 μ above; occurs on Rubiaceae: **Galium triflorum** Michx., Conn., Ind., Iowa, Mo., N.H., N.Y., Pa., S.D., Wash., W.Va., Wis. **Range:** New Hampshire to South Dakota, southward to West Virginia and Iowa, and in western Washington. (N. A. F. **7:** 418, 792, 842.)

Puccinia difformis.

(N. A. F. **7:** 473, 800.)

(*Aecidium galii ambiguum* A. & S., Consp. Fung. 116. 1805.)
Puccinia difformis Kunze, Myk. Hefte **1:** 71. 1817.
Puccinia ambigua Lagerh.; Bubák, Sits.-ber. Böhm. Ges. Wiss. **1898**[28]**:** 14. 1898.
Allodus ambigua Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia and aecia as in *Puccinia punctata.* Uredia wanting. Telia hypophyllous, often closely associated with the aecia, long covered by epidermis, when naked blackish-brown, becoming cinereous by germination; teliospores slightly smaller but otherwise like *P. punctata.*

On Rubiaceae: **Galium aparine** L., Calif., Ind., Iowa, Kans., Mont., N.D., Ohio, Ore., S.D., Tenn., Wash.; B.C. **Range:** Ohio to North Dakota, southward to Tennessee and Kansas, and from British Columbia southward to northern California; also in South America and Europe.

The aecia of this species are capable of producing secondary aecia, *i. e.*, aecidioid uredia, which are unaccompanied by pycnia, as shown by Bubák (Sitz.-ber. Böhm. Ges. Wiss. **1898**[28]**:** 1–23. 1898) and confirmed by Treboux (Ann. Myc. **10:** 305. 1912).

Puccinia rubefaciens.

(N. A. F. **7:** 568, 805.)

Puccinia rubefaciens Johans., Bot. Notiser **1886:** 174. 1886.
Micropuccinia rubefaciens A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia and teliospores as in *Puccinia punctata* except telia hypophyllous.

On Rubiaceae: **Galium bloomeri** Gray, Calif.—**G. boreale** L., Alas., Colo., Ida., Iowa, Mont., N.D., Ore., S.D., Utah, Wash., Wis.; Alta.—**G. californicum** H.&A., Calif. **Range:** Southern Wisconsin to northwestern Alaska, southward to Colorado and central California; also in Europe and northern and eastern Asia.

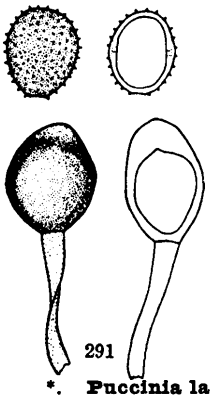
The correlation of this and the preceding species with *P. punctata* was recorded in the N. Am. Flora **7:** 568. 1922.

166. UROMYCES SPERMACOCES. Fig. 291.

(N. A. F. 7: 266, 769, 814, 832.)

Puccinia spermacoces Schw., Schr. Nat. Ges. Leipzig **1:** 74. 1822.
Uromyces spermacoces (Schw.) Curt., Cat. Pl. N. Car. 123. 1867.
Nigredo spermacoces Arth., N. Am. Flora **7:** 266. 1912.

Pycnia epiphyllous, few. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 21–26 by 21–28 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia chiefly epiphyllous, cinnamon-brown; urediospores ellipsoid, 18–24 by 26–32 μ; wall golden-brown, 1–2 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, blackish; teliospores globoid or ellipsoid, 19–27 by 29–37 μ; wall chestnut-brown, 2–3 μ thick at sides, 6–10 μ above, smooth; pedicel light-yellow, about twice length of spore.



291

On Rubiaceae: **Diodia teres** Walt. (*Spermacoce diodina* Michx.), Ala., Ark., Del., D.C., Fla., Ga., Ill., Ind., Kans., Md., Miss., Mo., N.J., N.C., S.C., Okla., Tenn., Tex., W.Va. **Range:** New Jersey to Kansas, southward to Florida and Texas.

*. **Puccinia lateritia** B. & C. (*P. spermacoces* B. & C., *P. houstoniae* Syd., *Micropuccinia l.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia chiefly hypophyllous, chestnut-brown, becoming cinereous by germination, teliospores ellipsoid, 16–23 by 26–40 μ, rounded or obtuse above and below, not constricted at septum, the wall chestnut-brown, 2.5–4 μ thick at sides, little or no thicker above, smooth, with nearly or quite colorless pedicel, about length of spore; occurs on Rubiaceae: **Borreria terminalis** Small, Fla.—**Diodia rigida** C.&S. (*Diodella r.* C.&S.), Fla.—**Ernodia angusta** Small, Fla.—**E. littoralis** Sw., Fla.—**Houstonia angustifolia** Michx., Texas.—**Spermacoce glabra** Michx., Ala., Ill., La.; ranging from southernmost Illinois to Florida and Texas; also in Bahamas, West Indies, Mexico, Central and South America and Formosa. (N. A. F. **7:** 568, 805, 847.)

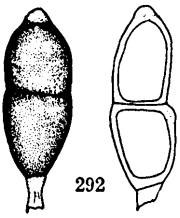
The characters of this species so nearly parallel those of *Uromyces spermacoces* as to constitute correlation. If this is accepted as a case of correlation, one is driven to assume that a corresponding long cycle form of *Puccinia* exists or has become extinct.

167. PUCCINIA COMMUTATA. Fig. 292.

(N. A. F. 7: 473, 800.)

Puccinia commutata Syd., Monog. Ured. **1:** 201. 1902.
Allodus commutata Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia chiefly epiphyllous, in groups surrounded by aecia. Aecia chiefly hypophyllous, cupulate; aeciospores globoid, 12–18 by 15–21 μ; wall colorless,


292

1–1.5 μ thick, minutely verrucose. Uredia wanting. Telia amphigenous, arising about the aecia or separately, chocolate-brown; teliospores oblong, 20–26 by 39–60 μ, rounded or obtuse at both ends, slightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, somewhat thicker above, with a hyaline papilla over the pores, smooth; pedicel nearly or quite colorless, short.

On Valerianaceae: **Valeriana septentrionalis** Rydb., Alta.—**V. sitchensis** Bong., Ore.; B.C.—**V. uliginosa** Rydb., N.Y. **Range:** Southern British Columbia, northeastern Oregon and northern New York, one locality each; also in Europe.

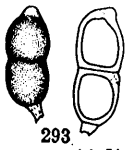
Collections from Colorado, Utah and New Mexico, bearing aecia only, are placed under *Puccinia extensicola valerianae* (see page 200).

168. PUCCINIA CAMPANULAE. Fig. 293.

(N. A. F. 7: 571, 805.)

Puccinia campanulae Carm.; Berk., in Smith, Engl. Fl. 5²: 356. 1836.
Micropuccinia campanulae A. & J., N. Am. Flora **7**: 571. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, cinnamon-brown; teliospores ellipsoid or oblong, 14–18 by 26–38 μ, rounded or obtuse at both ends, slightly constricted at septum; wall golden-brown, 1.5–2.5 μ thick at sides, somewhat thicker above, with a hyaline papilla over the pore, minutely rugose, appearing smooth; pedicel colorless, short, fragile.


293

On Campanulaceae: **Campanula intercedens** Witasek(*C. rotundifolia* Am.auth., not L.), N.Y.—**C. petiolata** A.DC.(*C. rotundifolia* Am. auth.), Mont.—**C. scouleri** Hook., Ore. **Range:** Only three localities known, one each in New York, Montana and Oregon; also in Europe.

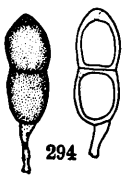
(1). **Puccinia campanulae novae-zembliae** (Jørstad) n. comb. (*P. n.-z.* Jørstad, *Micropuccinia n.-z.* Arth.), with pycnia, aecia and uredia wanting; telia as in *Puccinia campanulae,* but darker, teliospores more usually ellipsoid, 14–22 by 25–33 μ, otherwise as in *P. campanulae;* occurs on Campanulaceae: **Campanula uniflora** L., east coast of Greenland; also in northern Norway. (N. A. F. 7: 805.)

169. PUCCINIA LOBELIAE. Fig. 294.

(N. A. F. 7: 571, 805.)

Puccinia microsperma B. & C.; Curt., Cat. Pl. N. Car. 121, hyponym. 1867.
Puccinia lobeliae Ger.; Peck, Bull. Buffalo Soc. Nat. Sci. **1**: 66. 1873.
Micropuccinia lobeliae A. & J.; Arth., Bull. Torrey Club **48**: 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, small, chestnut-brown, cinereous by germination; teliospores oblong, 14–18 by 30–44 μ, obtuse at both ends, somewhat constricted at septum; wall golden-brown, 1–1.5 μ thick at sides, 3–7 μ above, smooth; pedicel colorless, short, fragile.


294

On Lobeliaceae: **Lobelia kalmii** L., N.Y.—**L. puberula** Michx., Ala., N.C., S.C.—**L. syphilitica** L., Ark., Conn., Del., Ill., Ind., Iowa, Ky., Mo., Neb., N.Y., Pa., W.Va., Wis.; Ont. **Range:**

New York to Nebraska, southward to South Carolina and northwestern Nebraska.

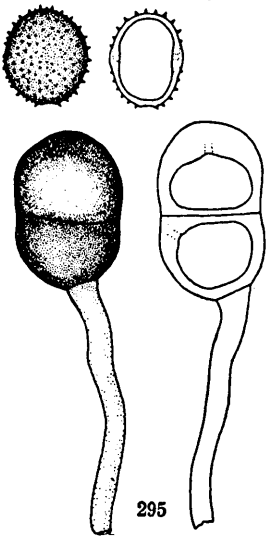
This species should doubtless be considered a synonym of *P. campanulae,* although on a different but closely related host-family, as the gross and microscopic variations are only such as commonly occur in a leptosporic form.

170. PUCCINIA SPLENDENS. Fig. 295.

(N. A. F. 7: 419, 792, 842.)

Puccinia splendens Vize, Grev. **7**: 11. 1878.
Dicaeoma splendens Ktze., Rev. Gen. **3**^{3}: 470. 1898.
Puccinia fraseriae Syd., Ann. Myc. **1**: 326. 1903.

Pycnia amphigenous. Aecia amphigenous, in groups, cupulate; aeciospores ellipsoid, 15–19 by 23–29 μ; wall colorless, 1.5 μ thick, minutely verrucose. Uredia amphigenous, cinnamon- or chestnut-brown; urediospores globoid or obovate, flattened at sides, 24–29 by 27–34 μ, wall cinnamon-brown, 1–2 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, on stems producing large (3–6 cm. long), fusiform, gall-like swellings, chestnut-brown or blackish; teliospores ellipsoid or obovoid, 27–32 by 39–50 μ on leaves, 28–36 by 46–62 μ on stems, rounded at both ends, slightly constricted at septum; wall chestnut-brown, 2.5–4 μ thick at sides, 7–10 μ above, smooth; pedicel nearly or quite colorless, very long, often five times length of spore, flexuous.


295

On Ambrosiaceae: **Franseria ambrosioides** Cav., Ariz.—**F. deltoidea** Torr., Ariz.—**F. dumosa** Gray, Calif.—**Hymenoclea monogyra** T.&G., Ariz., Calif., N.M., Tex., Utah.—**H. salsola** T.&G., Calif. **Range:** Utah to central California, southward to western Texas and southern California; also in Mexico and South America.

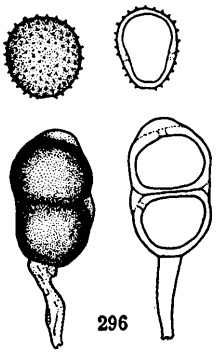
Cultures with teliosporic material from *Hymenoclea monogyra* were made in 1914 by Arthur (Mycol. **7**: 85. 1915), sown on plants of the same species, producing aecia. The resulting aeciospores were then used for infection, producing uredia and telia.

171. PUCCINIA XANTHIIFOLIAE. Fig. 296.

(N. A. F. 7: 419, 792.)

Puccinia xanthiifoliae E. & E., Jour. Myc. **6**: 120. 1891.
Dicaeoma (?) *xanthiifoliae* Ktze., Rev. Gen. **3**^{3}: 471. 1898.

Pycnia and aecia unknown. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid or obovoid, flattened at sides, 19–24 by 21–26 μ; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, equatorial or somewhat subequatorial. Telia chiefly hypophyllous, dark chestnut-brown; teliospores ellipsoid, 23–27 by 35–48 μ, rounded at both ends, slightly constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, 7–9 μ above, with a wide paler umbo, smooth; pedicel colorless, about length of spore.


296

On Ambrosiaceae: **Iva xanthifolia** Nutt. (*Cyclachaena x.* Fresen.), Ariz., Colo., Ida., Kans., Neb., S.D. **Range:** South Dakota to southern Idaho, southward to Kansas and Colorado.

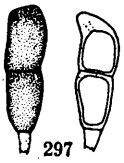
The species closely resembles *Puccinia helianthi*, and probably the aecia, as in that species, are inconspicuous and not abundant.

172. PUCCINIA TENUIS. Fig. 297.

(N. A. F. 7: 474, 800, 844.)

(*Caeoma* (*Aecidium*) *tenue* Schw., Trans. Am. Phil. Soc. II. **4:** 293. 1832.)
Puccinia tenuis [Schw.] Burr., Bot. Gaz. **9:** 188. 1884.
Allodus tenuis Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 11–15 by 12–17 μ; wall colorless, 1 μ thick, minutely verrucose. Uredia wanting. Telia chiefly hypophyllous, often surrounding the aecia, blackish-brown, with subepidermal paraphyses; teliospores oblong, 11–15 by 26–34 μ, obtuse or narrowed at both ends, slightly or not constricted at septum; wall cinnamon-brown, 1–1.5 μ thick at side, 5–7 μ above, smooth; pedicel colorless, short.


297

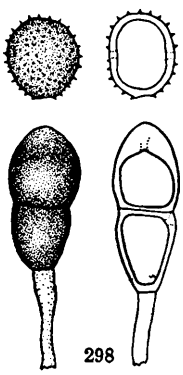
On Carduaceae (tribe *Eupatorieae*): **Eupatorium urticaefolium** Reich. (*E. ageratoides* L.f.), Conn., Ill., Ind., Iowa, Mass., Minn., Neb., N.Y., Ohio, Pa., Tenn., Vt., W.V., Wis. **Range:** Vermont to Minnesota, southward to Tennessee and central Nebraska.

*. **Puccinia spegazzinii** De-T. (*Micropuccinia s.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia hypophyllous, cinnamon-brown, teliospores germinating at maturity, oblong or cylindric, 14–18 by 38–60 μ, obtuse or rounded at both ends, slightly or not constricted at septum, the wall pale-yellowish, uniformly 1 μ thick, or slightly thickened above, smooth, with colorless pedicel, as broad and about as long as spore; occurs on Carduaceae (tribe *Eupatorieae*): **Mikania cordifolia** (L. f.) Willd., Fla.—**M. scandens** (L.) Willd., Ala., Fla., Miss., N.C., Texas; ranging along the coastal states from North Carolina to Texas; also in West Indies, Central and South America. (N. A. F. **7:** 574.)

173. PUCCINIA GNAPHALII. Fig. 298.

(N. A. F. 7: 596.)

Uredo gnaphalii Speg., Anal. Soc. Ci. Argent. **12:** 73. 1881.
Puccinia gnaphaliicola P. Henn., Hedw. Beibl. **38:** 68. 1899.
Puccinia gnaphalii (Speg.) P. Henn., Hedw. Beibl. **41:** 66. 1902.
Puccinia gnaphalii Speg., Anal. Mus. Nac. Buenos Aires **19:** 309. 1909.


298

Pycnia and aecia unknown. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid, 18–23 by 23–26 μ; wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 2, rarely 3, nearly equatorial. Telia hypophyllous, chestnut-brown; teliospores oblong or clavate-oblong, 18–24 by 32–56 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, 7–10 μ above, smooth; pedicel nearly or quite colorless, about as long as spore. Mesospores sometimes present.

On Carduaceae (tribe *Inuleae*): **Gnaphalium purpureum** L., Ala., La., S.C.—**G. spathulatum** Lam., Ala., N.C. **Range:** North Carolina to southern Louisiana; also in Central and South America, and New Zealand.

*. **Puccinia plucheae** (Syd.) Arth. (*Uredo p., P. biocellata* Arth.), with pycnia not seen; aecia hypophyllous, cupulate, aeciospores globoid, 13–17 μ in diameter, the wall colorless, 1 μ thick, minutely verrucose; uredia amphigenous, chocolate-brown, urediospores globoid or obovoid, 23–27 by 27–32 μ, the wall chestnut-brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial, having cuticle greatly inflated over the pores;

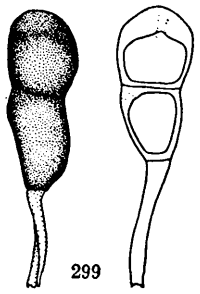
telia hypophyllous, cinnamon-brown, teliospores oblong, 19–28 by 40–50 μ, rounded or obtuse at both ends, slightly constricted at septum, the wall light cinnamon-brown, 1–1.5 μ thick, somewhat thicker above with a hyaline papilla, smooth, with colorless, fragile pedicel; occurs on CARDUACEAE (tribe *Inuleae*): **Pluchea camphorata** (L.)DC., Fla.—**P. purpurascens** (Sw.)DC., Fla.; in southern Florida; also in West Indies and Central and South America. (N. A. F. **7:** 793.)

174. PUCCINIA INVESTITA. Fig. 299.

(N. A. F. 7: 475, 800.)

(*Caeoma* (*Aecidium*) *gnaphaliatum* Schw., Trans. Am. Phil Soc. II. **4:** 292. 1832.)
Puccinia investita Schw., Trans. Am. Phil. Soc. II. **4:** 296. 1832.
Allodus gnaphaliata Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.
Puccinia gnaphaliata Arth. & Bisby, Proc. Am. Phil. Soc. **57:** 221. 1918.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous, cupulate; aeciospores globoid, 16–23 by 20–29 μ; wall colorless, 1.5–2 μ thick, noticeably verrucose. Uredia wanting. Telia hypophyllous, chocolate-brown; teliospores oblong or clavate-oblong, 17–25 by 36–53 μ, rounded or obtuse above, narrowed below, slightly constricted at septum; wall chestnut-brown, 1.5–2 μ thick at sides, 7–12 μ above, smooth; pedicel nearly or quite colorless, length of spore or shorter.


299

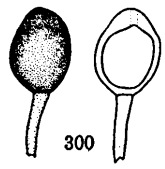
ON CARDUACEAE (tribe *Inuleae*): **Gnaphalium chilense** Spreng., Calif.—**G. macounii** Greene(*G. decurrens* Ives, not L.), Ariz., N.Y., Vt., Wis.; Ont.—**G. obtusifolium** L., N.Y., Pa., W.Va.—**G. ramosissimum** Nutt., Calif. **Range:** Vermont to southwestern Ontario, southward to West Virginia, and from central California to southern Arizona; also in Santo Domingo, Mexico and Central and South America.

175. UROMYCES AMOENUS. Fig. 300.

(N. A. F. 7: 519.)

Uromyces amoenus Syd., Ann. Myc. **4:** 28. 1906.
Teleutospora amoena Arth. & Bisby, N. Am. Flora **7:** 519. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, in groups, pulvinate, dark chestnut-brown; teliospores globoid or obovoid, 16–23 by 22–30 μ; wall dark cinnamon-brown, 1.5–2.5 μ thick, 4–7 μ above, smooth; pedicel pale-yellowish, about length of spore.


300

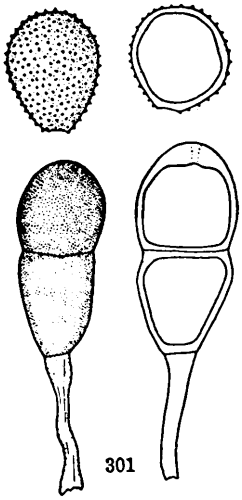
ON CARDUACEAE (tribe *Inuleae*): **Anaphalis margaritacea occidentalis** Greene, Ore.—**A. subalpina** (Gray)Rydb.(*A. m. s.* Gray), Ida., Mont., Ore., Wash., Wyo.; B.C. **Range:** Northwestern Montana to British Columbia, southward to Wyoming and Oregon.

176. PUCCINIA EVADENS. Fig. 301.

(N. A. F. 7: 423, 793, 842.)

Coleosporium baccharidis Cooke & Hark., Grev. **9:** 7. 1880. Not *Puccinia baccharidis* D. & H.
Puccinia evadens Hark., Bull. Calif. Acad. **1:** 34. 1884.
Eriosporangium evadens Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.
Dicaeoma evadens A. & J., N. Am. Flora **7:** 423. 1921.

Pycnia and aecia amphigenous, on branches causing fusiform or irregular swellings, sometimes forming witches' brooms, the aecia without peridium;



301

aeciospores ellipsoid or fusiform-ellipsoid, 22–26 by 35–60 μ, often narrowed and acute at both ends; wall nearly or quite colorless, 2–3 μ thick at sides, somewhat thicker above, finely and irregularly verrucose. Uredia chiefly hypophyllous, orange-colored, becoming pale; urediospores globoid or obovoid, 23–27 by 27–35 μ; wall nearly colorless, 1.5–2 μ thick, sparsely verrucose-echinulate, the pores indistinct. Telia chiefly hypophyllous, pale cinnamon-brown, cinereous by germination; teliospores oblong, 27–32 by 48–63 μ, rounded above, narrowed below, slightly constricted at septum; wall pale-brownish, 1.5–2 μ thick at sides, 3–6 μ above, smooth; pedicel nearly or quite colorless, once to twice length of spore.

On Carduaceae (tribe *Astereae*): **Baccharis consanguinea** Greene, Calif.—**B. emoryi** Gray, Ariz.—**B. halimifolia** L., Fla., N.C., Va.—**V. pilularis** DC., Calif.—**B. salicina** T.&G., N.M.—**B. sarothroides** Gray, Ariz.—**B. thesioides** H.B.K., Ariz. **Range:** Virginia to Florida on the cultivated *B. halimifolia,* and from central California southward to central New Mexico; also in West Indies, Mexico and South America.

The genus *Eriosporangium* is maintained by Dietel (E. & P., Nat. Pflanzenfam. 2te Aufl. **6:** 79. 1928) to include species with a caeomoid aecium, or with poorly developed peridium, and teliospores having pale or colorless walls.

*. **Puccinia baccharidis** D. & H. (*Caeoma punctato-striatum* Diet. & Neg., *Eriosporangium p.* Arth., *Dicaeoma b.* A. & J.), with pycnia amphigenous, in groups; aecia chiefly hypophyllous, without peridium, on branches forming long fissures, without hypertrophy, aeciospores ovoid-ellipsoid, 20–29 by 27–60 μ, narrowed or even acute above, rounded below, wall nearly or quite colorless, 2–2.5 μ thick, rarely thicker above, verrucose in more or less evident striae; uredia amphigenous, cinnamon-brown, urediospores obovoid, 20–27 by 29–45 μ, the wall pale cinnamon-brown, 1.5–2.5 μ thick, finely and closely echinulate, with about 6 scattered pores, large and evident; telia chiefly hypophyllous, pale cinnamon-brown, cinereous by germination, teliospores oblong, 24–29 by 45–70 μ, rounded or obtuse at both ends, slightly constricted at septum, the wall pale cinnamon-brown, about 1.5 μ thick at sides, 2–6 μ above, with colorless pedicel, once to twice length of spore, usually inflated in upper part; occurs on Carduaceae (tribe *Astereae*): **Baccharis emoryi** Gray, Arizona and southern California, **B. glutinosa** Pers., Arizona, New Mexico, California and Texas, **B. viminea** DC., southern California; also in South America. (N. A. F. **7:** 423, 793.)

*. **Puccinia pistorica** Arth. (*Dicaeoma p.* Arth., *Eriosporangium p.* Arth.), with pycnia and aecia unknown; uredia hypophyllous, light cinnamon-brown, urediospores globoid, 24–32 by 30–39 μ, wall nearly colorless, about 2 μ thick, echinulate, the pores obscure; telia amphigenous, chocolate-brown, usually shining, teliospores linear-oblong, 12–16 by 39–50 μ, obtuse or rounded above, narrowed below, slightly or not constricted at septum, the wall chestnut-brown above, much lighter below, 1–1.5 μ thick at sides, 6–12 μ above, smooth, with colored pedicel, half length of spore or less; occurs on Carduaceae (tribe *Astereae*): **Baccharis glomeruliflora** Pers., one collection only, from southern Florida. (N. A. F. **7:** 424.)

*. **Uromyces compactus** Peck (*Nigredo c.* Arth.), with pycnia caulicolous, in groups; aecia caulicolous, cupulate, aeciospores globoid or ellipsoid, 20–26 by 26–32 μ, the wall colorless, 1–2 μ thick, minutely verrucose; uredia caulicolous, cinnamon-brown, urediospores ellipsoid, 23–30 by 32–45 μ, the wall cinnamon-brown, 1–1.5 μ thick, echinulate, with 2 equatorial pores; telia caulicolous, dark chocolate-brown, teliospores obovate, 19–30 by 30–42 μ, the wall chestnut-brown, 1.5–2 μ thick at sides, 5–8 μ above, smooth, with colorless pedicel, once to twice length of spore; occurs on Carduaceae (tribe *Astereae*); **Leucosyris spinosa** (Benth.)Greene(*Aster s.*), in southern Arizona, New Mexico and northern Texas. (N. A. F. **7:** 769.)

*. **Puccinia marianae** Syd. (*Micropuccinia m.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia amphigenous, blackish-brown, teliospores oblong, 18–28 by 40–60 μ, rounded or obtuse at both ends, slightly or not constricted at septum, the wall chestnut-brown, 2–3.5 μ thick at sides, 4–8 μ above,

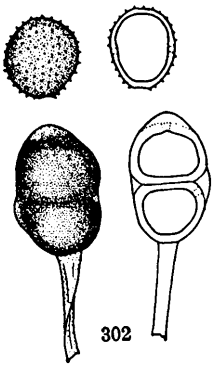
smooth, with colorless pedicel, once to twice length of spore; mesospores common; occurs on CARDUACEAE (tribe *Astereae*): **Sideranthus megacephalus** (Nash) Small (not *Chrysopsis mariana*), in southern Florida. (N. A. F. **7**: 579.)

177. PUCCINIA VERBESINAE. Fig. 302.

(N. A. F. 7: 432, 794, 843.)

(*Aecidium verbesinae* Schw., Schr. Nat. Ges. Leipzig **1**: 68. 1822.)
Puccinia verbesinae Schw., Schr. Nat. Ges. Leipzig **1**: 73. 1822.
Dicaeoma verbesinae Ktze., Rev. Gen. **3**^{3}: 471. 1898.

Pycnia epiphyllous, in groups. Aecia hypophyllous, cupulate; aeciospores globoid, 15–20 by 19–28 μ; wall pale-yellowish, 1–1.5 μ thick, verrucose. Uredia chiefly hypophyllous, dark cinnamon-brown; urediospores globoid, 19–23 by 20–26 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial. Telia chiefly hypophyllous, blackish-brown; teliospores ellipsoid or oblong, 23–29 by 30–42 μ, rounded at both ends, slightly or not constricted at septum; wall dark chestnut-brown, 2–4 μ thick at sides, 5–7 μ above, smooth; pedicel nearly colorless, length of spore, fragile.



302

ON CARDUACEAE (tribe *Heliantheae*): **Verbesina occidentalis** (L.) Walt., Ala., Ga., Ky., Md., N.C., S.C., Tenn., Va., W.Va. **Range**: Maryland and Kentucky, southward to Georgia and Alabama.

* **Puccinia cognata** Syd. (*P. similis* Long, not E. & E., *Dicaeoma c.* A. & J.), with pycnia epiphyllous, in groups; aecia hypophyllous, cupulate, aeciospores globoid, 16–22 by 22–26 μ, the wall colorless, 1–2 μ thick, verrucose; uredia chiefly hypophyllous, dark cinnamon-brown, urediospores globoid, 19–28 by 24–30 μ, the wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, with 2 equatorial pores; telia chiefly hypophyllous, blackish-brown, teliospores oblong or ellipsoid, 22–30 by 32–50 μ, obtuse at both ends, slightly or not constricted at septum, the wall chestnut-brown, 2–3.5 μ thick at sides, 5–12 μ above, with nearly or quite colorless pedicel, as long as spore or shorter, fragile; occurs on CARDUACEAE (tribe *Heliantheae*): **Verbesina texana** Buckl., **V. virginica** L., southern Arkansas, Louisiana, Texas, **Ximenesia encelioides** Cav., Texas; also in West Indies, Mexico and Central America. (N. A. F. **7**: 432, 794.)

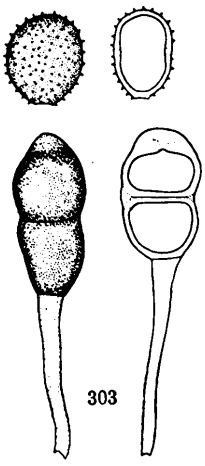
178. PUCCINIA HELIANTHI. Fig. 303.

(N. A. F. 7: 427, 793, 843.)

(*Aecidium helianthi-mollis* Schw., Schr. Nat. Ges. Leipzig **1**: 68. 1822.)
Puccinia heliopsidis Schw., Schr. Nat. Ges. Leipzig **1**: 72. 1822.
Puccinia helianthi Schw., Schr. Nat. Ges. Leipzig **1**: 73. 1822.
Puccinia helianthorum Schw., Trans. Am. Phil. Soc. II. **4**: 296. 1832.
Puccinia viguierae Peck, Bull. Torrey Club **12**: 35. 1885.
Dicaeoma helianthi-mollis Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 16–23 by 20–28 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia chiefly hypophyllous, dark cinnamon-brown; urediospores globoid or obovoid, 19–26 by 23–34 μ, flattened laterally; wall dark cinnamon-brown, 1–2 μ thick, echinulate, the pores 2, equatorial. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid or oblong, 20–30 by 36–58 μ, obtuse or rounded above and below, slightly constricted at septum; wall chestnut-brown, 1.5–3 μ thick at sides, 7–12 μ above, smooth; pedicel colorless, twice to thrice length of spore.

ON CARDUACEAE (tribe *Heliantheae*): **Helianthus ambiguus** (Gray) Britt., Ohio.—**H. angustifolius** L., Ala., Del., Miss., N.C.—**H. annuus** L., throughout



303

southern Canada and the United States.—**H. atrorubens** L., Miss.—**H. australis** Small, Ga.—**H. californicus** DC., Calif. —**H. cucumerifolius** T.&G., Tex.—**H. debilis** Nutt., Calif., Fla.—**H. decapetalus** L., Conn., Del., Ill., Ind., Iowa, Mich., Neb., N.Y., N.C., Ohio, Pa., Vt., W.Va.—**H. divaricatus** L., Ark., Conn., Ill., Ind., Mass., Mich., Minn., Mo., N.J., N.Y., N.C., Ohio, S.C., Tenn.—**H. doronicoides** Lam., Iowa, Kans., Neb., N.J., N.Y., N.D.—**H. fascicularis** Greene, Colo., Utah; Man.—**H. giganteus** L., Conn., Ind., Mich., Minn., Neb., N.Y., S.D.; Ont.—**H. grosseserratus** Martens, Colo., Ind., Iowa, Kans., Minn., Mo., Mont., Neb., S.D., Wis.—**H. heterophyllus** Nutt., S.C.—**H. hirsutus** Raf., Ark., Ga., Ind., Kans., Miss., Mo., N.C., Ohio, Okla.—**H. kellermani** Britt., Wis.—**H. laetiflorus** Pers., Iowa, Neb.—**H. lenticularis** Dougl., Ariz., Calif., Colo., Kans., Utah, Wyo.—**H. maximiliani** Schrad., Iowa, Kans., Minn., Mont., Neb., N.D., S.D.—**H. microcephalus** T.&G., Ga., Ky., Tenn.—**H. mollis** Lam., Ark., Ill., Ind., Iowa, Kans., Miss., Mo., N.C., Ohio, Okla., Pa.—**H. nitidus** Lunell, N.D.—**H. nuttallii** T.&G., Mont., Wyo.—**H. occidentalis** Ridd., Iowa.—**H. parishii** Gray, Calif.—**H. petiolaris** Nutt., Colo., Kans., Mont., Neb., Wyo.; Alta.—**H. rigidus** (Cass.)Desf.(*H. scaberrimus* Ell.), Ark., Ill., Ind., Iowa, Kans., Minn., Mo., Neb., S.D., Wis., Wyo.; Ont.—**H. rydbergii** Britt., Neb.—**H. salicifolius** Dietr.(*H. orgyalis* DC.), Kans., Wis.—**H. strumosus** L., Ark., Ill., Ind., Iowa, Mo., Neb., N.Y., Pa., S.C., Vt., Va., Wis.; Ont.—**H. subrhomboideus** Rydb., N.D., S.D.—**H. tomentosus** Michx., S.C.—**H. trachelifolius** Mill., Iowa, Kans., Pa.—**H. tuberosus** L., Ala., Ark., Conn., Del., Ga., Ind., Iowa, Kans., Ky., Me., Mich., Minn., Miss., Mo., Neb., N.Y., N.C., N.D., Ohio, Pa., S.C., S.D., Tenn., Va., W.Va.; Ont.—**Heliopsis helianthoides** (L.)Sweet(*H. laevis* Pers.), Ind., Minn., N.C., Pa. **Range:** Southern Canada and all of the United States; also in Cuba, Santo Domingo, Mexico, Europe and Australia.

Cultures establishing the autoecious nature of the sunflower rust were first made by Woronin (Bot. Zeit. **38:** 677. 1872) in 1869–1871, and repeated with American material in 1900 by Carleton (Science II. **13:** 250. 1901). Occurrence of the aecia had not been definitely established up to 1902, when the first part of Sydows' "Monographia Uredinearum" was published, which led the authors of that work to think that the species was a Hemi-puccinia, and the reported production of aecia to be an error. More recent cultures by Carleton (U. S. Dept. Agr., Bur. Pl. Ind. Bull. 63, p. 12. 1904) and Bailey (Minn. Agr. Exp. Sta. Tech. Bull. 16, p. 6. 1923) have shown that in exceptional instances pycnia may be followed directly by uredia, with entire omission of aecia. In 1903 a rust with uredia and telia on *Xanthium strumarium* was collected near Moscow, Russia, which was determined as *P. helianthi*. A culture in 1908 by Tranzschel (Ann. Myc. **7:** 182. 1909) proved that teliospores from *Helianthus annuus* sown on *Xanthium strumarium* would produce aecia, uredia and telia, and later he made the reverse culture (Mycol. Centr. **4:** 70. 1914). *Xanthium* as a host for this species has not been noted in America, and no cultures have been attempted. Cultures with many species of *Helianthus* have shown that a number of physiologic forms exists, but none so distinctive that they could be called varieties. Consult Woronin (*l. c.*), Jacky (Centr. Bakt. **9:** 802. 1902; same **18:** 78. 1907), Arthur (Bot. Gaz. **35:** 17. 1903; Jour. Myc. **10:** 12. 1904; same **11:** 53. 1905; same **12:** 18. 1906), Kellerman (Jour. Myc. **9:** 230. 1903; same **11:** 30. 1905), and Bailey (*l. c.*). The occurrence of a bridging species, as defined by Marshall Ward, has been discredited.

Puccinia batesiana.

(N. A. F. 7: 475, 800.)

Puccinia batesiana Arth., Bull. Torrey Club **28:** 661. 1901.
Allodus batesiana Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia and aecia as in *Puccinia helianthi.* Uredia wanting. Telia with subepidermal paraphyses; teliospores as in *P. helianthi,* except narrower, 15–20 by 45–58 μ, often narrowed above and below; wall about 1 μ thick at sides, 7–16 μ above; pedicel short, fragile.

On Carduaceae (tribe *Heliantheae*): **Heliopsis helianthoides** (L.)Sweet (*H. laevis* Pers.), Del., Pa.—**H. scabra** Dunal, Iowa, Minn., Neb., Wis. **Range:** Two localities in eastern and four in west-central United States.

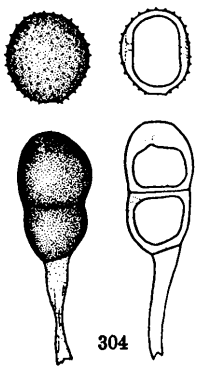
*. **Puccinia parthenices** Jacks., with pycnia and aecia unknown; uredia not seen, urediospores in the telia ellipsoid, 16–23 by 24–26 μ, slightly flattened laterally, the wall light cinnamon-brown, 1.5–2.5 μ thick, minutely echinulate, with 2 equatorial pores; telia chiefly hypophyllous, blackish-brown, teliospores oblong, 20–26 by 32–45 μ, rounded or obtuse at both ends, slightly constricted at septum, the wall light chestnut-brown, 1.5–2.5 μ thick at sides, 7–9 μ above, smooth, with colorless pedicel, once to thrice length of spore; occurs on Carduaceae (tribe *Heliantheae*) : **Parthenice mollis** Gray, in southern Arizona. (N. A. F. **7:** 598.)

179. PUCCINIA NUDA. Fig. 304.

(N. A. F. 7: 598.)

Puccinia nuda E. & E., Jour. Myc. **3:** 57. 1887.
Puccinia hemizoniae Ellis & Tr., Jour. Myc. **7:** 43. 1891.
Puccinia lagophyllae D. & H.; Diet., Erythea **1:** 250. 1893.
Puccinia madiae Syd., Monog. Ured. **1:** 121. 1902.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 22–26 by 26–32 μ; wall dark cinnamon-brown, 2.5–3 μ thick, minutely echinulate, the pores 2, equatorial. Telia amphigenous, blackish-brown; teliospores oblong, 20–26 by 32–48 μ, rounded or obtuse at both ends, slightly constricted at septum; wall chestnut-brown, 2–2.5 μ thick at sides, 6–10 μ above, smooth; pedicel colorless, about length of spore.



304

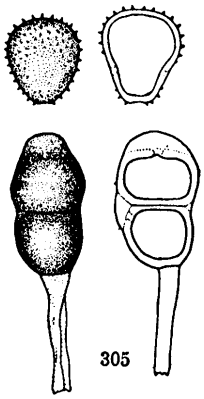
On Carduaceae (tribe *Heliantheae*): **Hemizonia citrina** Greene, Calif.—**H. clevelandii** Greene, Calif.—**H. luzulaefolia** DC., Calif.—**H. truncata** Gray(*Calycadenia t.* DC.), Ore.—**Lagophylla congesta** Greene, Calif.—**L. ramosissima** Nutt., Ore., Wash.—**Madaria elegans** (D.Don)DC.(*Madia e.*), Ore.—**Madia sativa** Molina, Wash.· **Range:** Washington to central California; also in South America.

The species is imperfectly known, both as to hosts and distribution. Scanty collections leave doubt regarding the identity of the hosts in many instances.

180. PUCCINIA AEMULANS. Fig. 305.

(N. A. F. 7: 426.)

Puccinia aemulans Syd., Ann. Myc. **4:** 31. 1906.
Dicaeoma aemulans A. & J., N. Am. Flora **7:** 426. 1921.



305

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 15–20 by 18–24 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores obovoid, flattened laterally, 19–23 by 20–26 μ; wall pale cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, small, subequatorial. Telia chiefly hypophyllous, blackish-brown; teliospores oblong or ellipsoid, 22–28 by 35–55 μ, rounded at both ends or somewhat narrowed below, slightly constricted at septum; wall chestnut-brown, 2–3 μ thick at sides, 7–12 μ above, smooth; pedicel colorless, once to twice length of spore.

On Carduaceae (tribe *Heliantheae*): **Heliomeris multiflora** Nutt.(*Gymnolomia m.* B.&H.), Ariz., Colo., N.M., Utah, Wyo. **Range:** Wyoming southward to New Mexico and Arizona.

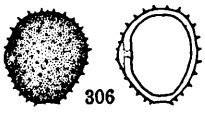
*. **Puccinia melampodii** D. & H. (*Micropuccinia m.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia hypophyllous, chestnut-brown, cinereous by germination, teliospores oblong, 16–19 by 35–50 μ, obtuse or rounded above, narrowed below, slightly or not constricted at septum, the wall cinnamon-brown, 1–1.5 μ thick at sides, 4–7 μ above, smooth, with nearly or quite colorless pedicel, about as long as spore; occurs on Carduaceae (tribe *Heliantheae*): **Parthenium lyratum** Gray(*P. hysterophorum l.* Gray), in western Texas; also on other hosts in Mexico, West Indies, Central and South America. (N. A. F. **7**: 581, 806, 848.)

181. PUCCINIA CHRYSANTHEMI. Fig. 306.

(N. A. F. 7: 508.)

Puccinia chrysanthemi Roze, Bull. Soc. Myc. Fr. **17**: 92. 1900.
Bullaria? chrysanthemi Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia and aecia unknown. Uredia hypophyllous, chestnut-brown; urediospores globoid or ellipsoid, 10–25 by 25–34 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3, equatorial. Telia hypophyllous, dark chocolate-brown; teliospores ellipsoid, 18–28 by 34–57 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, 1–2 μ thick at sides, 5–10 μ above, finely verrucose; pedicel colorless, once to twice length of spore.



306

On Carduaceae (tribe *Anthemideae*): **Chrysanthemum morifolium** Ramat.(*C. sinense* Sabine), throughout the United States and Canada where the host is cultivated; also in Santo Domingo and in most temperate parts of the world, but only in the uredial stage, except in northern Japan where teliospores are plentiful.

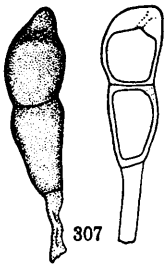
No cultures with teliospores have yet been reported, and the full life cycle is not yet definitely known.

182. PUCCINIA FLAVERIAE. Fig. 307.

(N. A. F. 7: 582, 584, 848.)

Puccinia flaveriae Jacks., Mycol. **14**: 117. 1922.
Micropuccinia flaveriae A. & J., N. Am. Flora **7**: 582. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, in groups, chestnut-brown; teliospores oblong, 14–20 by 35–55 μ,


307

rounded or obtuse above, narrowed below, slightly or not constricted at septum; wall cinnamon-brown, 1–1.5 μ thick at sides, 5–10 μ above, smooth; pedicel colored, short.

On Carduaceae (tribe *Helenieae*): **Flaveria campestris** Johnst.(*F. angustifolia* Gray, not Pers.), Kans.; (tribe *Calenduleae*): **Calendula officinalis** L., Ill., Ind., Iowa, Kans., Mo., Neb., Tex.—**Dimorphotheca cuneata** (Thunb.)DC., Ind., Neb. **Range:** Indiana to Kansas, southward to Texas; also in Cuba.

The rust on *Calendula* and *Dimorphotheca* was placed under *Puccinia emiliae* in the N. Am. Flora, p. 584. It occurs on cultivated plants in greenhouses and gardens. The microcyclic forms on these and related genera have much similarity and are difficult to place with present knowledge.

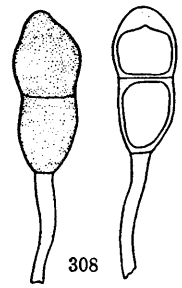
*. **Puccinia emiliae** P. Henn. (*Micropuccinia e.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia chiefly hypophyllous, chestnut-brown, teliospores oblong, 15–20 by 32–48 μ, rounded or obtuse above, narrowed below, slightly or not constricted at septum, the wall cinnamon-brown, 1–1.5 μ thick at sides, 3–8 μ above, smooth, with short nearly colorless pedicel; occurs on Carduaceae (tribe *Senecioneae*): **Emilia sonchifolia** (L.)DC., in southern Florida; also in West Indies and Central America. (N. A. F. **7:** 584.)

183. PUCCINIA FRASERI. Fig. 308.

(N. A. F. 7: 585, 806, 848.)

Puccinia fraseri Arth., Bull. Torrey Club **42:** 591. 1915.
Micropuccinia fraseri A. & J., N. Am. Flora **7:** 585. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting; urediospores occasionally in the telia, ellipsoid or obovoid, 15–20 by 23–29 μ; wall nearly or quite colorless, 2–2.5 μ thick, echinulate, the pores obscure, probably 3 or 4, equatorial. Telia chiefly hypophyllous, systemic, pale yellowish-brown, becoming cinereous by germination; teliospores oblong, 13–20 by 30–42 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall nearly or quite colorless, 1–1.5 μ thick at sides, 3–9 μ above, smooth; pedicel colorless, as long as spore, or less.


308

On Cichoriaceae: **Hieracium albiflorum** Hook., Mont. —**H. scabrum** Michx., Neb., N.Y.; N.S., Queb.—**H. venosum** L., Pa. **Range:** Locally from Nova Scotia and central Pennsylvania, westward to northern Montana.

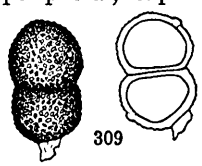
(§ Bullaria)

184. PUCCINIA PARADOXICA. Fig. 309.

(N. A. F. 7: 326.)

Puccinia paradoxica Ricker, Jour. Myc. **11:** 114. 1905.
Dicaeoma paradoxicum A. & F., N. Am. Flora **7:** 326. 1920.

Pycnia and aecia unknown. Uredia hypophyllous, orange-yellow, with peripheral, capitate or clavate-capitate paraphyses; urediospores ellipsoid or globoid, 18–22 by 20–28 μ; wall pale-yellow, 2–3 μ thick, echinulate, the pores 6–8, obscure. Telia hypophyllous, elongate, chestnut-brown; teliospores ellipsoid, 20–26 by 32–38 μ, rounded at both ends, much constricted at septum; wall chestnut-brown, uniformly 2–2.5 μ thick, prominently verrucose with irregular warts, the pores of both cells more or less depressed, covered with a small papilla; pedicel colorless, sometimes oblique, short, fragile.


309

On Poaceae (tribe *Festuceae*): **Melica smithii** (Porter)Vasey(*Avena s.*), Mich. **Range:** Vicinity of the junction of upper and lower Michigan.

185. PUCCINIA PATTERSONIANA. Fig. 310.

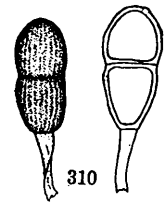
(N. A. F. 7: 330, 781, 836.)

Puccinia pattersoniana Arth., Bull. Torrey Club **33:** 29. 1906.
Dicaeoma pattersonianum A. & F., N. Am. Flora **7:** 330. 1920.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, short cylindric; aeciospores globoid, 18–26 by 21–32 μ; wall colorless, 2–3 μ thick, verrucose.

On Alliaceae: **Brodiaea douglasii** Wats.(*Triteleia grandiflora* Lindl.), Ida., Utah, Wash.

Uredia epiphyllous, brownish-yellow; urediospores ellipsoid or obovoid, 19–30 by 29–39 μ; wall golden-yellow, 2–3 μ thick, echinulate, the pores 8–10, scattered. Telia chiefly epiphyllous, chestnut-brown; teliospores ellipsoid or oblong, 16–23 by 29–37 μ, usually rounded at both ends, somewhat constricted at septum; wall cinnamon-brown, uniformly 1–1.5 μ thick, minutely striate; pedicel colorless, about length of spore.



310

On Poaceae (tribe *Hordeae*): **Agropyron spicatum** (Pursh)Scribn.&Sm., Mont., Ore., Utah.—**Elymus condensatus** Presl, Utah.—**E. triticoides** Buckl., N.M., Utah.—**Sitanion jubatum** J.G.Sm., Calif., Wash.

Range: Western Montana to Washington, southward to New Mexico and central California.

The probable life history was detected by Mains (Proc. Ind. Acad. Sci. **1921:** 133. 1922) through the discovery that the pedicels of this species and those of *Puccinia moreniana* stained a dark blue except next the spores, using a mixture of iodine and chloral hydrate. As the latter is a microcylic species on *Brodiaea*, search was made for isolated aecia on *Brodiaea*. Observations by Garrett (Mycol. **13:** 110. 1921) helped to confirm the prediction. Later a carefully planned open-air culture, sowing aeciospores from *Brodiaea douglasii* on *Elymus condensatus*, by Garrett (Mycol. **16:** 33. 1924), conducted in 1923, resulted in production of uredia and telia.

Puccinia moreniana.

(N. A. F. 7: 524.)

Puccinia moreniana Dudl. & Thomp., Jour. Myc. **10:** 53. 1904.
Micropuccinia moreniana A. & J., N. Am. Flora **7:** 524. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia and teliospores as in *Puccinia pattersoniana*. Mesospores common, 15–20 by 25–35 μ.

On Alliaceae: **Brodiaea capitata** Benth.(*Dipterostemon c.* Rydb.), Calif. **Range:** Known only from vicinity of Searsville Lake, near San Francisco, California.

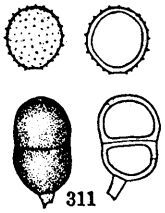
The correlation of this microcyclic species with *P. pattersoniana* was pointed out by Mains in 1922, *l. c.*

186. PUCCINIA KANSENSIS. Fig. 311.

(N. A. F. 7: 321, 780.)

Puccinia kansensis Ellis & Barth., Erythea **4:** 1. 1896.
Dicaeoma kansense Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Uredia chiefly epiphyllous, yellowish; urediospores globoid, 14–18 by 19–21 μ; wall nearly or quite colorless, 1.5–2 μ thick, finely echinulate, the pores indistinct, at least 6, scattered. Telia chiefly epiphyllous, chocolate-brown; teliospores ellipsoid, 16–20 by 23–30 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, the pore in both cells often somewhat depressed, smooth; pedicel nearly or quite colorless, as long as spore or less, fragile.


311

On Poaceae (tribe *Chlorideae*): **Buchloë dactyloides** (Nutt.)Engelm.(*Bulbilis d.* Raf.), Kans., Neb. **Range:** Eastern Kansas and Nebraska.

187. PUCCINIA VERATRI. Fig. 312.

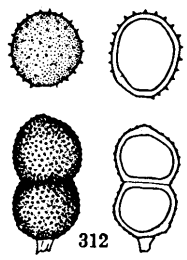
(N. A. F. 7: 371, 787, 840.)

Uredo veratri DC.; Poir., in Lam. Encycl. **8:** 224. 1808.
Puccinia veratri (DC.) Duby, Bot. Gall. 890. 1830.
Puccinia veratri Niessl, Verh. Zool.-Bot. Ges. Wien **9:** 177. 1859.
Dicaeoma veratri Ktze., Rev. Gen. **3³:** 471. 1898.

Pycnia hypophyllous, between the aecia. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 14–18 by 16–24 μ; wall light-yellow, 1 μ thick, finely verrucose.

On Onagraceae: **Chamaenerion latifolium** (L.)Sweet(*Epilobium l.*), B.C.—**Epilobium alpinum** L., Mont., N.H., Utah, Wyo.—**E. anagallidifolium** Lam., Alas., Mont.—**E. hornemannii** Reichenb., Utah; B.C.—**E. paniculatum** Nutt., Ida., Wash.—**E. rubescens** Rydb., Utah.—**E.** sp., Colo., Ore.

Uredia amphigenous, cinnamon-brown; urediospores globoid, 17–23 by 20–28 μ; wall golden-brown, 1.5–2 μ thick, echinulate, with 1 subequatorial pore. Telia amphigenous, cinnamon-brown; teliospores ellipsoid, 17–23 by 25–46 μ, rounded at both ends, strongly constricted at septum, both cells usually globoid and inclined to separate; wall cinnamon-brown, uniformly 1–2.5 μ thick, the pore of upper cell apical, of lower cell usually much depressed, verrucose; pedicel colorless, short, fragile.


312

On Melanthaceae: **Veratrum californicum** Durand (*V. speciosum* Rydb.), Calif., N.M., Ore., Utah, Wash.; B.C.—**V. eschscholtzianum** (R.&S.)Rydb., Ida., Ore.; B.C.—**V. tenuipetalum** Heller, Colo.—**V. viride** Ait., Conn., N.H., N.J., N.Y., Pa., W.Va.

Range: Mountainous regions, New Hampshire and New York, southward to West Virginia, and from western Montana to southeastern Alaska, southward to New Mexico and central California; also in Europe, Siberia and Japan.

Cultures were made in 1908 by Tranzschel (Ann. Myc. **7:** 182. 1909) by sowing from *Veratrum album* on *Epilobium roseum* with production of pycnia, and on *E. nervosum* showing pycnia and aecia. Aeciospores from the latter host again produced uredia and telia on *V. album*. No American cultures have been made, the aecial connection being based largely upon the repeatedly verified observations of Holway in British Columbia, with original data in the Arthur Herbarium. Other synonyms than the above, cited in the N. Am. Flora **7:** 371, do not belong here, but to *Uromyces veratri*, a non-correlated species of the Eastern Hemisphere.

Puccinia epilobii.

(N. A. F. 7: 550.)

Puccinia epilobii DC., Fl. Fr. **6**: 61. 1815.
Micropuccinia epilobii Rostr., Medd. Grønland **30**: 114. 1904.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia systemic, cinnamon-brown; teliospores as in *Puccinia veratri*. Mesospores few, 20–23 by 24–35 μ.

On Onagraceae: **Epilobium alpinum** L., Wyo.; Queb.—**E. hornemanii** Reichenb., Greenl. **Range:** The only three localities known are in western Greenland, mouth of St. Lawrence River and northwestern Wyoming; also in Europe and Japan.

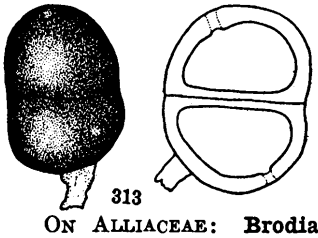
The correlation with *Puccinia veratri* was pointed out by Tranzschel (Ann. Myc. **7**: 182. 1909). The statement in the N. Am. Flora **7**: 550, correlating this species with *Uromyces plumbarius*, was an error.

188. PUCCINIA DICHELOSTEMMAE. Fig. 313.

(N. A. F. 7: 456, 797.)

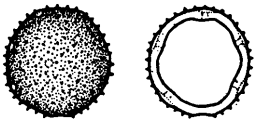
Puccinia dichelostemmae D. & H.; Diet., Erythea **3**: 78. 1895.
Allodus dichelostemmae Orton, Mem. N. Y. Bot. Gard. **6**: 183. 1916.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 16–23 by 23–27 μ; wall colorless, about 2 μ thick, minutely verrucose. Uredia wanting. Telia amphigenous, blackish-brown; teliospores broadly ellipsoid, 35–51 by 43–61 μ, rounded at both ends, slightly or not constricted at septum; wall dark chocolate-brown, uniformly 5–7 μ thick, the pore of upper cell apical, of lower cell much depressed, smooth; pedicel colorless, often oblique, usually short, fragile.



313

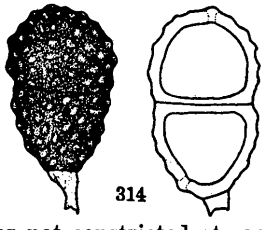
On Alliaceae: **Brodiaea pulchella** (Salisb.)Greene(*B. congesta* Smith, *Dichelostemma c.* Kunth), Ore., Wash.—**B. douglasii** Wats.(*Triteleia grandiflora* Lindl.), Wash.—**B. multiflora** Benth.(*Hookera m.* Britt.), Calif. **Range:** Southern Washington to northern California.



189. PUCCINIA NODOSA. Fig. 314.

(N. A. F. 7: 375.)

Puccinia nodosa Ellis & Hark., Bull. Calif. Acad. **1**: 27. 1884.
Dicaeoma nodosum Ktze., Rev. Gen. **3**[3]: 469. 1898.



314

Pycnia amphigenous. Aecia amphigenous, cupulate; aeciospores globoid or ellipsoid, 21–26 by 26–31 μ; wall golden-yellow, 1.5–2 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 23–32 by 30–39 μ; wall light golden-brown, 1.5–2.5 μ thick, echinulate, the pores 10–14, scattered. Telia amphigenous, blackish; teliospores oblong, 25–33 by 42–63 μ, rounded or truncate above, rounded or sometimes narrowed below, slightly or not constricted at septum; wall dark chocolate-brown, uniformly 3–4 μ thick, the pore in upper cell apical, in lower near pedicel, coarsely tuberculate; pedicel nearly or quite colorless, short, fragile.

On Alliaceae: **Brodiaea capitata** Benth.(*Dipterostemon c.* Rydb.), Calif. **Range:** Central to Southern California near the coast.

Puccinia carnegiana.

(N. A. F. 7: 456.)

Puccinia carnegiana Arth., Bull. Torrey Club **42:** 587. 1915.
Allodus carnegiana Orton, Mem. N. Y. Bot. Gard. **6:** 182. 1916.

Pycnia, aecia and telia essentially as in *Puccinia nodosa,* the telia closely associated with the aecia. Uredia wanting, but urediospores usually occur sparingly among the teliospores, and agree with those of *P. nodosa.*

On Alliaceae: **Brodiaea pauciflora** (Torr.)Standl.(*Dipterostemon p.* Rydb.), Ariz. **Range:** Vicinity of Tucson, Arizona.

An open air culture was made by Arthur and Fromme (Arthur, Mycol. **7:** 85. 1915) at Tuscon, Arizona, February 26, 1914, by sowing aeciospores from *Brodiaea pauciflora* on plants of the same species, from which teliospores were produced without the intervention of uredia, but with a few urediospores in the telia.

Puccinia tumamocensis.

(N. A. F. 7: 524.)

Puccinia tumamocensis Arth., Bull. Torrey Club **42:** 589. 1915.
Micropuccinia tumamocensis A. & J., N. Am. Flora **7:** 524. 1922.

Pycnia and telia essentially as in *Puccinia nodosa,* but teliospores more sparingly tuberculate. Aecia and uredia wanting.

On Alliaceae: **Brodiaea pauciflora** (Torr.)Standl.(*Dipterostemon p.* Rydb.), Ariz. **Range:** Only known from Tumamoc Hill, near Tucson, Arizona.

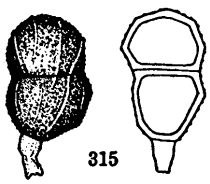
The three species, as listed above, are very closely correlated, as pointed out by the writer (Bull. Torrey Club **42:** 589. 1915), although morphologically showing certain small deviations from one another, as well as possessing different life histories.

190. PUCCINIA SUBANGULATA. Fig. 315.

(N. A. F. 7: 456.)

Puccinia subangulata Holw., N. Am. Ured. **1:** 25. 1905.
Allodus subangulata Orton, Mem. N. Y. Bot. Gard. **6:** 183. 1916.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, often encircling the pycnia, cupulate; aeciospores globoid, 18–23 by 24–33 μ; wall colorless, 2–2.5 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, chestnut-brown; teliospores broadly ellipsoid, usually angular, 20–30 by 35–40 μ, rounded or oblique at both ends, slightly constricted at septum; wall dark chestnut-brown, uniformly 1.5–2 μ thick, finely rugose, with a few prominent irregular longitudinal ridges, the pore of upper cell apical, of lower usually depressed; pedicel colorless, short, fragile.


315

On Alliaceae: **Brodiaea pulchella** (Salisb.)Greene(*B. congesta* Smith, *Dichelostemma c.* Kunth), Wash. **Range:** Southern Washington.

191. UROMYCES PRIMAVERILIS. Fig. 316.

(N. A. F. 7: 441, 795.)

Uromyces primaverilis Speg., Anal. Soc. Ci. Argent. **12:** 72. 1881.
Uromyces vernalis Speg.; De-T., in Sacc., Syll. Fung. **7:** 562. 1888.

Uromyces nothoscordi Syd., Hedw. Beibl. **40:** 125. 1901.
Puccinia primaverilis Arth., N. Am. Flora **7:** 441. 1921.

Pycnia amphigenous, among the aecia. Aecia amphigenous, systemic, cupulate; aeciospores globoid or ellipsoid, 15–19 by 19–26 μ; wall nearly or quite colorless, 1–2 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, cinnamon-brown; teliospores ellipsoid or obovoid, 15–22 by 21–25 μ; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pore, longitudinally rugose, often appearing faintly striate; pedicel colorless, as long as spore or shorter, fragile.


316

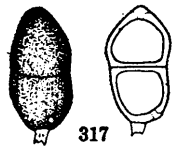
On Alliaceae: **Nothoscordum bivalve** (L.)Britt.(*Allium striatum* Jacq.), Ill., Mo., Tex. **Range:** Southern Illinois to Texas; also in Mexico and South America.

192. PUCCINIA PAGANA. Fig. 317.

(N. A. F. 7: 591.)

Puccinia pagana Arth., Bull. Torrey Club **38:** 372. 1911.

Pycnia and aecia unknown. Uredia not seen; urediospores in the telia, ellipsoid or obovoid, often flattened laterally, 13–18 by 19–24 μ; wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, cinnamon-brown; teliospores ellipsoid, 18–23 by 27–35 μ, rounded or obtuse at both ends, not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore of upper cell apical, covered with a hyaline papilla, of lower cell more or less depressed, minutely verrucose, often appearing striate; pedicel colorless, short, fragile.


317

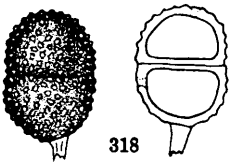
On Alliaceae: **Allium textile** Nels.&Macbr.(*A. reticulatum* Fraser, not Presl ex G.Don), Colo. **Range:** Only one collection; from near Dead Lake on Pike's Peak, Colorado.

193. PUCCINIA CALOCHORTI. Fig. 318.

(N. A. F. 7: 455, 797, 844.)

Puccinia calochorti Peck, Bot. Gaz. **6:** 228. 1881.
Puccinia holwayi Diet., Hedw. **32:** 29. 1893.
Allodus calochorti Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia chiefly epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 16–23 by 19–26 μ; wall pale-yellow, 1.5–2 μ thick, finely verrucose. Uredia not seen; urediospores sometimes occurring among the teliospores, broadly ellipsoid, 21–26 by 26–31 μ; wall light golden-brown, 2–2.5 μ thick, echinulate, the pores 5 or 6, scattered, indistinct. Telia chiefly hypophyllous, at first in groups, later scattered, dark chestnut-brown; teliospores broadly ellipsoid, 19–29 by 29–42 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, or slightly thicker above, prominently verrucose above, less so below, the pores of both cells somewhat depressed; pedicel nearly or quite colorless, half length of spore or less, fragile.


318

On Alliaceae: **Allium bisceptrum** Wats., Calif.; on Liliaceae: **Calochortus albus** Dougl., Calif.—**C. apiculatus** Baker, Mont.—**C. elegans** Pursh,

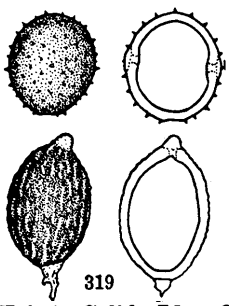
Wash.—**C. eurocarpus** Wats., Ida.—**C. euumbellatus** Nels., Ida.—**C. gunnisonii** Wats., Colo., Ida., Neb., Wyo.—**C. longebarbatus** Dougl., Wash.—**C. macrocarpus** Dougl., Ore.—**C. maweanus** Leicht., Calif.—**C. nitidus** Dougl., Ore.—**C. nudus** Wats., Calif.—**C. nuttallii** T.&G., Calif., Colo., Nev., Utah, Wyo.—**C. venustus** Dougl., Calif. **Range:** Western Nebraska to Washington, southward to New Mexico and California; also in Mexico.

194. UROMYCES HOLWAYI. Fig. 319.

(N. A. F. 7: 242, 754, 829.)

Uromyces lilii G. W. Clint.; Peck, Ann. Rep. N. Y. State Mus. **27:** 103. 1875. Not *U. lilii* Kunze, 1873.
Uromyces holwayi Lagerh., Hedw. **28:** 108. 1889.
Nigredo lilii Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Nigredo holwayi Arth., N. Am. Flora **7:** 754. 1926.

Pycnia chiefly hypophyllous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 14–19 by 16–22 μ; wall colorless, 1 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or obovoid, 20–26 by 23–30 μ; wall cinnamon-brown, 2.5–3 μ thick, echinulate, the pores 2 or 3, equatorial. Telia amphigenous, chocolate-brown; teliospores oval, 18–25 by 29–39 μ; wall chestnut-brown, uniformly 2–3.5 μ thick, with a hyaline papilla over the pore, moderately striately rugose; pedicel colorless, short, fragile.


319

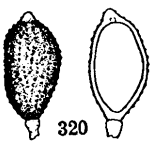
On Liliaceae: **Lilium canadense** L., Conn., Me., Mass., Mich., N.J., N.Y., Wis.; Ont.—**L. candidum** L., Conn., Mass.—**L. columbianum** Hanson(*L. parviflorum* Holz.), Calif., Ida., Ore., Wash.; B.C.—**L. michiganense** Farwell, Iowa, Mich., Minn., Wis.; Ont.—**L. pardalinum** Kellogg, Calif.—**L. parvum** Kellogg, Calif.—**L. philadelphicum** L., Mass., N.H., N.Y.—**L. rubescens** Wats., Calif.—**L. superbum** L., Conn.—**L. umbellatum** Pursh, Ida., Neb.—**L. washingtonianum** Kellogg, Calif. **Range:** Maine to Minnesota, southward to New Jersey and Nebraska, and from British Columbia southward to central California; also in Japan.

195. UROMYCES MIURAE. Fig. 320.

(N. A. F. 7: 442, 795.)

Uromyces miurae Syd., Ann. Myc. **11:** 94. 1913.
Pucciniola miurae Arth., N. Am. Flora **7:** 442. 1921.

Pycnia and aecia unknown. Uredia wanting. Telia amphigenous, in groups, cinnamon-brown; teliospores narrowly oval, 14–23 by 26–35 μ; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pore, inconspicuously and striately verrucose, appearing almost smooth when wet; pedicel short, with a sac-like swelling next the spore, fragile.


320

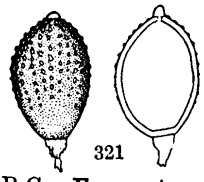
On Liliaceae: **Fritillaria kamtschatcensis** Ker, Alas.; B.C.—**F. lanceolata** Pursh, Wash. **Range:** Southeastern Alaska to Washington; also in Japan.

196. UROMYCES HETERODERMUS. Fig. 321.

(N. A. F. 7: 516, 801.)

Uromyces heterodermus Syd., Ann. Myc. **4:** 29. 1906.
Teleutospora heteroderma Arth. & Bisby, N. Am. Flora **7:** 516. 1922.

Pycnia amphigenous, in groups with the telia. Aecia and uredia wanting. Telia amphigenous, in groups, dark cinnamon-brown; teliospores ellipsoid, 19–26 by 26–43 μ; wall dark golden-brown, uniformly 1.5 μ thick, with a hyaline papilla over the pore, striately verrucose above, nearly or quite smooth below; pedicel colorless, short, fragile.


321

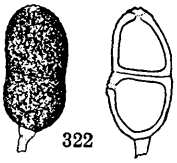
On Liliaceae: **Erythronium giganteum** Lindl., Wash.—**E. grandiflorum** Pursh, Mont., Utah, Wash.; B.C.—**E. montanum** Wats., Wash.—**E. obtusatum** Goodd., Mont., Wyo.—**E. parviflorum** (Wats.)Goodd., Calif., Colo., Mont., Ore., Utah, Wyo. **Range:** Wyoming to British Columbia, southward to Colorado and Utah.

197. PUCCINIA MESOMAJALIS. Fig. 322.

(N. A. F. 7: 524.)

Puccinia mesomajalis B. & C.; Peck, Ann. Rep. N. Y. State Mus. **25:** 111. 1873.
Micropuccinia mesomajalis A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, dark cinnamon-brown; teliospores oblong or narrowly ellipsoid, 15–24 by 26–40 μ, rounded or somewhat narrowed at both ends, slightly constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, with a hyaline papilla over the pores, the pore in upper cell apical, in lower cell at septum or more or less depressed, finely rugose; pedicel colorless, short, fragile.


322

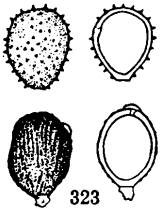
On Convalariaceae: **Clintonia borealis** (Ait.)Raf., Mich., Minn., N.H., N.Y., Wis.; N.S.—**C. uniflora** (Schult.)Kunth, Calif., Ida., Mont., Ore., Wash.; B.C. **Range:** Nova Scotia to Minnesota, and from British Columbia southward to central California.

198. UROMYCES AFFINIS. Fig. 323.

(N. A. F. 7: 755.)

Uromyces affinis Wint., Hedw. **24:** 259. 1885.
Nigredo affinis Arth., N. Am. Flora **7:** 755. 1926.

Pycnia unknown. Aecia amphigenous, in groups, cupulate; aeciospores globoid or broadly ellipsoid, 15–21 by 19–24 μ; wall colorless, 1–2 μ thick, finely verrucose. Uredia chiefly hypophyllous, tardily opening by a central pore; urediospores globoid or obovate, 15–19 by 18–26 μ; wall pale cinnamon-brown, 1.5 μ thick, echinulate, the pores 3, slightly superequatorial, usually indistinct. Telia amphigenous, tardily naked, chestnut-brown; teliospores oblong or obovate, often irregular, 14–20 by 22–32 μ, rounded or obtuse at both ends; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore apical or depressed, covered with a hyaline papilla, finely striate or sometimes appearing smooth; pedicel colorless, short, fragile.


323

On Amaryllidaceae: **Hypoxis hirsuta** (L.)Cov.(*H. erecta* L.), Conn., Miss., Mo., N.Y.—**H. juncea** Smith, Fla. **Range:** Local from Connecticut and Missouri, southward to Florida and Mississippi; also in West Indies, Mexico, and Central and South America.

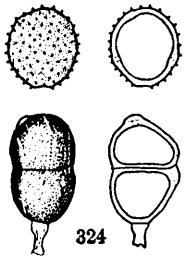
The aecia and telia are rarely produced.

199. PUCCINIA AMPHISPILUSA. Fig. 324.

(N. A. F. 7: 384.)

Puccinia amphispilusa D. & H.; Diet., Erythea **3:** 79. 1895.
Dicaeoma amphispilusum Arth., N. Am. Flora **7:** 384. 1920.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 20–24 by 24–28 μ; wall light golden-brown, 1.5–2 μ thick, echinulate, the pores 4 or 5, scattered, often 2 above and 2 below the equator. Telia amphigenous, chocolate-brown; teliospores oblong or ellipsoid, often irregular, 18–23 by 27–39 μ, usually rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, 1.5–2 μ thick, the pore in upper cell apical or somewhat depressed, in lower various but usually depressed one-third, with a hyaline papilla over each pore, smooth except for a few faint longitudinal striae; pedicel colorless, short, fragile.



324

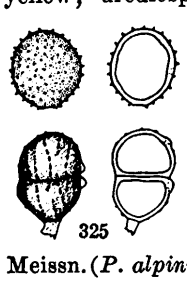
On Polygonaceae: **Polygonum davisiae** Brewer, Calif.—**P. newberryi** Small, Calif. **Range:** Mountains of northern California.

200. PUCCINIA POLYGONI-ALPINI. Fig. 325.

(N. A. F. 7: 385, 789, 841.)

Puccinia polygoni-alpini Cruch. & May.; Cruch., Bull. Herb. Boiss. II. **8:** 245. 1908.
Dicaeoma polygoni-alpini Arth., N. Am. Flora **7:** 385. 1920.

Pycnia and aecia unknown. Uredia hypophyllous, yellow or brownish-yellow; urediospores globoid or ellipsoid, 18–24 by 23–27 μ; wall yellowish, 1.5–2 μ thick, echinulate, the pores 4–6, scattered, sometimes appearing equatorial, indistinct. Telia chiefly hypophyllous, dark cinnamon-brown; teliospores ellipsoid, 16–21 by 22–32 μ, rounded above and below, slightly constricted at septum; wall dark cinnamon-brown, uniformly 1–1.5 μ thick, finely verrucose in irregular longitudinal lines 5–7 μ apart, the pores usually near septum, with a prominent hyaline papilla over each; pedicel colorless, short, fragile.



325

On Polygonaceae: **Polygonum phytolaccaefolium** Meissn.(*P. alpinum* Am.auth., *Aconogonum p.* Small), Calif., Ida., Ore. **Range:** Idaho southward to central California; also in Europe and eastern Asia.

Puccinia poromera.

(N. A. F. 7: 552.)

Puccinia poromera Holw., N. Am. Ured. **1:** 90. 1913.
Micropuccinia poromera A. & J., N. Am. Flora **7:** 552. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, small, on stems often confluent into large groups, dark cinnamon-

brown; teliospores as in *Puccinia polygoni-alpini*, but much less distinctly verrucose, or smooth.

On Ammiaceae (*Umbelliferae*): **Angelica dilatata** Nels., Utah. **Range:** Only known from one collection near Salt Lake City, Utah.

201. PUCCINIA BISTORTAE. Fig. 326.

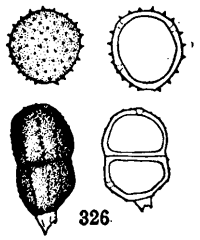
(N. A. F. 7: 382, 383, 789, 841.)

Uredo polygoni bistortae Str., Ann. Wett. Ges. **2:** 103. 1810.
Puccinia bistortae (Str.) DC., Fl. Fr. **6:** 61. 1815.
Puccinia polygoni-vivipari Dietr.; Karst., Not. Sällsk., Fauna Flora Fennica **8:** 221. 1869.
Dicaeoma bistortae Ktze., Rev. Gen. **3³:** 468. 1898.
Dicaeoma polygoni-vivipari Arth., N. Am. Flora **7:** 382. 1920.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, opening through a central pore, the peridium fragile, with peridial cells abutted; aeciospores globoid or ellipsoid, 16–24 by 24–29 μ; wall colorless, 2–3 μ thick, finely verrucose.

On Ammiaceae (*Umbelliferae*): **Coelopleurum gmelini** (DC.)Ledeb., Alas.—**Ligusticum apiifolium** (Nutt.)Gray, Wash.—**Oxypolis fendleri** (Gray) Heller, Wyo.

Uredia hypophyllous, golden-brown; urediospores globoid or broadly ellipsoid, 18–24 by 22–26 μ; wall 1.5–2.5 μ thick, echinulate, the pores about 6, scattered, indistinct. Telia hypophyllous, dark chestnut-brown; teliospores ellipsoid or oblong, 15–21 by 20–35 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1–2 μ thick, the pore nearly apical in upper cell, more or less depressed in lower cell, finely verrucose in a few longitudinal lines; pedicel colorless, often attached laterally, short, fragile.


326

On Polygonaceae: **Bistorta bistortoides** (Pursh) Small(*Polygonum b.*), Ariz., Calif., Colo., Ida., Mont., N.M., Ore., Utah, Wash., Wyo.—**B. vivipara** (L.)S.F.Gray(*P. v.*), Alas., Colo., N.H., Wyo.; Alta., Ont.(Lat. 72°, 45′).—**Polygonum newberryi** Small, Ore., Wash.—**P. spergulariaeforme** Meissn., Calif.—**P. watsonii** Small, Ore.

Range: Cool habitats and mountain summits from the Arctic Circle to the White Mountains in New Hampshire, and from southeastern Alaska southward to southern California and New Mexico; also in Europe, eastern Asia and Japan.

The species is separable into two main varieties, the one on *Ligusticum, Bistorta vivipara*, and in part on *B. bistortoides* with pycnia usually obsolete and having all the spores somewhat smaller than those of the other variety on other hosts. Many European cultures, made by Soppitt, Juel and Klebahn are summarized by Klebahn (Wirtsw. Rostp. 318–321. 1904). Teliospores were used to infect *Conopodium, Carum* and *Angelica*, with indications of a number of physiologic races. No cultures have been made in America.

Puccinia ligustici.

(N. A. F. 7: 552, 803, 847.)

Puccinia ligustici E. & E., Bull. Torrey Club **22:** 363. 1895.
Micropuccinia ligustici A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous; teliospores as in *Puccinia bistortae*, except more sparingly verrucose.

On Ammiaceae (*Umbelliferae*): **Angelica ampla** Nels., Colo.—**A. grayi** C.&R., Colo.—**Carum gairdneri** Gray(*Atenia g.* H.&A.), Utah.—**C. garrettii** Nels.(*A. g.* Rydb.), Utah.—**Cogswellia geyeri** (Wats.)Jones(*Peucedanum g.*), Ida.—**C. gormani** (Howell)Jones(*Lomatium g.* C.&R.), Wash.—**Coneoselinum scopulorum** (Gray)C.&R.(*Ligusticum s.*), Colo.—**Ligusticum apiifolium** (Nutt.) Gray, Ore., Wash.; B.C.—**L. cusickii** C.&R., Nev.—**L. filicinum** Wats., Utah. —**L. grayi** C.&R., Calif., Wash., Wyo.—**L. leibergii** C.&R., Ida.—**L. porteri** C.&R., Colo., Wyo.—**L. simulans** C.&R., Wyo.—**Oxypolis fendleri** (Gray)Heller, Colo., Wyo.—**O. occidentalis** C.&R., Calif.—**Sanicula nevadensis** Wats., Calif.—**S. tuberosa** Torr., Calif. **Range:** Mountains from British Columbia southward to southern Colorado and central California.

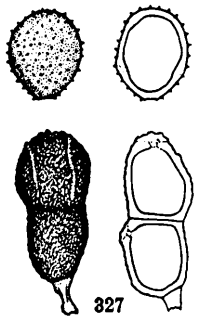
The correlation of this microcyclic species was recorded in the N. Am. Flora **7:** 552, 803. 1922, 1927.

202. PUCCINIA OXYRIAE. Fig. 327.

(N. A. F. 7: 386.)

Puccinia oxyriae Fckl., Jahrb. Nass. Ver. Nat. **29–30:** 14. 1875.
Dicaeoma oxyriae Ktze., Rev. Gen. **3³:** 469. 1898.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 21–28 by 27–35 μ; wall golden-brown, 2–2.5 μ thick, echinulate, the pores 4–6, scattered, indistinct. Telia chiefly hypophyllous, chestnut-brown; teliospores oblong, 18–23 by 32–54 μ, rounded above and below, somewhat constricted at septum; wall light chestnut-brown, uniformly 2–3 μ thick, with a cap-like thickening over the apical pore, the pore in lower cell more or less depressed, finely rugose and with a few prominent ridges on upper cell; pedicel colorless, short, fragile.

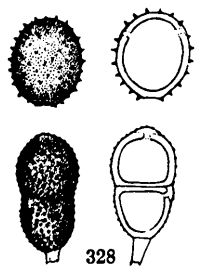

327

On Polygonaceae: **Oxyria digyna** (L.)Hill, Calif., Colo., Ida., Ore., Utah; Alta., B.C. **Range:** Alpine stations from Alberta and British Columbia, southward to Colorado and central California; also in northern Europe.

203. PUCCINIA ACETOSAE. Fig. 328.

(N. A. F. 7: 385, 789, 841.)

Uredo acetosae Schum., Enum. Pl. Saell. **2:** 231. 1803.
Puccinia acetosae (Schum.) Körn., Hedw. **15:** 184. 1876.
Dicaeoma acetosae Ktze., Rev. Gen. **3³:** 467. 1898.


328

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 20–25 by 23–30 μ; wall light chestnut-brown, 1.5–2.5 μ thick, echinulate, the pores 2, superequatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid or oblong, 19–26 by 30–46 μ, rounded at both ends, slightly constricted at septum; wall dark chestnut-brown, uniformly 2–3 μ thick, sometimes with a hyaline papilla over apical pore, the pore in lower cell near the septum, finely verrucose; pedicel colorless, short, fragile.

On Polygonaceae: **Rumex acetosella** L., Calif., Fla., Ind., Mass., N.Y., Ore.—**R. hastatulus** Baldw., Ala., Fla., Mass., S.C. **Range:** Atlantic coast from Massachusetts to Florida, Pacific coast from Oregon to central California, and locally in Indiana; also in Europe, Asia and Japan.

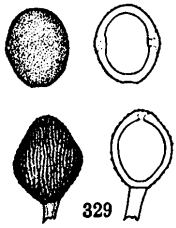
Only uredia have been seen in America.

204. UROMYCES RICKERIANUS. Fig. 329.

(N. A. F. 7: 443, 757, 795, 843.)

Uromyces rickerianus Arth., Bull. Torrey Club **29:** 227. 1902.
Pucciniola rickeriana Arth., N. Am. Flora **7:** 443. 1921.
Nigredo rickeriana Arth., N. Am. Flora **7:** 757. 1926.

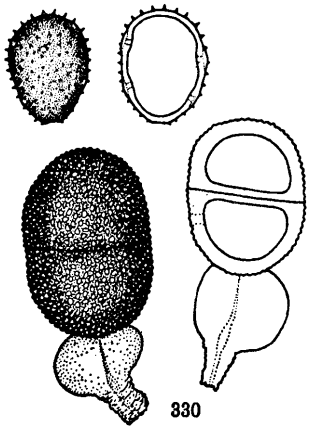
Pycnia unknown. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 16–22 μ in diameter; wall colorless, 1–1.5 μ thick, finely verrucose, often appearing smooth when wet. Uredia amphigenous, dark cinnamon-brown; urediospores globoid or broadly ellipsoid, 18–24 by 22–29 μ; wall cinnamon-brown, 2–3 μ thick, finely verrucose, the pores 3 or 4, nearly equatorial. Telia amphigenous, dark chestnut-brown; teliospores globoid or broadly ellipsoid, 18–23 by 23–28 μ, rounded at both ends; wall chestnut-brown, uniformly 2–2.5 μ thick, or slightly thicker above, striately verrucose; pedicel colorless, short, fragile.


329

On Polygonaceae: **Rumex paucifolius** Nutt.(*R. geyeri* Trel.), Ida., Utah. **Range:** Idaho to northern Utah.

205. PUCCINIA DONDIAE. Fig. 330.

(N. A. F. 7: 592.)


330

Puccinia dondiae Arth., Bull. Torrey Club **42:** 592. 1915.

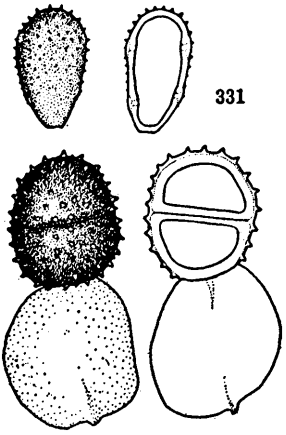
Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores broadly ellipsoid; 26–29 by 32–39 μ; wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 8, scattered. Telia amphigenous, blackish-brown; teliospores ellipsoid, 32–39 by 42–51 μ, rounded at both ends, not constricted at septum; wall dark chocolate-brown, uniformly 4–5 μ thick, both pores often somewhat depressed, indistinct, coarsely verrucose; pedicel colorless, about as long as spore, swelling in water to 32 μ in diameter.

On Chenopodiaceae: **Suaeda intermedia** Wats.(*Dondia i.* Heller), Calif. **Range:** Vicinity of San Diego, in southern California.

206. PUCCINIA GRAYIAE. Fig. 331.

(N. A. F. 7: 609.)

Uredo grayiae Arth., Bull. Torrey Club **34:** 591. 1907.
Puccinia grayiae n. comb.



331

Pycnia and aecia unknown. Uredia amphigenous, chocolate-brown; urediospores ellipsoid, 19–23 by 32–42 μ; wall cinnamon-brown, 2–2.5 μ thick, somewhat darker and thicker above, echinulate above, smooth below, the pores 8, in two transverse zones, equidistant from the equator. Telia not seen; teliospores in uredia broadly ellipsoid, 32–40 by 42–48 μ, rounded at both ends, not constricted at septum; wall dark chocolate-brown, uniformly 3–4 μ thick, conic-verrucose; pedicel colorless, once and a half length of spore, swelling greatly in water to broadly ellipsoid, often bursting.

On Chenopodiaceae: **Grayia spinosa** (Hook.) Moq.(*G. polygaloides* H.&A.), Nev. **Range:** Only one collection known, from vicinity of Fallon, Nevada.

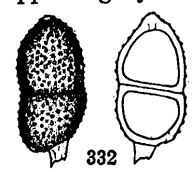
*. **Puccinia raunkaerii** Ferd. & Winge (*Aecidium rivinae* B. & C., *Dicaeoma r.* Arth.), with pycnia amphigenous, in groups; aecia amphigenous, in groups or locally systemic, forming hypertrophied and distorted shoots, cupulate, aeciospores ellipsoid, 15–23 by 26–37 μ, the wall cinnamon-brown, 1.5–2 μ thick, finely verrucose; uredia chiefly epiphyllous, cinnamon-brown, urediospores ellipsoid, 17–23 by 23–30 μ, wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 2 rarely 3, usually superequatorial; telia chiefly epiphyllous, chestnut-brown, teliospores ellipsoid, 22–27 by 29–43 μ, rounded at both ends, slightly or not constricted at septum, the wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore of upper cell usually apical, of lower cell much depressed, sparsely verrucose, the colorless pedicel short, fragile; occurs on Petiveriaceae: **Rivina humilis** L., in southern Texas; also in West Indies and South America. (N. A. F. **7**: 126, 388, 841.)

207. PUCCINIA MARIAE-WILSONI. Fig. 332.

(N. A. F. 7: 457, 797.)

(*Caeoma* (*Aecidium*) *claytoniatum* Schw., Trans. Am. Phil. Soc. II. **4**: 294. 1832.)
Puccinia mariae-wilsoni G. W. Clint.; Peck, Bull. Buffalo Soc. Nat. Sci. **1**: 66. 1873.
Puccinia claytoniata Peck, Bull. N. Y. State Mus. **6**: 226. 1899.
Allodus claytoniata Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia chiefly epiphyllous, in groups. Aecia amphigenous, evenly scattered, appearing systemic, cupulate; aeciospores globoid or broadly ellipsoid, 13–21 by 18–23 μ; wall nearly or quite colorless, 1–1.5 μ thick, very minutely verrucose. Uredia wanting. Telia chiefly hypophyllous, cinnamon-brown; teliospores ellipsoid or oblong, 18–27 by 30–48 μ, often narrowed at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pores, the pore of upper cell apical, of the lower much depressed, finely verrucose; pedicel colorless, short, fragile. Mesospores occasional, 19–22 by 29–33 μ.



332

On Portulacaceae: **Claytonia caroliniana** Michx., N.H., N.Y., Vt.; Ont.—**C. megarrhiza** (Gray)Parry, Colo.—**C. virginica** L., Del., D.C., Ill., Ind., Iowa, Ky., Md., Mich., Mo., N.J., N.Y., Ohio, Pa., Tenn., Vt., Va., W.Va., Wis.; Ont., Queb.—**Limnia alsinoides** (Sims)Haw.(*Claytonia a., Montia sibirica* Howell), Utah.—**L. asarifolia** (Bong.)Rydb.(*C. a., M. a.* Howell), Wash. **Range:** Vermont to Wisconsin, southward to Tennessee and Missouri, and sparingly in the mountains from Colorado to Washington.

Uromyces claytoniae.

(N. A. F. 7: 444.)

Uromyces claytoniae C. & P.; Peck, Ann. Rep. N. Y. State Mus. **29:** 50. 1878.
Pucciniola claytoniae Arth., N. Am. Flora **7:** 444. 1921.

Pycnia as in *Puccinia mariae-wilsoni.* Aecia as in *P. mariae-wilsoni,* but with slightly larger spores, 18–24 by 23–29 μ and thicker walls, 1.5–3 μ. Uredia wanting. Telia as in *P. mariae-wilsoni,* but teliospores 1-celled, 19–26 by 29–45 μ, the wall finely verrucose in faint striae.

On Portulacaceae: **Claytonia caroliniana** Michx., N.Y. **Range:** Vicinity of Cold Spring in southern New York.

Puccinia agnita.

(N. A. F. 7: 526.)

Puccinia agnita Arth., Bull. Torrey Club **42:** 590. 1915.
Micropuccinia agnita A. & J., N. Am. Flora **7:** 526. 1922.

Pycnia as in *Puccinia mariae-wilsoni.* Aecia and uredia wanting. Telia and teliospores as in *P. mariae-wilsoni.*

On Portulacaceae: **Claytonia megarrhiza** (Gray)Parry, Colo. **Range:** Vicinity of Cumberland Mine, La Plata Mountains, Colorado, altitude 12,000 feet.

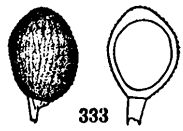
The correlation of this microcyclic species with *Puccinia mariae-wilsoni* was recorded in the N. Am. Flora **7:** 526. 1922.

208. UROMYCES SPRAGUEAE. Fig. 333.

(N. A. F. 7: 444, 795.)

Uromyces spragueae Hark., Bull. Calif. Acad. **1:** 36. 1884.
Pucciniola spragueae Arth., N. Am. Flora **7:** 444. 1921.

Pycnia unknown, probably not formed. Aecia chiefly hypophyllous, scattered or in groups, cupulate; aeciospores globoid or irregular, 15–19 by 16–23 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, single or in groups, for a time covered with epidermis, chocolate-brown; teliospores ovoid or obovate-oblong, 19–26 by 24–35 μ, rounded or obtuse at both ends; wall chestnut-brown, 2–3 μ thick at sides, 3–5 μ above, striately verrucose; pedicel colorless, short, fragile.



333

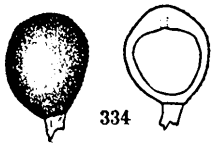
On Portulacaceae: **Calyptridium roseum** Wats., Ore.—**Spraguea multiceps** Howell, Ore., Wyo.—**S. umbellata** Torr.(*Calyptridium u.* Greene), Calif. **Range:** Western Wyoming to eastern Oregon, southward to central California.

209. UROMYCES UNITUS. Fig. 334.

(N. A. F. 7: 445.)

Uromyces unitus Peck, Bull. Torrey Club **10:** 74. 1883.
Pucciniola unita Arth., N. Am. Flora **7:** 445. 1921.

Pycnia unknown. Aecia amphigenous, in groups, cupulate; aeciospores globoid, often angular, 13–18 by 16–25 μ; wall nearly or quite colorless, 1.5–2 μ


334

thick, very minutely verrucose. Uredia wanting. Telia amphigenous, at first intimately associated with the aecia, blackish-brown; teliospores globoid or broadly ellipsoid, 21–30 by 23–32 μ, rounded above and below; wall chocolate-brown, 3–4 μ thick at sides, 5–9 μ above, very minutely verrucose; pedicel nearly or quite colorless, short, fragile.

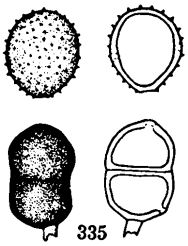
On Portulacaceae: **Lewisia columbiana** (Howell) B.L.Rob., Wash.—**L. rediviva** Pursh, Mont. **Range:** Western Montana and one station in Washington.

210. PUCCINIA TARDISSIMA. Fig. 335.

(N. A. F. 7: 389, 789, 841.)

Puccinia tardissima Garrett, Mycol. **6:** 251. 1914.
Dicaeoma tardissimum Arth., N. Am. Flora **7:** 389. 1920.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or obovate, 18–23 by 20–26 μ; wall golden-brown, 1–2 μ thick, echinulate, the pores uncertain, either 3 or 4 near the equator, or 3–6 and scattered. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 18–24 by 26–35 μ, rounded at both ends, slightly constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pores much depressed in both cells, smooth; pedicel colorless, short, fragile.


335

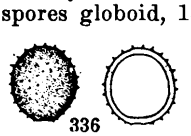
On Caryophyllaceae: **Arenaria burkei** Howell, Colo.—**A. congesta** Nutt., Colo., Wyo.—**A. fendleri** Gray, Colo., N.M.—**A. laxiflora** Rydb., Colo.—**A.** sp., Utah. **Range:** Northern Wyoming, southward to New Mexico.

211. UROMYCES VERRUCULOSUS. Fig. 336.

(N. A. F. 7: 759.)

Uredo lychnidis Schroet., Abh. Schles. Ges. **48:** 30, hyponym. 1870.
Uromyces verruculosus Schroet., Jahresb. Schles. Ges. **50:** 140. 1873.
Uromyces schroeteri De-T.; Sacc., Syll. Fung. **7:** 551. 1888.
Uromyces lychnidis Lagerh., Bol. Soc. Brot. **8:** 7. 1890.
Nigredo verruculosa Arth., Bull. Torrey Club **51:** 59. 1924.

Pycnia and aecia unknown. Uredia hypophyllous, cinnamon-brown; urediospores globoid, 18–22 by 19–26 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3–5, scattered, equatorial or in upper part of spore. Telia sparingly produced, blackish-brown; teliospores globoid or broadly obovoid, 17–22 by 18–25 μ; wall dark chestnut-brown, uniformly 2.5 μ thick, with a hyaline papilla over the pore, minutely verrucose; pedicel colorless, short, fragile.


336

On Caryophyllaceae: **Lychnis alba** Mill. (*Melandrium a.* Garcke), Ind., Mich., N.Y. **Range:** Southern peninsula of Michigan to southern Indiana, and on Long Island, New York; also in Europe.

A recently introduced species. Only uredia have been reported for this country.

212. UROMYCES CARYOPHYLLINUS. Fig. 337.

(N. A. F. 7: 246, 759, 829.)

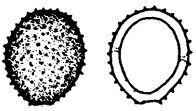
Lycoperdon caryophyllinum Schr., Baier. Fl. **2:** 668. 1789.
Uredo dianthi Pers., Syn. Fung. 222. 1801.

Uromyces dianthi Niessl, Verh. Nat. Ver. Brünn **10²**: 162. 1872.
Uromyces caryophyllinus (Schr.) Wint., in Rab., Krypt. Fl. **1**: 149. 1881.
(*Aecidium euphorbiae-gerardianae* Fisch., Beitr. Krypt. Schweiz **2²**: 530. 1904.)
Nigredo caryophyllina Arth., N. Am. Flora **7**: 246. 1912.

Pycnia hypophyllous, systemic. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 16–22 μ in diameter; wall nearly or quite colorless, 1 μ or less thick, finely verrucose.

On Euphorbiaceae: **Euphorbia gerardiana** Jacq., only in Europe.

Uredia amphigenous, dark cinnamon-brown; urediospores broadly ellipsoid, 20–24 by 24–30 μ; wall golden-brown, 2.5–3 μ thick, echinulate, the pores 3 or 4, equatorial. Telia amphigenous, chestnut-brown; teliospores ellipsoid, 19–23 by 25–29 μ, obtuse or rounded above and below; wall light chestnut-brown, uniformly 3 μ thick, with a hyaline papilla over the pore, very finely verrucose; pedicel colorless, short, fragile.


337

On Caryophyllaceae: **Dianthus barbatus** L., Neb.—**D. caryophyllus** L., Ind., and every other state and province where the host is grown.—**D. chinensis** L., Neb.—**D. pelviformis** Heuffel, Neb. **Range:** Introduced throughout the United States and southern Canada, chiefly in greenhouses; also in West Indies, South America, Europe, Asia, Japan, Formosa, Australia, New Zealand and Africa.

Cultures in 1910 made by Fischer (Centr. Bakt. **28**: 141. 1910) with aeciospores from *Euphorbia gerardiana* gave infection on *Saponaria ocymoides*, but not on *Dianthus sylvestris* or on *Ononis*, *Silene* and *Viscaria*. The earlier report by Krieg (Centr. Bakt. **17**: 210. 1906) is considered to be an error. Treboux (Ann. Myc. **10**: 563. 1912) reported successful cultures by sowing aeciospores from *Euphorbia gerardiana* on *Dianthus arenarius*, *D. campestris*, *D. capitatus*, *D. caryophyllus* and *D. pseudarmeria*.

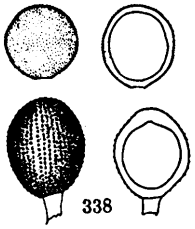
The description given by Schrank applies to the telia, although he placed the species in the genus *Lycoperdon*.

213. UROMYCES SUKSDORFII. Fig. 338.

(N. A. F. 7: 759.)

Uromyces suksdorfii D. & H.; Diet., Erythea **3**: 77. 1895.
Uromyces lychnidis Tr. & Earle; Jones, Proc. Calif. Acad. II. **5**: 729. 1895
Nigredo suksdorfii Arth., Bull. Torrey Club **51**: 58. 1924.

Pycnia unknown. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 13–18 by 19–24 μ; wall colorless, 1.5 μ thick, minutely verrucose. Uredia chiefly epiphyllous, golden-yellow; urediospores globoid, 18–23 by 19–26 μ; wall golden-yellow, 1.5–2 μ thick, evenly verrucose, the pores 3 or 4, nearly equatorial. Telia chiefly epiphyllous, blackish-brown; teliospores broadly ellipsoid, 18–24 by 23–32 μ; wall chestnut-brown, 3–3.5 μ thick at sides, 4–6 μ above, coarsely verrucose in close longitudinal lines; pedicel nearly or quite colorless, short, fragile.


338

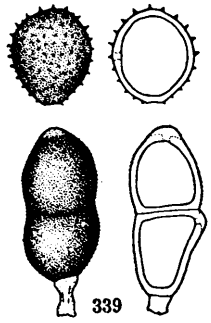
On Caryophyllaceae: **Silene drummondii** Hook. (*Wahlbergella d.* Rydb.), Utah.—**S. hallii** Wats., Colo., N.M.—**S. occidentalis** Wats., Calif.—**S. oregana** Wats., Ida., Wash.—**S. scouleri** Hook., Wash.—**S. verecunda** Wats., Calif. **Range:** Idaho and Washington to central California and northern New Mexico.

214. PUCCINIA CALTHAECOLA. Fig. 339.

(N. A. F. 7: 390, 790.)

Puccinia calthaecola Schroet., Beitr. Biol. Pfl. **3**: 61. 1879.
Puccinia zopfii Wint., Hedw. **19**: 39. 1880.
Dicaeoma calthaecola Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid or ellipsoid, 16–24 by 20–28 μ; wall about 1 μ thick, finely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores ellipsoid or obovoid, 20–27 by 24–33 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2 or 3, approximately equatorial. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid or oblong, 23–30 by 37–51 μ, rounded or obtuse at both ends, or narrowed below, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–2.5 μ thick, usually with a hyaline papilla over apical pore, pore of upper cell apical, of lower cell more or less depressed, inconspicuously verrucose; pedicel colorless, short, fragile.


339

On Ranunculaceae: **Caltha palustris** L., Iowa, Mich., Minn., N.Y., Wis.; Man. **Range:** Lake region, from northern New York to western Manitoba, southward to northeastern Iowa; also in Europe and Japan.

Puccinia treleasiana.

(N. A. F. 7: 529.)

Puccinia treleasiana Paz.; Rab.-Wint.-Paz., Fungi Eur. *3821*. 1892.
Micropuccinia treleasiana A. & J., N. Am. Flora **7**: 529. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous and petiolicolous, otherwise as in *P. calthaecola;* teliospores as in *P. calthaecola* except slightly smaller, 19–25 by 33–48 μ and with thinner wall, 1.5–2 μ.

On Ranunculaceae: **Caltha biflora** DC., Wash.—**C. leptosepala** DC., B.C.—**C. rotundifolia** (Huth)Greene, Colo., Nev., Utah, Wyo. **Range:** Wyoming to British Columbia, southward to Colorado and northern Nevada.

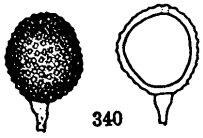
Although differing in hosts and distribution the morphology of this species agrees so closely with that of *P. calthaecola* as to indicate that the two species are correlated.

215. UROMYCES JONESII. Fig. 340.

(N. A. F. 7: 445, 795.)

Uromyces jonesii Peck, Bot. Gaz. **7**: 45. 1882.
Pucciniola jonesii Arth., N. Am. Flora **7**: 445. 1921.

Pycnia hypophyllous, among the aecia. Aecia chiefly hypophyllous, systemic, cupulate; aeciospores globoid, 16–23 by 21–26 μ; wall nearly or quite colorless, 1–1.5 μ thick, very finely verrucose. Uredia wanting. Telia amphigenous, reddish-brown; teliospores globoid or obovoid, 19–26 by 24–35 μ, rounded at both ends or narrowed below; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, coarsely verrucose; pedicel colorless, short, fragile.


340

On Ranunculaceae: **Ranunculus alismaefolius** Geyer, Colo., Mont., Wyo.—**R. alismellus** (Gray)Greene, Calif., Colo., Wyo.—**R. hartwegii** Greene,

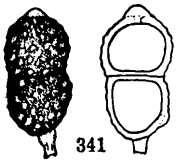
Calif. **Range:** Northwestern Wyoming to western Colorado and central California.

216. PUCCINIA RANUNCULI. Fig. 341.

(N. A. F. 7: 530.)

Puccinia ranunculi Blytt, Forh. Vid-Selsk. Christ. **1882**[5]: 12. 1882.
Puccinia nuttallii E. & E., Bull. Torrey Club **24:** 283. 1897.
Micropuccinia ranunculi A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia wanting, although a few aeciospores occur in particularly vigorous telial sori in the Arizona collections, globoid, 16–20 by 18–24 μ; wall nearly or quite colorless, 1–1.5 μ thick, very finely verrucose. Uredia wanting. Telia amphigenous, blackish-brown; teliospores ellipsoid or oblong, 19–26 by 32–45 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, with a hyaline papilla over the pores, the pore of upper cell apical, of lower more or less depressed, irregularly tuberculate; pedicel colorless, short, fragile.


341

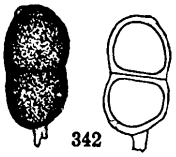
On Ranunculaceae: **Cyrtorhyncha neglecta** Greene, Colo.—**C. ranunculina** Nutt.(*Ranunculus nuttallii* Gray), Colo., Wyo.—**Ranunculus eschscholtzii** Schl., Alas., Utah.—**R. glaberrimus** Hook., Colo.—**R. stenolobus** Rydb., Utah.—**R. subsagittatus** (Gray)Greene, Ariz.—**R. suksdorfii** Gray, Wash.; B.C. **Range:** British Coumbia and Alaska to central Colorado, southwestward to Arizona; also in Europe.

217. PUCCINIA RETECTA. Fig. 342.

(N. A. F. 7: 152, 802.)

Puccinia retecta Syd., Ann. Myc. **1:** 34. 1903.
Polythelis retecta Arth., Rés. Sci. Congr. Bot. Vienna 341. 1906.
Micropuccinia retecta A. & J., N. Am. Flora **7:** 802. 1927.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, cinnamon-brown; teliospores oblong or ellipsoid, 21–22 by 32–40 μ, rounded at both ends or narrowed below, slightly constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pores of both cells more or less depressed, finely rugose; pedicel colorless, short, fragile.


342

On Ranunculaceae: **Anemone zephyra** Nels., Alas., Colo. **Range:** Southeastern Alaska and western Colorado; also in Turkestan.

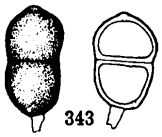
The species was erroneously assigned to the genus *Polythelis* in the N. Am. Flora (p. 152), and also (p. 802) said to occur on *Anemone lithophila* in Wyoming. The latter collection has since been found to be *Tranzschelia* (*Polythelis*) *suffusca* on *Pulsatilla occidentalis*.

218. PUCCINIA ANDINA. Fig. 343.

(N. A. F. 7: 529.)

Puccinia ranunculi Seym.; Burr., Bot. Gaz. **9:** 191. 1884. Not *P. ranunculi* A. Blytt, 1882.
Puccinia andina Diet. & Neg., Bot. Jahrb. **27:** 4. 1899.
Puccinia diffusa Holw., N. Am. Ured. **1:** 13. 1905.
Micropuccinia andina A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, systemic, chestnut-brown; teliospores ellipsoid or oblong, 18–24 by 24–36 μ, rounded above and below, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1–1.5 μ thick, the pore of upper cell usually apical, of lower much depressed, minutely verrucose; pedicel colorless, often oblique, very short, fragile. Mesospores common.


343

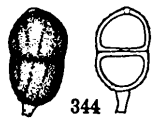
On Ranunculaceae: **Ranunculus septentrionalis** Poir., Ill. **Range:** Vicinity of Chicago, Illinois, one collection only; also in Mexico and South America.

219. PUCCINIA DELPHINII. Fig. 344.

(N. A. F. 7: 529.)

Puccinia delphinii D. & H.; Diet., Hedw. **32:** 29. 1893.
Micropuccinia delphinii A. & J., N. Am. Flora **7:** 529. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, systemic, chestnut-brown; teliospores ellipsoid, 16–24 by 21–30 μ, rounded at both ends, slightly constricted at septum; wall cinnamon-brown, uniformly 1–1.5 μ thick, the pore of upper cell usually apical, of lower much depressed, minutely verrucose in striae; pedicel colorless, very short, fragile.


344

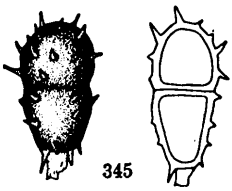
On Ranunculaceae: **Delphinium** sp., Calif. **Range:** Only one collection from King's River Canyon, northern California.

220. PUCCINIA PODOPHYLLI. Fig. 345.

(N. A. F. 7: 458, 798, 844.)

(*Aecidium podophylli* Schw., Schr. Nat. Ges. Leipzig **1:** 66. 1822.)
Puccinia podophylli Schw., Schr. Nat. Ges. Leipzig **1:** 72. 1822.
Puccinia aculeata Link, in Willd., Sp. Pl. **6**[2]**:** 79. 1825.
Allodus podophylli Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous, usually in large groups, cupulate; aeciospores globoid or broadly ellipsoid, 18–24 by 19–29 μ; wall colorless, about 1 μ thick, minutely verrucose. Uredia wanting. Telia amphigenous, in large groups when on young leaves, sheaths and base of stems, but hypophyllous and scattered when on mature leaves, chocolate-brown; teliospores oblong or clavate, 19–26 by 40–55 μ, rounded above, narrowed below, rarely constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, the pore of upper cell usually apical, of the lower much depressed, sparingly beset with straight or slightly curved spines about 7 μ long; pedicel usually colored, short, fragile.


345

On Berberidaceae: **Podophyllum peltatum** L., Ala., Ark., Conn., Del., D.C., Ill., Ind., Iowa, Kans., Ky., La., Md., Mich., Minn., Miss., Mo., N.J., N.Y., N.C., Ohio, Pa., S.C., Tenn., Va., W.Va., Wis.; Ont. **Range:** New York to Minnesota, southward to South Carolina and Arkansas.

Cultures were made in 1904 by Arthur (Jour. Myc. **11:** 65. 1905) using aeciospores sown on fully expanded leaves, and producing scattered telia. Extensive and varied cultures were undertaken between 1915 and 1921 by Whetzel, Jackson & Mains (Jour. Agr. Res. **30:** 65–79. 1925) and further discussed by Jackson (Mem. Torrey Bot. Club **18:** 8–66. 1931).

221. PUCCINIA BRANDEGEI. Fig. 346.

(N. A. F. 7: 531, 802.)

Puccinia brandegei Peck, Bot. Gaz. **7**: 44. 1882.
Micropuccinia brandegei A. & J., N. Am. Flora **7**: 531. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous dark cinnamon-brown; teliospores ellipsoid, 18–21 by 29–34 μ, usually narrowed at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1–1.5 μ thick, with a hyaline papilla over the pores, the pore of upper cell usually apical, of the lower much depressed, minutely verrucose, appearing smooth when wet; pedicel colorless, short, fragile.


346

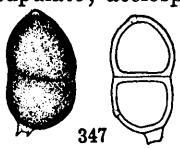
On Fumariaceae: **Corydalis brandegei** Wats.(*Capnoides b.* Heller), Colo.—**C. scouleri** Hook.(*C. s.* Ktze.), Wash. **Range:** Only two collections reported, central Washington and Colorado.

222. PUCCINIA ARABICOLA. Fig. 347.

(N. A. F. 7: 459, 798.)

Puccinia arabicola E. & E., Jour. Myc. **6**: 119. 1891.
Allodus arabicola Arth. & Orton, N. Am. Flora **7**: 459. 1921.

Pycnia chiefly epiphyllous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 16–19 by 19–21 μ; wall colorless, about 1 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, tardily naked, at first somewhat plumbeous, when naked dark chestnut-brown; teliospores ellipsoid, 19–24 by 32–40 μ, usually rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pore in upper cell usually apical, in the lower much depressed, smooth; pedicel colorless, short, fragile.


347

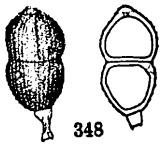
On Brassicaceae (*Cruciferae*): **Cardamine douglasii** (Torr.)Britt., Ont. **Range:** Vicinity of Ottawa, Canada, only one collection reported.

223. PUCCINIA OUDEMANSII. Fig. 348.

(N. A. F. 7: 532.)

Puccinia oudemansii Tranz.; Sydow, Monog. Ured. **1**: 894. 1904.
Puccinia utahensis Garrett; Holw., N. Am. Ured. **1**: 46. 1906.
Micropuccinia utahensis A. & J., N. Am. Flora **7**: 532. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chocolate-brown; teliospores ellipsoid or oblong, 16–19 by 30–44 μ, rounded or obtuse at both ends, somewhat constricted at septum; wall light chestnut-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over pore of upper cell, the pore in upper cell apical, in the lower more or less depressed, minutely striate-verrucose; pedicel colorless, short, fragile.


348

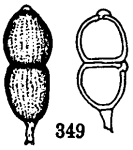
On Brassicaceae (*Cruciferae*): **Parrya platycarpa** Rydb., Utah.—**Thlaspi glaucum** Nels., Utah. **Range:** Northern Utah; also in Norway and Turkestan.

224. PUCCINIA EUTREMAE. Fig. 349.

(N. A. F. 7: 531.)

Puccinia eutremae Lindr., Acta Soc. Fauna Flora Fennica **22**[3]: 9. 1902.
Puccinia cochleariae Lindr., Acta Soc. Fauna Flora Fennica **22**[3]: 10. 1902.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous and petiolicolous, pulvinate or pulverulent, chocolate-brown; teliospores ellipsoid or oblong, 13–18 by 27–45 μ, rounded at both ends, somewhat constricted at septum, the two cells readily falling apart; wall dark cinnamon-brown, uniformly 1.5 μ thick, with a small hyaline papilla over the pores, the pore of lower cell at the septum, smooth or minutely striate; pedicel colorless, short, fragile.


349

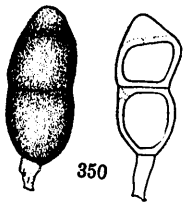
On Brassicaceae (*Cruciferae*): **Cochlearia officinalis** L.(*C. fenestrata* R.Br., *C. groenlandica* L.), Greenl. **Range:** Western Greenland; also in Europe.

225. PUCCINIA ABERRANS. Fig. 350.

(N. A. F. 7: 533, 846.)

Puccinia aberrans Peck, Bot. Gaz. **4:** 217. 1879.
Micropuccinia aberrans A. & J., N. Am. Flora **7:** 533. 1922.

Pycnia amphigenous, preceding or among the telia. Aecia and uredia wanting. Telia chiefly hypophyllous, systemic, chestnut-brown; teliospores oblong, 22–28 by 35–45 μ, rounded above, usually narrowed below, slightly or not constricted at septum; wall chestnut-brown, 2–3.5 μ thick at sides, 7–10 μ above, the pores apical or more or less depressed, minutely verrucose-rugose; pedicel colorless, short, fragile. Mesospores and three-celled spores occur.


350

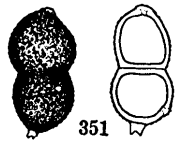
On Brassicaceae (*Cruciferae*): **Smelowskia americana** Rydb.(*S. calycina* Am.auth.), Colo., Mont., Utah, Wash.—**S. lobata** Rydb., Nev. **Range:** Northern Montana southward to central Colorado and Nevada.

226. PUCCINIA DRABAE. Fig. 351.

(N. A. F. 7: 531, 802, 846.)

Puccinia drabae Rud., Linnaea **4:** 115. 1829.
Micropuccinia drabae A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia caulicolous, fruticolous, or rarely hypophyllous, long covered by cinereous epidermis, chestnut-brown when naked; teliospores ellipsoid or oblong, 13–20 by 26–38 μ, rounded above and below, slightly constricted at septum; wall dark cinnamon-brown, uniformly 1.5–3 μ thick, the pores of both cells usually more or less depressed, finely verrucose-rugose; pedicel colorless, short, fragile.


351

On Brassicaceae (*Cruciferae*): **Draba arabisans** Michx., Queb.—**D. aurea** Vahl, Alas.—**D. globosa** Payson, Utah.—**D. hirta** L.(*D. arctica* Vahl), Greenl.—**D. incana** L., Greenl.—**D. incerta** Payson, Wyo.; Alta. **Range:**

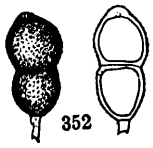
Boreal stations, from western Greenland to southeastern Alaska, southward to southeastern Quebec and northern Utah; also in Europe.

227. PUCCINIA CRUCIFERARUM. Fig. 352.

(N. A. F. 7: 533, 846.)

Puccinia cruciferarum Rud., Linnaea **4**: 391. 1829.
Puccinia cardamines-bellidifoliae Diet., Bot. Jahrb. **27**: 4. 1899.
Micropuccinia cruciferarum A. & J.; Arth., Bull. Torrey Club **48**: 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chestnut-brown; teliospores oblong, 14–18 by 30–38 μ, rounded or obtuse at both ends, somewhat constricted at septum; wall dark cinnamon-brown, uniformly 1–2 μ thick, with a hyaline papilla over the pores, the pore in both cells usually somewhat depressed, finely verrucose; pedicel colorless, short, fragile.


352

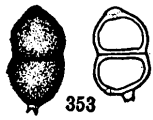
On Brassicaceae (*Cruciferae*): **Cardamine bellidifolia** L., Greenl.; B.C.—**C. cordifolia** Gray, Utah, Wyo. **Range:** Boreal stations, eastern Greenland, Wyoming, northern Utah and British Columbia.

228. PUCCINIA RYDBERGII. Fig. 353.

(N. A. F. 7: 534.)

Puccinia rydbergii Garrett, Mycol. **6**: 251. 1914.
Micropuccinia rydbergii A. & J., N. Am. Flora **7**: 534. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, dark cinnamon-brown; teliospores ellipsoid, 16–20 by 26–32 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, or slightly thicker above, the pore of upper cell apical, of the lower much depressed, finely verrucose; pedicel colorless, short, fragile.


353

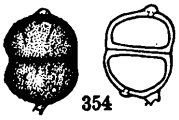
On Crassulaceae: **Sedum debile** Wats.(*Gormannia d.* Britt.), Utah.—**S. stenopetalum** Pursh, Utah; B.C. **Range:** Mountains of Utah and British Columbia.

229. PUCCINIA UMBILICI. Fig. 354.

(N. A. F. 7: 534.)

Puccinia umbilici Guep.; Duby, Bot. Gall. **2**: 890. 1830.
Puccinia rhodiolae B. & Br., Ann. Mag. Nat. Hist. II. **5**: 462. 1850.
Micropuccinia rhodiolae A. & J., N. Am. Flora **7**: 534. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, cinnamon-brown; teliospores broadly ellipsoid, 20–26 by 28–32 μ, rounded at both ends, not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pores, pore in upper cell apical, in lower cell near pedicel, smooth or with a few faint verrucose striae; pedicel colorless, short, fragile.


354

On Crassulaceae: **Rhodiola integrifolia** Raf.(*Sedum rhodiola* Coult., not DC.), Colo. **Range:** Mountains of central Colorado; also in Europe.

230. PUCCINIA HEUCHERAE. Fig. 355.

(N. A. F. 7: 535, 536, 537, 802, 803, 846.)

Uredo heucherae Schw., Schr. Nat. Ges. Leipzig **1**: 71. 1822.
Puccinia saxifragae Schl., Fl. Berol. **2**: 134. 1824.

Puccinia curtipes Howe, Bull. Torrey Club **5:** 3. 1874.
Puccinia heucherae (Schw.) Diet., Ber. Deuts. Bot. Ges. **9:** 42. 1891.
Puccinia pallido-maculata E. & E.; Holw., N. Am. Ured. **1:** 49. 1906.
Puccinia lithophragmae Holw., N. Am. Ured. **1:** 51. 1906.
Micropuccinia heucherae A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.
Micropuccinia curtipes A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.
Micropuccinia pallido-maculata A. & J., N. Am. Flora **7:** 535. 1922.
Micropuccinia lithophragmae A. & J., N. Am. Flora **7:** 537. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chestnut- or chocolate-brown, often cinereous by germination; teliospores in germinating condition oblong or fusiform-oblong, 13–19 by 28–45 μ, obtuse above, narrowed below, in resting condition ellipsoid, rarely oblong, 16–20 by 26–34 μ, rounded above and below, in both forms slightly or not constricted at septum; wall in resting condition dark cinnamon-brown, uniformly 1–2.5 μ thick, with hyaline papilla over pore of upper cell, the pore of lower cell usually at or near the septum, strongly striate, in germinating condition paler, 1–2 μ thick at sides, 5–8 μ above, the pore of lower cell at septum, smooth or somewhat striate; pedicel colorless, short or sometimes long, fragile.


355

On Saxifragaceae: **Heuchera americana** L., N.C., S.D., Wis.—**H. bracteata** (Torr.)Seringe, Colo., Wyo.—**H. cylindrica** Dougl., Wash.—**H. elegans** Abrams, Calif.—**H. glabella** T.&G., Mont., Wash.—**H. glabra** Willd., Alas.; B.C.—**H. hallii** Gray, Colo.—**H. hispida** Pursh, Neb., N.D., S.D.—**H. micrantha** Dougl., Calif., Ore., Wash.—**H. ovalifolia** Nutt., Alta.—**H. parvifolia** Nutt., Colo., N.M., Utah, Wyo.—**H. richardsonii** R.Br., Man.—**H. rubescens** Torr., Ariz., Utah.—**H. villosa** Michx., N.C.—**Lithophragma affinis** Gray (*Tellima a.* Boland.), Calif.—**L. parviflora** (Hook.)Nutt.(*T. p.*), Utah.—**Micranthes arguta** (D.Don)Small(*Saxifraga a., S. punctata* Am.auth.), Colo., Ida., Mont., N.M., Utah, Wash., Wyo.—**M. californica** (Greene)Small(*S. c.*), Calif., Ore.—**M. columbiana** (Piper)Small(*S. c.*), Ida.—**M. fragosa** (Suks.) Small(*S. f.* Greene), Wash.—**M. integrifolia** (Hook.)Small(*S. i.*), B.C.—**M. lyallii** (Engelm.)Small(*S. l.* Small), Alta.—**M. marshallii** (Greene)Small(*S. m.*), Ore.—**M. nelsoniana** (D. Don)Small(*S. n.*), Alas.—**M. nivalis** (L.)Small (*S. n.*), Greenl.—**M. occidentalis** (Wats.)Small(*S. o.*), Wash.—**M. oregana** (Howell)Small(*S. o.*), Wash.—**M. pennsylvanica** (L.)Haw.(*S. p.*), Ind., Minn. —**M. rhomboidea** (Greene)Small(*S. r.*), Wyo.—**M. virginiensis** (Michx.)Small (*S. v.*), Conn., N.J., N.Y., Ohio, Pa., W.Va.—**Mitella breweri** Gray(*Pectiantia b.* Rydb.), Calif., Ore., Wash.; B.C.—**M. caulescens** Nutt., Wash.—**M. diphylla** L., Conn., Ind., Iowa, Mich., N.Y., Pa., Tenn., Wis.; Ont.—**M. nuda** L., Me., Mich., Mont., N.Y., Wis.; Alta., Ont., Sask.—**M. ovalis** Greene, Ore.—**M. pentandra** Hook., Colo., Ida., Utah, Wash.—**M. stauropetala** Piper(*Ozomelis s.* Rydb.), Ida., Wyo.—**M. stenopetala** Piper(*O. s.* Rydb.), Utah.—**Saxifraga cernua** L., Greenl.—**S. debilis** Engelm., Utah.—**S. mertensiana** Bong.(*Heteresia m.* Small), Ida., Wash.—**S. rivularis** L., Mont., Wyo.; B.C.—**Tellima grandiflora** (Pursh)Dougl.(*Mitella g.*), Alas., Calif., Ore., Wash.; B.C.—**Tiarella cordifolia** L., Colo., Conn., Mich., N.Y., Tenn., Vt., W.Va.; Ont., Queb.—**T. trifoliata** L., Alas., Wash.—**T. unifoliata** Hook., Ida., Mont., Ore., Wash.; B.C.—**Tolmiea menziesii** T.&G.(*Leptaxis m.* Raf.), Ore. **Range:** Greenland to southeastern Alaska, southward to North Carolina and central California; also in Europe, eastern Asia and Japan.

The teliospores grade from entirely smooth to striate, sometimes even in the same sorus. In the resting condition the telia are usually pulverulent and the teliospores more or less striate, while in the germinating condition the telia are usually pulvinate and the teliospores more elongated and smooth or nearly so. Occasionally both teliosporic conditions exist in the same sorus, even in pulverulent telia.

231. PUCCINIA PAZSCHKEI. Fig. 356.

(N. A. F. 7: 537, 538.)

Puccinia pazschkei Diet., Hedw. **30:** 103. 1891.
Puccinia saxifragae-tricuspidatae P. Henn.; Allesch. & Henn., Bibl. Bot. 8^{42a}: 41. 1897.
Puccinia jueliana Diet., Hedw. **36:** 298. 1897.
Puccinia aspera D. & H.; Arth., Bull. Torrey Club **29:** 230. 1902. Not *P. aspera* Bon., 1869.
Puccinia heterisiae Jacks.; Arth., Bull. Torrey Club **47:** 471. 1920.
Micropuccinia heterisiae A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.
Micropuccinia saxifragae-tricuspidatae A. & J., N. Am. Flora **7:** 538. 1922.
Micropuccinia jueliana A. & J., N. Am. Flora **7:** 538. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chestnut-brown; teliospores oblong, 16–23 by 30–45 μ, rounded or obtuse above and below, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, with a hyaline papilla over pore of upper cell, the pore of upper cell usually apical, of lower cell at septum, rugose, sometimes nearly smooth; pedicel colorless, short, fragile.


356

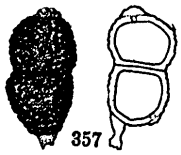
On Saxifragaceae: **Leptasea tricuspidata** (Retz.)Haw. (*Saxifraga t.*), N.W.Terr.; Greenl.—**Saxifraga mertensiana** Bong.(*Heterisia m.* Small), Ida., Mont., Wash.—**S. nootkana** Moc.(*Spatularia brunoniana* Small), B.C. **Range:** Greenland to North West Territory southward to northern Montana and central Washington.

232. PUCCINIA TURRITA. Fig. 357.

(N. A. F. 7: 537.)

Puccinia turrita Arth., Bull. Torrey Club **29:** 230. 1902.
Micropuccinia turrita A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chestnut-brown; teliospores oblong or ellipsoid, 20–24 by 36–45 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, with a hyaline papilla over pore of upper cell, the pore of upper cell usually apical, of lower cell more or less depressed, coarsely and irregularly tuberculate, especially at apex; pedicel colorless, short, fragile.


357

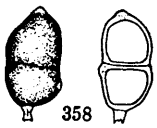
On Saxifragaceae: **Saxifraga austromontana** (Wieg.)Small(*S. bronchialis* Pursh, *Leptasea a.* Small), Colo., Utah. **Range:** Central Coloradb and southeastern Utah, only two collections known.

233. PUCCINIA PARNASSIAE. Fig. 358.

(N. A. F. 7: 538.)

Puccinia parnassiae Arth., Bull. Torrey Club **31:** 3. 1904.
Micropuccinia parnassiae A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.
Puccinia parnassiaecola Barth., Handb. N. Am. Ured. ed. 2. 138. 1933.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 16–20 by 30–36 μ, rounded or sometimes obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1–2 μ thick, usually with a hyaline papilla over pore of upper cell, the pore of upper cell apical, of the lower usually more or less depressed, minutely verrucose; pedicel colorless, short, fragile.


358

On Parnassiaceae: **Parnassia fimbriata** Banks, Utah; Alta., B.C. **Range:** High altitudes, British Columbia to northern Utah.

234. PUCCINIA RIBIS. Fig. 359.

(N. A. F. 7: 538, 846.)

Puccinia ribis DC., Fl. Fr. **2:** 221. 1805.
Puccinia pulchella Peck, Bull. Buffalo Soc. Nat. Sci. **1:** 66. 1873.
Micropuccinia ribis Rostr., Plantep. Haandb. 266. 1902.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly epiphyllous, chestnut-brown; teliospores ellipsoid or oblong, 13–19 by 26–35 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, with a hyaline papilla over pore of upper cell, the pore of upper cell apical, of the lower usually near pedicel, noticeably verrucose; pedicel colorless, short, fragile.


359

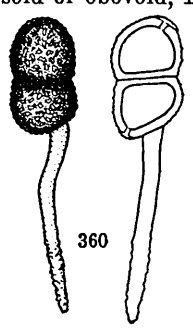
On Grossulariaceae: **Ribes glandulosum** Weber (*R. prostratum* L'Her.), Me., N.Y., Vt., Wis.—**R. rubrum** L., Mich., Minn., Wis.—**R. triste** Pall. (*R. rubrum* Gray, not L.), Me., Wash.; Sask.—**R. vulgare** Lam., Minn. **Range:** Maine to southeastern Washington; also in Europe and Japan.

235. PUCCINIA AGRIMONIAE. Fig. 360.

(N. A. F. 7: 723.)

Uropyxis agrimoniae Arth., Bull. Torrey Club **37:** 575. 1910.
Puccinia agrimoniae n. comb.

Pycnia and aecia unknown. Uredia unknown; urediospores broadly ellipsoid or obovoid, 16–18 by 18–21 μ; wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 2, equatorial. Telia hypophyllous, chocolate-brown, pulverulent; teliospores ellipsoid, 18–21 by 25–27 μ, the wall chestnut-brown, uniformly 3 μ thick, the pore in upper cell apical, in lower cell depressed, with a small hyaline papilla over pores, rugose; pedicel long, hyaline, often inserted obliquely.


360

On Rosaceae: **Agrimonia pubescens** Wallr. (*A. mollis* Britt.), Mo. **Range:** Central Missouri, in the vicinity of Sumner.

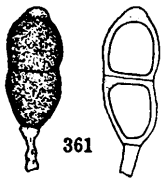
Urediospores as here described are found in small numbers among the teliospores and probably belong to this species.

236. PUCCINIA SIEVERSIAE. Fig. 361.

(N. A. F. 7: 539.)

Puccinia sieversiae Arth., Bull. Torrey Club **31:** 3. 1904.
Micropuccinia sieversiae A. & J., N. Am. Flora **7:** 539. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chestnut-brown; teliospores ellipsoid or oblong, 16–22 by 30–39 μ, rounded or sometimes obtuse at both ends, slightly or not constricted at septum; wall cinnamon-brown, 1.5–2.5 μ thick at sides, 4–6 μ above, the pore in upper cell apical, of the lower at the septum, obscurely rugose; pedicel colorless, short, fragile.



361

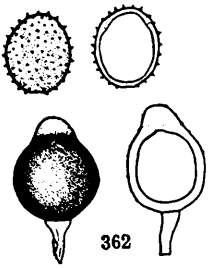
On Rosaceae: **Sieversia turbinata** (Rydb.)Greene (*Acomastylis t.* Greene), Colo., Utah. **Range:** Northeastern Utah and adjacent Colorado.

237. UROMYCES PHASEOLI. Fig. 362.

(N. A. F. 7: 257, 764, 831.)

Uredo appendiculata Pers., Ann. Bot. Usteri **15:** 16. 1795.
Uredo appendiculata phaseoli Pers., Ann. Bot. Usteri **15:** 17. 1795; Syn. Fung. 222 1801.
Puccinia phaseoli Rebent., Prodr. Fl. Neom. 356. 1804.
(*Aecidium phaseoli* Funck, Crypt. Gew. Ficht. **20:** 4. 1814.)
Uromyces appendiculatus Fries, Summa Veg. Scand. 514. 1849. Not *U. appendiculatus* Ung. 1836.
Uromyces phaseoli (Pers.) Wint., in Rab., Krypt. Fl. **1:** 157. 1881.
Uromyces vignae Barclay, Jour. As. Soc. Bengal **60²:** 211. 1891
Nigredo appendiculata Arth., Rés. Sci. Congr. Bot. Vienne 343. 1906.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores ellipsoid, 16–20 by 20–26 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 16–23 by 20–33 μ; wall golden-brown, 1–1.5 μ thick, echinulate, the pores 2, equatorial or superequatorial. Telia amphigenous, blackish-brown; teliospores globoid or broadly ellipsoid, 20–26 by 24–32 μ; wall dark chestnut-brown, uniformly 3–3.5 μ thick, with a hyaline papilla over the pore, smooth or with a few verrucose marks; pedicel colorless, short, rarely as long as spore, fragile.



362

On Fabaceae (*Leguminosae*): Hosts given under the varieties.

(1). **Uromyces phaseoli typica** n. nom., with urediospore-pores indistinct, usually equatorial, and teliospores generally sparingly verrucose, requiring a period of rest before germinating. On **Phaseolus lunatus** L., Calif., S.C., Miss.—**P. multiflorus** Willd., Mass.—**P. polystachyus** (L.)B.S.P. (*P. perennis* Walt.), W.Va.—**P. sinuatus** Nutt., Fla.—**P. vulgaris** L.(*P. nanus* L.), Ala., Ariz., Ark., Conn., Del., Ill., Ind., Iowa, Kans., Ky., La., Me., Mass., Minn., Miss., Mo., Neb., N.H., N.J., N.M., N.Y., N.C., N.D., Ohio, Pa., S.C., Tenn., Tex., Vt., Va., W.Va., Wis.; Ont. **Range:** Maine to North Dakota, southward to Florida and New Mexico, and in southern California; also in West Indies, Central and South America, Europe and Asia.

Cultures were made by de Bary (Ann. Sci. Nat. IV. **20:** 80. 1863), seemingly with teliospores, but without recording details, and apparently no one since has successfully attempted teliosporic cultures, unless it may be inferred that this was done by Andrus (Jour. Agric. Res. **42:** 559. 1931). The aecia form small groups and are rarely observed.

(2). **Uromyces phaseoli strophostylis** n. nom., with urediospore-pores equatorial or slightly superequatorial, and teliospores somewhat verrucose

or longitudinally ridged, requiring a period of rest before germinating. On **Strophostyles helvola** (L.)Ell.(*Phaseolus diversifolius* Pers.), Ala., Ark., Conn., Del., Ill., Ind., Iowa, Kans., La., Md., Miss., Mo., Neb., N.J., N.Y., N.C., Ohio, Okla., R.I., S.C., Tenn., W.Va., Wis.—**S. pauciflora** (Benth.)Wats.(*P. p.*), Ill., Ind., Kans., Miss., Mo., Neb., N.M., Okla., S.D., Tex.—**S. umbellata** (Muhl.)Britt., Del., Fla., Ill., Ind., Pa. **Range:** Southeastern Pennsylvania to southeastern South Dakota, southward to Florida and Texas.

Cultures were made in 1903 by Arthur (Jour. Myc. **10:** 14. 1904), by sowing teliospores from *S. helvola* on plants of the same species, producing an abundance of pycnia and aecia.

(3). **Uromyces phaseoli vignae** (Barcl.) n. comb., with urediospore-pores distinct, usually more or less superequatorial, and smooth teliospores, germinating upon maturity. On **Vigna repens** (L.)Ktze., Fla.—**V. sinensis** (L.)Endl., Ala., Ariz., Calif., Fla., Ind., Iowa, Md., Mo., Tenn., Tex., Va. **Range:** Virginia to Iowa, southward to Florida and Texas, and in southern California; also in West Indies, Central and South America, southern Europe, Asia, Japan, northern Africa, and islands of the Pacific Ocean.

Cultures were made in 1920 and 1921 by Fromme (Phytop. **14:** 75. 1924), using both aeciospores and teliospores from *V. sinensis* on same host, and probably the same was done by Andrus (Jour. Agr. Res. **42:** 559. 1931).

238. UROMYCES OCCIDENTALIS. Fig. 363.

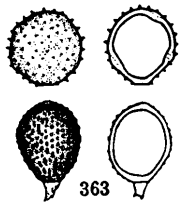
(N. A. F. 7: 252, 253, 762, 830.)

Uromyces occidentalis Diet., Hedw. Beibl. **42:** 98. 1903.
Uromyces rugosus Arth., Bot. Gaz. **39:** 386. 1905.
Uromyces substriatus Syd., Ann. Myc. **4:** 30. 1906.
Nigredo occidentalis Arth., N. Am. Flora **7:** 252. 1912.
Nigredo substriata Arth., N. Am. Flora **7:** 253. 1912.

Pycnia chiefly hypophyllous, sparsely scattered among the aecia. Aecia hypophyllous, systemic, thickly scattered over leaf-surface, at first bullate and opening by a pore, cupulate; aeciospores globoid, 15–20 by 19–24 μ; wall colorless, 1.5–2 μ thick, finely verrucose.

On Euphorbiaceae: **Tithymalus chamaesula** (Boiss.)W.&S.(*Euphorbia c.*), N.M.—**T. luridus** (Engelm.)W.&S.(*E. l.*), N.M.—**T. robustus** (Engelm.) Small(*E. r.*), Ariz., Colo., Mont., Nev., Utah.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid, 16–23 by 19–29 μ; wall golden-brown, 1.5–2 μ thick, echinulate, the pores 6–8, scattered. Telia chiefly hypophyllous, cinnamon-brown; teliospores globoid or obovoid, 15–22 by 18–30 μ; wall cinnamon-brown, uniformly 1.5–2 μ thick, usually with a small hyaline papilla over the pore, verrucose, sometimes in striae; pedicel colorless, short, fragile.


363

On Fabaceae (*Leguminosae*): **Lupinus aduncus** Greene, N.M.—**L. ammophilus** Greene, N.M.—**L. arboreus** Sims, Calif.—**L. argenteus** Pursh(*L. decumbens* Torr.), Colo., Mont., Wyo.—**L. bakeri** Greene, Colo.—**L. caespitosus** Nutt., Colo.—**L. douglasii** J.Ag., Calif.—**L. holosericeus** Nutt., Mont.—**L. kingii** Wats., Colo., N.M. —**L. latifolius** J.Ag., Calif.—**L. laxiflorus** Dougl., Mont., Wyo.—**L. leptophyllus** Benth., Calif.—**L. lyallii** Gray, Wash.—**L. monticola** Rydb., Wyo.—**L.**

palmeri Wats., Ariz.—**L. parviflorus** Nutt., Colo., Utah.—**L. pulcherrimus** Rydb., Utah.—**L. pusillus** Pursh, Colo.—**L. sericeus** Pursh, Mont.

Range: Montana to south-central Washington, southward to New Mexico and Arizona; also in Mexico.

Cultures were made in the open, with control plants, in 1921 by Bethel, using aeciospores from *Euphorbia robusta*, sown on *Lupinus argenteus*, producing uredia and telia. The results were not published, but the data with specimens are in the Arthur Herbarium.

Uromyces coördinatus.

(N. A. F. 7: 451, 796.)

Uromyces coördinatus Arth., Bull. Torrey Club **48:** 33. 1921.
Pucciniola coördinata Arth., N. Am. Flora **7:** 451. 1921.

Pycnia and aecia as in *Uromyces occidentalis*. Uredia wanting. Telia at first arising in and about the aecia, otherwise and also the teliospores as in *U. occidentalis*.

On Euphorbiaceae: **Tithymalus palmeri** (Engelm.)Abrams(*Euphorbia p.*), Calif.—**T. robustus** (Engelm.) Small (*E. r.*), Utah. **Range:** Locally in northern Utah and central California.

Uromyces tranzschelii.

(N. A. F. 7: 517, 802.)

Uromyces tranzschelii Syd.; Tranz., Ann. Myc. **8:** 20. 1910.
Teleutospora tranzschelii Arth. & Bisby, N. Am. Flora **7:** 517. 1922.

Pycnia as in *Uromyces occidentalis*. Aecia and uredia wanting. Telia at first bullate and opening by a pore, otherwise and also the teliospores as in *U. occidentalis*.

On Euphorbiaceae: **Tithymalus chamaesula** (Boiss.)W.&S.(*Euphorbia c.*), N.M.—**T. montanus** (Engelm.)Small(*E. m.*), Colo., Utah, Wyo.—**T. palmeri** (Engelm.)Abrams(*E. p.*), Calif.—**T. robustus** (Engelm.)Small(*E. r.*), Ariz., Colo., Mont., Utah, Wyo. **Range:** Wyoming to western Montana, southward to New Mexico and southern California; also in Mexico.

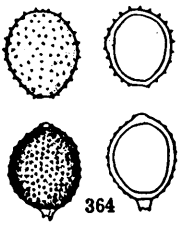
The correlation of this and the two preceding species was recorded in the N. Am. Flora **7:** 518. 1922.

239. UROMYCES COLUTEAE. Fig. 364.

(N. A. F. 7: 255.)

Uromyces coluteae Arth., Bull. Torrey Club **37:** 574. 1910.
Nigredo coluteae Arth., N. Am. Flora **7:** 255. 1912.

Pycnia and aecia unknown. Uredia hypophyllous, cinnamon-brown; urediospores globoid, 18–24 by 21–27 μ; wall golden-brown, 1.5–2 μ thick, echinulate, the pores 3, sometimes 4, equatorial. Telia hypophyllous, chestnut-brown; teliospores ellipsoid, 15–19 by 19–23 μ; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a small hyaline papilla over the pore, evenly or somewhat striately verrucose; pedicel colorless, short, fragile.



364

On Fabaceae (*Leguminosae*): **Colutea arborescens** L., Kans. **Range:** Reported only from Manhattan, Kansas; adventive from Europe.

The rust on this host is included with those on *Caragana, Cytisus* and *Genista* under *Uromyces genistae-tinctoriae* (Pers.) Wint., by Schroeter (Pilze Schles., 1887), Saccardo (Syll. Fung. 1888), Fischer (Ured. Schweiz 1904), Magnus (Pilze Tirol, 1905), Sydow (Monog. Ured., 1909) and Klebahn (Krypt. Brand., 1913). Magnus (*l. c.*, p. 51) considers that the rust on *Colutea* should be called *Uromyces caraganae* (Thüm.) Magn., as he believes the host on which Thümen founded *Uredo caraganae* (1881) to be *Colutea* and not *Caragana.* Trotter (Flora Ital., 1908) unites the forms occurring on *Colutea* and *Cytisus* under the name *Uromyces laburni* (DC.) Fckl. The only cultures in this difficult group have been made by Treboux (Ann. Myc.:**10:** 562. 1912), who obtained strong infection on *Caragana arborescens* with aeciospores from *Euphorbia virgata,* while three species of *Cytisus* remained free. Using urediospores from *Caragana,* the three species of *Cytisus* and also *Colutea* remained free, while *Caragana* was readily infected. For the purpose of listing the rusts of the United States and Canada the above name is retained, as it may represent a variety, if not a species, in this little understood group, and as it is the only representative now known in Ameria.

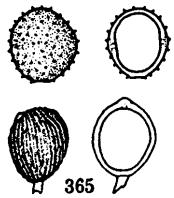
240. UROMYCES STRIATUS. Fig. 365.

(N. A. F. 7: 256, 764, 831.)

Uredo fabae medicaginis-falcatae DC., Fl. Fr. **6:** 69, hyponym. 1815.
Uromyces striatus Schroet., Abh. Schles. Ges. **48:** 11. 1870.
Uromyces medicaginis Pass.; Thüm., Herb. Myc. Oecon. *156.* 1874.
Uromyces oblongus Vize, Grev. **5:** 110. 1877.
Uromyces loti Blytt, Forh. Vid.-Selsk. Christ. **1896**[6]: 37. 1896.
Uromyces euphorbiae-corniculati Jordi, Centr. Bakt. II. **11:** 791. 1904.
Nigredo medicaginis Arth., N. Am. Flora **7:** 256. 1912.

Pycnia and aecia occur on **Euphorbia cyparissias, E. gerardiana** and **E. virgata** in Europe, but have not been found in America.

Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid, 16–20 by 18–23 μ; wall golden-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, equatorial, distinct. Telia chiefly hypophyllous, dark cinnamon-brown; teliospores globoid or ellipsoid, 15–20 by 19–24 μ; wall cinnamon-brown, uniformly 1.5 μ thick, with a hyaline papilla over the pore, striately verrucose with more or less elongate warts; pedicel colorless, short, fragile.


365

On Fabaceae (*Leguminosae*): Hosts given under the following varieties, which show only slight morphologic differences.

(1). **Uromyces striatus medicaginis** (Pass.) n. comb., with urediospores 16–20 by 18–23 μ; teliospores strongly striate. On **Medicago falcata** L., S.D.—**M. hispida** Gaertn. (*M. denticulata* Willd.), Calif., La.—**M. lupulina** L., Calif., Del., Ky., Mass., N.Y., N.C., Ohio, Ore., Pa., W.Va.; Ont.—**M. sativa** L., Ala., Ariz., Calif., Colo., Ind., Iowa, Kans., La., Neb., Ohio, Okla., Pa., S.D., Tenn., Tex., Utah.—**M. tuberculata** Willd., La. **Range:** Massachusetts to South Dakota, southward to North Carolina and Texas, and from Oregon southward to Arizona and southern California; also in West Indies, Mexico, South America, Europe, southern Asia, northern Africa, Japan and New Zealand.

The first culture was by Schroeter (Pilze Schles. **1:** 306. 1887), which he reports thus: By sowing spores from *Aec. Euph.* on *Trifol. agrarium* in 1884 I obtained the *Uromyces.* Treboux (Ann. Myc. **10:** 75. 1912) reports that he many time successfully sowed aeciospores from *Euphorbia gerardiana* and *E. virgata* on *Medicago falcata, M. lupulina* and *M. sativa,* and later says (*l. c.*, p. 562) he infected *M. minima, M. murex* and *Trifolium arvense* with aeciospores from *E. virgata,* adding this proves that the assignment of *Uromyces striatus* to both *Medicago* and *Trifolium* as hosts is correct. The species has not yet been reported in America on *Trifolium.* Cultures have also been reported by Kobel (Centr. Bakt. II. **52:** 234. 1920), who successfully

applied aeciospores from *Euphorbia cyparissias* both to species of *Medicago* and *Trifolium*. In America cultures with urediospores were made in 1910 and again in 1911 by Arthur (Mycol. **4:** 24, 56. 1912), using spores from *Medicago sativa*, sown on *M. sativa, Trifolium pratense, T. medium* and *T. repens*, producing infection only on the *Medicago*. Teliospores are rarely found in American collections.

(2). **Uromyces striatus loti** (Blytt) n. comb., with urediospores 16–23 by 18–27 μ; teliospores moderately striate, especially toward base. On **Hosackia argophylla** Gray(*Lotus a.* Greene), Calif.—**H. glabra** Torr.(*L. g.* Greene), Calif.—**H. ornithopus** Greene(*L. o.* Greene), Calif. **Range:** Central to southern California; also in Europe and Japan.

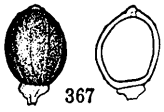
Lotus corniculatus was infected with aeciospores from *Euphorbia cyparissias* in 1903 by Jordi (Centr. Bakt. II. **11:** 784. 1904), and at the same time gave slight infection on *Astragalus depressus, Oxytropis campestris* and *O. montana*, while *Medicago sativa* remained free. This variety stands in both morphologic and biologic characters between *Uromyces striatus medicaginis* and *U. punctatus*, as previously indicated by Sydow (Monog. Ured. **2:** 110. 1909). No teliospores have been seen in American collections.

241. UROMYCES ELEGANS. Fig. 367.

(N. A. F. 7: 449.)

(*Aecidium orobi elegans* Berk., Grev. **3:** 61. 1874.)
Uromyces elegans [Berk.] Lagerh., Tromsø Mus. Aarsh. **17:** 34. 1895.
Pucciniola elegans Arth., N. Am. Flora **7:** 449. 1921.

Pycnia unknown, probably not formed. Aecia hypophyllous, systemic, cupulate; aeciospores globoid or ellipsoid, 10–19 by 13–21 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose. Uredia wanting; urediospores occasionally found in the telia, globoid, 15–18 by 18–22 μ; wall yellowish-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, equatorial, distinct. Telia amphigenous, in small groups, chestnut-brown; teliospores globoid or ellipsoid, 15–19 by 19–27 μ; wall chestnut-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pore, minutely ridged in striae 5–7 μ apart; pedicel colorless, short, broad near the spore, fragile.


367

On Fabaceae (*Leguminosae*): **Trifolium carolinianum** Michx., Ala., Fla., Ga., La., Miss., S.C., Tex. **Range:** Coastal states, South Carolina to Florida and westward to Texas.

Cultures in 1913 by Arthur (Mycol. **7:** 85. 1915) were made by sowing aeciospores from *Trifolium carolinianum* on same host, resulting in telia, without appearance of uredia or secondary aecia. The morphology of the spores allies the species closely to *Uromyces striatus*. The assignment of *Trifolium arvense* to this species (N. Am. Flora **7:** 449. 1921) was an error in determination.

242. UROMYCES COLORADENSIS. Fig. 366.

(N. A. F. 7: 450, 796.)

(*Aecidium porosum* Peck, Bot. Gaz. **3:** 34. 1878.)
Uromyces coloradensis E. & E., Erythea **1:** 204. 1893.
Uromyces albus D. & H.; Diet., Hedw. **36:** 297. 1897.
Pucciniola porosa Arth., N. Am. Flora **7:** 450. 1921.

Pycnia hypophyllous, scattered among the aecia. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 15–19 by 18–26 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose. Uredia wanting; urediospores occasionally found in the telia, ellipsoid, 19–24 by 23–28 μ; wall light golden-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, nearly equatorial. Telia chiefly epiphyllous, cinnamon- or chestnut-brown; teliospores globoid or ellipsoid, 13–24 by 21–38 μ; wall cinnamon- or chestnut-brown, uniformly 1–3 μ thick,


366

often somewhat thicker above, with a hyaline umbo or papilla over the pore, finely verrucose in striae; pedicel colorless, usually short, fragile.

On Fabaceae (*Leguminosae*): Hosts given under the varieties. The occasional urediospores and the form and apical thickening of the teliospores show relationship to *Uromyces fabae* (page 242).

(1). **Uromyces coloradensis campester** n. nom., with small telia, scattered, early naked, cinnamon-brown; teliospores 13–21 by 21–29 μ; wall cinnamon-brown, 1.5–2 μ thick at sides, 3–5 μ above, including papilla; On **Vicia americana** Muhl., Ariz., Colo., Ind., Iowa, Kans., Minn., Mont., Neb., N.M., S.D., Wis.; Alta., Man.—**V. oregana** Nutt.(*V. truncata* Nutt.), Colo., Utah; Ont.—**V. sparsifolia** Nutt.(*V. linearis* Greene), Colo., Iowa, Kans., Mont., Neb., Nev., N.D., S.D., Utah; Sask.—**V. trifida** Dietr., Utah, Wyo. **Range:** Northwestern Ontario to Alberta, southward to Indiana and southern New Mexico.

(2). **Uromyces coloradensis montanus** n. nom., with telia of intermediate size, tardily naked, chestnut-brown; teliospores 18–24 by 24–32 μ; wall chestnut-brown, 2–3 μ thick at sides, 4–7 μ above, including papilla; On **Vicia americana** Muhl., Colo., Mont., Utah.—**V. oregana** Nutt.(*V. truncata* Nutt.), Colo., Nev., Wyo.—**V. sparsifolia** Nutt.(*V. linearis* Greene), Mont.—**V. trifida** Dietr., Wyo.—**V.** sp., Wash. **Range:** Western Montana to central Washington, southward to Colorado and Nevada.

(3). **Uromyces coloradensis maritimus** n. nom., with large telia, becoming confluent, ruptured epidermis usually inconspicuous, chestnut-brown; teliospores 19–24 by 26–38 μ; wall chestnut-brown, 2–3 μ thick at sides, 5–9 μ above, including papilla; On **Vicia americana** Muhl., Calif., Ore., Wash.; B.C.—**V. californica** Greene, Calif.—**V. sparsifolia** Nutt.(*V. linearis* Greene), Wash. **Range:** Pacific coast slope from southwestern British Columbia to southern California.

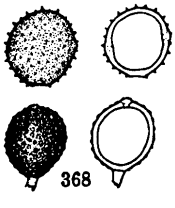
243. UROMYCES PUNCTATUS. Fig 368.

(N. A. F. 7: 253, 762, 830.)

Uredo leguminosarum d astragali α, β, γ Opiz, Seznam 151, hyponym. 1852.
Uredo acuminata Kirchn., Lotos **6:** 179. 1856. Not *Uromyces acuminatus* Arth., 1883.
Uromyces punctatus Schroet., Abh. Schles. Ges. **48:** 10. 1870.
Uromyces astragali Sacc., Mycol. Ven. Specim. 208, hyponym. 1873.
Uromyces euphorbiae-astragali Jordi, Centr. Bakt. II. **11:** 790. 1904.
Nigredo punctata Arth., N. Am. Flora **7:** 253. 1912.

Pycnia and aecia hypophyllous, systemic; on **Euphorbia cyparissias** and **E. virgata**, in Europe; not yet found in America.

Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 16–23 by 19–30 μ; wall light cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3–5, scattered or appearing equatorial. Telia amphigenous, chestnut-brown; teliospores globoid or obovoid, 15–19 by 19–23 μ; wall chestnut-brown, uniformly 1.5 μ thick, with a hyaline papilla over the pore, finely verrucose; pedicel colorless, short, fragile.


368

On Fabaceae (*Leguminosae*): **Astragalus aboriginorum** Richards., Mont.—**A. amphioxus** Gray(*Xylophacos a.*

Rydb.), Utah.—**A. arizonicus** Gray, Ariz.—**A. bigelovii** Gray, Ariz., N.M.—**A. caespitosus** Gray, N.D.—**A. canadensis** L., Minn., Neb., S.D., Utah, Wis.—**A. candolleanus** (H.B.K.)Sheldon(*A. triflorus* Gray), Ariz., Nev.—**A. coulteri** Benth., Calif.—**A. crassicarpus** Nutt.(*A. caryocarpus* Ker), Minn., Neb., S.D.—**A. crotalariae** (Benth.)Gray, Calif.—**A. cyaneus** Gray, Colo.—**A. decumbens** Gray, Utah.—**A. elegans** (Hook.)Britt.(*A. eucomus* B.L.Rob.), Colo.—**A. flexuosus** Dougl.(*Homalobus f.* Rydb.), Colo.—**A. glareosus** Dougl.(*A. argophyllus* Nutt.), Ida., Utah, Wash.—**A. goniatus** Nutt., Mont.—**A. hornii** Gray, Calif.—**A. hosackiae** Greene, Ariz.—**A. humistratus** Gray, Utah.—**A. impensa** W.&S., Utah.—**A. lentiginosus** Dougl., Nev.—**A. leptocarpus** T.&G., Tex.—**A. leucophyllus** T.&G., Calif.—**A. leucopsis** Torr., Calif.—**A. lindheimeri** Engelm., Tex.—**A. menziesii** Gray, Calif.—**A. mollissimus** Torr., Colo., Kans., Neb., Tex., Wyo.—**A. nebraskensis** Bates, Neb.—**A. nitidus** Dougl.(*A. adsurgens* Hook., not Pall.), Colo., Mont., Neb., N.D.—**A. nuttallianus** DC., Tex.—**A. plattensis** Nutt., Neb.—**A. preusii** Gray, Calif.—**A. purshii** Dougl., Calif., Mont., Ore., Utah.—**A. pycnostachyus** Gray, Calif.—**A. sonorae** Gray, Utah.—**A. sulphurescens** Rydb., Colo.—**A. tennesseensis** Gray, Tenn.—**A. thurberi** Gray, Ariz.—**A. tracyi** Greene, Tex.—**A. tridactylicus** Gray, Wyo.—**A. triphyllus** Pursh, Mont., N.D.—**A. uintensis** Jones, Colo.—**A. utahensis** T.&G., Ida., Utah.—**A. wardii** Gray, Utah.—**A. wootoni** Sheldon, Ariz., N.M.—**Oxytropis albiflora** (Nels.)Schum.(*Aragallus a.*), Colo., Mont., Wyo.—**O. alpicola** (Rydb.)Jones, Mont.—**O. deflexa** (Pall.)DC.(*A. d.* Heller), N.M.—**O. lamberti** Pursh(*A. l.* Greene), Colo., Kans., Mont., Neb., N.D., Wyo.—**O. podocarpa** Gray(*A. p.* Greene), Ida.—**O. sericea** Nutt.(*A. s.* Greene), Neb., Wyo.—**O. spicata** Standl.(*A. s.* Rydb.), Mont.

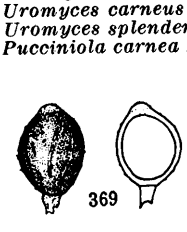
Range: Wisconsin to Washington, southward to Texas and southern California, with one station in Tennessee; also in Mexico, Central America, Europe, Western Asia and northern Africa.

In 1903 extensive cultures were made by Jordi (Centr. Bakt. II. **11:** 781–792. 1904) by using aeciospores from *Euphorbia cyparissias*, sown on various species of *Astragalus*, *Oxytropis*, *Lotus*, and a number of other leguminous genera, who arrived at the conclusion, confirmed by cultures with urediospores and morphologic studies, that he was dealing with three species, the most common one being on several species of *Astragalus* and *Oxytropis*. One on *Astragalus excapus* with 6–8 urediospore-pores and one on *Lotus corniculatus*, he considered distinct. In using American material negative results were obtained in 1910 by Arthur (Mycol. **4:** 23. 1912) by sowing teliospores from *Oxytropis lamberti* on *Euphorbia cyparissias*, but infection resulted when urediospores from *O. lamberti* and *Astragalus sulphurescens* were sown on *A. carolinianus*.

244. UROMYCES LAPPONICUS. Fig. 369.

(N. A. F. 7: 449, 796 in part.)

(*Aecidium carneum* Nees; Funck, Crypt. Gew. Ficht. **25:** 4. 1818.)
Uromyces lapponicus Lagerh., Bot. Notiser **1890:** 274. 1890.
Uromyces carneus Hariot, Journ. de Bot. **7:** 376. 1893.
Uromyces splendens Blytt, Forth. Vid-Selsk. Christ. **1896**[6]: 39. 1896.
Puccinia carnea Arth., N. Am. Flora **7:** 449. 1921.


369

Pycnia scattered among the aecia. Aecia hypophyllous or caulicolous, systemic, cupulate; aeciospores globoid or ellipsoid, 13–20 by 16–26 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Uredia wanting. Telia chiefly hypophyllous, dark cinnamon-brown; teliospores globoid or ellipsoid, 19–23 by 23–33 μ; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a

hyaline papilla over the pore, the pore often more or less depressed, verrucose, with a few longitudinal lines 5–10 μ apart; pedicel colorless, short, fragile.

On Fabaceae (*Leguminosae*): **Astragalus alpinus** L.(*Tium a.* Rydb.), Colo., Ida.—**A. flexuosus** Dougl.(*Homalobus f.* Rydb.), Colo.—**A. macounii** Rydb.(*Atelophragma m.*), Alta.—**A.** sp., Alas., Ore.; Alta.—**Oxytropis albiflora** (Nels.)Schum.(*Aragallus a.*), Colo.—**Phaca frigida** L.(*Astragalus f.* Gray), N.W.Terr. (115° west, 69° north). **Range:** Arctic Circle, southward to Colorado and Oregon; also in Europe and Asia.

The species is evidently related to *Uromyces punctatus*.

Uromyces phacae-frigidae.

(N. A. F. 7: 796 in part.)

Aecidium phacae-frigidae Wahl., Fl. Lapp. 525. 1812.
Caeoma appendiculatum Sommerf., Suppl. Fl. Lapp. 232. 1826.
Uromyces phacae-frigidae (Wahl.) Hariot, Jour. de Bot. **7:** 376. 1893.
Uromyces phacae-frigidae Lagerh., Tromsø Mus. Aarsh. **16:** 151. 1894.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, systemic; teliospores as in *Uromyces lapponicus*.

On Fabaceae (*Leguminosae*): **Phaca** sp.(*Astragalus* sp.), Alas. **Range:** Unga Island, southwestern Alaska; also in northern Europe.

The correlation of this microcyclic species with *Uromyces lapponicus* is marked, the microtelia assuming the systemic habit of the aecia of *U. lapponicus*. *Aecidium phacae-frigidae* of Wahlenberg was shown by Sommerfeldt (*l. c.*) to be a telial form, a statement which was overlooked in preparing the synonymy for the North American Flora **7:** 796. In Europe this species is only known to occur on *Phaca frigida*, a plant which, in America, is known only as a host for *U. lapponicus*.

245. UROMYCES HEDYSARI-OBSCURI. Fig. 370.

(N. A. F. 7: 450, 796, 843.)

Puccinia hedysari-obscuri DC., Syn. Pl. Gall. 46. 1806.
Uromyces hedysari-obscuri (DC.) Car. & Picc., Erb. Critt. Ital. II. 447. 1871.
Uromyces astragalicola P. Henn., Hedw. **37:** 268. 1898.
Pucciniola hedysari-obscuri Arth., N. Am. Flora **7:** 450. 1921.

Pycnia chiefly epiphyllous, in groups. Aecia hypophyllous and petiolicolous, in groups, cupulate; aeciospores globoid, 13–19 by 15–19 μ; wall colorless, 1 μ thick, finely verrucose. Uredia epiphyllous, scattered, cupulate, with a peridium as in the aecia; urediospores like the aeciospores. Telia chiefly epiphyllous, dark chocolate brown; teliospores globoid or ellipsoid, 14–18 by 18–29 μ; wall chestnut-brown, uniformly 1.5–2.5 μ thick, with a large papilla or umbo over the pore, finely verrucose; pedicel colorless, short, fragile.


370

On Fabaceae (*Leguminosae*): **Hedysarum americanum** (Michx.)Britt., Alas., Ida., Mont., S.D., Wyo.; Alta.—**H. boreale** Nutt., Alta., Man.—**H. cinerascens** Rydb., Mont., N.D., Utah, Wyo.; Alta.—**H. mackenzii** Richards., Alta.—**H. marginatum** Greene(*H. uintahense* Nels.), Colo., Wyo.—**H. pabulare** Nels., Colo., N.M., Utah, Wyo.—**H. sulphurascens** Rydb., Mont., Wyo.; Alta.—**H. utahense** Rydb., Utah. **Range:** Manitoba to southeastern Alaska, southward to New Mexico; also in Europe, Asia, and Japan.

Jordi (Centr. Bakt. II. **11:** 778. 1904) first showed that this species can produce aecidioid uredia (secondary aecia). Uredia occur singly among the telia and are

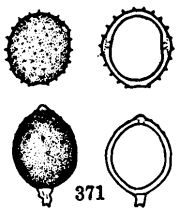
unaccompanied by pycnia. Both spores and peridium have the same appearance as in the aecia.

246. UROMYCES TRIFOLII. Fig. 371.

(N. A. F. 7: 254, 255, 763, 830, 831.)

Puccinia trifolii Hedw. f.; DC., Fl. Fr. **2**: 225. 1805.
(*Aecidium trifolii-repentis* Cast., Obs. **1**: 33. 1842.)
Uredo fallens Desm., Pl. Crypt. *1325*. 1843.
Uromyces trifolii (Hedw. f.) Lév., Ann. Sci. Nat. III. **8**: 371. 1847.
Uromyces trifolii-repentis Liro, Acta Soc. Fauna Flora Fennica **29**[6]: 15. 1906.
Nigredo trifolii Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.
Uromyces fallens Kern, Phytop. **1**: 6. 1911.
Nigredo fallens Arth., N. Am. Flora **7**: 254. 1912.
Uromyces hybridi W. H. Davis, Proc. Iowa Acad. **24**: 472. 1917.

Pycnia chiefly epiphyllous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 13–17 by 15–21 μ; wall nearly or quite colorless, about 1 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or broadly ellipsoid, 18–23 by 21–26 μ; wall light cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2–6, scattered or equatorial. Telia chiefly hypophyllous, chestnut-brown; teliospores globoid or broadly ellipsoid, 13–20 by 20–29 μ; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over the pore, smooth or with a few scattered warts; pedicel colorless, short, fragile.


371

On Fabaceae (*Leguminosae*): **Trifolium** sp., distributed under the following varieties. Numerous cultures using urediospores, and also to some extent aeciospores and teliospores, made by Howell, Liro, Paul, Davis and Kobel, show that the three following varieties are not wholly distinct as to hosts. Neither are they wholly distinct morphologically or biologically.

(1). **Uromyces trifolii trifolii-repentis** (Liro) n. comb., with aecia common; urediospore-pores 2–4, usually equatorial; On **Trifolium incarnatum** L., Wis.—**T. repens** L., Calif., Colo., Conn., D.C., Ida., Ill., Ind., Iowa, Me., Mass., Mich., Minn., Mo., Mont., Neb., N.H., N.J., N.Y., N.D., Ore., Pa., Utah, Vt., Va., Wash., W.Va., Wis.; Newf.; Man., Ont. **Range**: Newfoundland to Montana, southward to Virginia and Nebraska, and from Idaho and Washington southward to Utah and southern California; also in Europe, Asia, Japan, Australia, and New Zealand.

The earliest cultures were in 1890 by Howell (Bull. Cornell Univ. Agric. Exper. Sta. No. 24, p. 137. 1890), by sowing aeciospores from *Trifolium repens* on same host and on *T. pratense*, with the former abundantly infected, and the latter sparingly. In 1906 Liro (Acta Soc. Fauna Flora Fennica **29**[6]: 15. 1906) from morphology and cultures established the species *Uromyces trifolii-repentis*. Cultures with both aeciospores and teliospores from *T. repens* sown on same host were made by Kobel (Centr. Bakt. II. **52**: 220. 1920).

(2). **Uromyces trifolii hybridi** (W. H. Davis) n. comb., with aecia rare; urediospore-pores, 2–4, usually equatorial; On **Trifolium hybridum** L., Ala., Conn., Del., Ind., Me., Md., Mass., Mich., Mont., Neb., N.H., N.J., N.Y., Ore., Pa., R.I., S.D., Vt., Va., Wash., W.Va., Wis.; Ont. **Range**: Maine to Montana, southward to Virginia, northern Alabama and Nebraska, and in Washington and Oregon; also in Europe and New Zealand.

Cultures were successfully made in 1916 and again in 1917 by W. H. Davis (Proc. Iowa Acad. Sci. **24:** 469. 1917) by sowing both aeciospores and teliospores from *Trifolium hybridum* on the same species of host, and with negative results when sown on *T. repens, T. pratense, T. incarnatum* and *T. medium.* From cultural and morphologic data he established the species *U. hybridi.* About the same time Paul (Krypt. Forsch. no. 2, p. 50. 1917) also proposed *U. hybridi* as a new species upon biologic grounds. Successful cultures were made by Kobel (*l. c.,* p. 219), using teliospores from *T. hybridum* on same host.

(3). **Uromyces trifolii fallens** (Desm.) n. comb., with aecia rare; urediospore-pores 4–7, usually scattered; On **Trifolium incarnatum** L., Del., S.D.—**T. medium** L., Neb., N.Y., S.D.—**T. pratense** L., Ala., Calif., Colo., Conn., Del., D.C., Ida., Ill., Ind., Iowa, Kans., Me., Md., Mass., Mich., Miss., Mo., Mont., Neb., N.H., N.J., N.Y., N.C., N.D., Ohio, Okla., Ore., Pa., R.I., S.C., S.D., Tenn., Vt., Va., Wash., W.Va., Wis., Wyo.; B.C., Man., N.S., Ont., Queb. **Range:** Nova Scotia to Montana, southward to South Carolina and Oklahoma, and from British Columbia to central California; also in Europe, Asia and New Zealand.

Cultures were made in 1919 by Kobel (*l. c.,* p. 217) in which overwintered teliospores from *T. pratense* were sown on same host with positive results.

Uromyces nerviphilus.

(N. A. F. 7: 448, 796, 843.)

Puccinia nerviphila Grognot, Pl. Crypt. Saône-et-Loire 154. 1863.
Puccinia neurophila Grognot; De-T., in Sacc., Syll. Fung. **7:** 698. 1898.
Uromyces flectens Lagerh., Sv. Bot. Tidskr. **3:** 36. 1909.
Pucciniola nerviphila Arth., N. Am. Flora **7:** 448. 1921.
Uromyces nerviphilus (Grognot) Hotson, Publ. Puget Sd. Biol. Sta. Univ. Wash. **4:** 368. 1925.

Pycnia and aecia as in *Uromyces trifolii,* but more usually hypophyllous, more closely associated and usually grouped along the midribs, veins or on the petioles, often causing hypertrophy, sometimes wanting. Uredia wanting. Telia as in *U. trifolii,* but generally confluent in elongate groups; teliospores as in *U. trifolii,* but usually somewhat more verrucose.

On Fabaceae (*Leguminosae*): **Trifolium repens** L., Colo., Mont., N.Y., Wash., Wis.; Ont. **Range:** Locally from northeastern United States westward through southern Canada to southern Washington; also in South America, Europe and New Zealand. Adventive from Europe.

The species is correlated with *Uromyces trifolii trifolii-repentis.* To its microcyclic form, which is not uncommon, Lagerheim gave the name *U. flectens.* The latter form was cultured by Kobel (*l. c.,* p. 221).

Uromyces minor.

(N. A. F. 7: 447, 796, 843.)

Uromyces minor Schroet., Krypt. Fl. Schles. **3:** 310. 1887.
Pucciniola oblonga Arth., N. Am. Flora **7:** 447. 1921. Not *Uromyces oblongus* Vize, 1877.

Pycnia unknown, probably not formed. Aecia as in *Uromyces trifolii,* or wanting. Uredia wanting. Telia as in *U. trifolii,* but usually tardily naked and often intermixed with the aecia; teliospores as in *U. trifolii,* but usually slightly smaller, 13–19 by 18–26 μ, and somewhat more verrucose.

On Fabaceae (*Leguminosae*): **Trifolium aitonii** Rydb., Mont.—**T. albopurpureum** T.&G., Calif., Ore.—**T. amphianthum** T.&G., Tex.—**T. amplectens**

T.&G., Calif.—**T. andinum** Nutt., Wyo.—**T. bifidum** Gray, Calif.—**T. b. decipiens** Greene, Calif.—**T. breweri** Wats., Calif.—**T. ciliatum** Nutt., Calif.—**T. cyathiferum** Lindl., Calif.—**T. dasyphyllum** Torr., Colo.—**T. depauperatum** Desv., Calif.—**T. dubium** Sibth., Calif., Ore., Wash.—**T. eriocephalum** Nutt., Ore.—**T. fendleri** Greene, Colo., Nev.—**T. gracilentum** T.&G., Calif.—**T. gymnocarpon** Nutt., Ariz., Colo.—**T. hallii** Howell, Ore.—**T. macraei** H.&A., Calif.—**T. microcephalum** Pursh, Calif.—**T. microdon** H.&A., Calif., Ore.; B.C.—**T. obtusifolium** Hook., Calif.—**T. oliganthum** Steud.(*T. pauciflorum* Nutt.), Calif., Nev., Ore., Utah; B.C.—**T. olivaceum** Greene, Calif.—**T. parryi** Gray, Colo., Utah, Wyo.—**T. procumbens** L., Ore., Wash.—**T. rydbergii** Greene, Colo., Mont.—**T. scariosum** Nels., Utah.—**T. stenophyllum** Nutt., Calif.—**T. tridentatum** Lindl., Calif., Ore.—**T. variegatum** Nutt., Calif., Nev., Wash.—**T. wormskjoldii** Lehm., Calif. **Range:** Mountainous regions from Montana to British Columbia, southward to Texas and southern California; also in Europe and Japan.

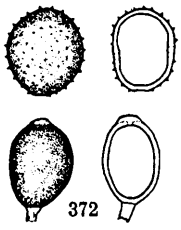
Aeciospores from *Trifolium montanum* were sown on the same host by Dietel (Flora **81:** 398. 1895), and in two weeks produced telia. Cultures were made by Kobel (*l. c.*, p. 228), using both aeciospores and teliospores from *T. montanum* sown on same host. The species is related to *Uromyces trifolii trifolii-repentis*, but the aecia do not cause hypertrophy, as in *U. nerviphilus*, although they are closely associated with the telia in the early part of the season. Other characters also show the two species to be wholly distinct, and yet both have the same correlation. The name *Uromyces oblongus* Vize (Grev. **5:** 110. 1877) was published, by a typographical error of one letter, as on "burr cloves," but should have read burr clover, which is *Medicago hispida*, a common plant in California (see p. 299). An unfortunate attempt to correct the error was made by Holway (Jour. Myc. **11:** 268. 1905), who was misled by the *Trifolium*-like leaves of the *Medicago*.

247. UROMYCES GLYCYRRHIZAE. Fig. 372.

(N. A. F. 7: 478, 800, 844.)

Uredo leguminosarum glycyrrhizae Rab., Flora **33:** 626. 1850.
Uromyces glycyrrhizae (Rab.) Magn., Ber. Deuts. Bot. Ges. **8:** 383. 1890.
Klebahnia glycyrrhizae Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia chiefly hypophyllous, systemic. Aecia chiefly hypophyllous, uredinoid, systemic, dark cinnamon-brown; aeciospores globoid, 23–32 by 24–32 μ, flattened laterally; wall chestnut-brown, 1–2 μ thick, echinulate, the pores 2, equatorial. Uredia wanting, or if present indistinguishable from the aecia; urediospores in localized telia resembling aeciospores. Telia chiefly hypophyllous, either from localized mycelium or systemic, dark chestnut-brown; teliospores ellipsoid, 15–22 by 23–32 μ; wall chestnut-brown, uniformly 1.5–2.5 μ thick, with a hyaline umbo over the pore, smooth; pedicel colorless, short, fragile.


372

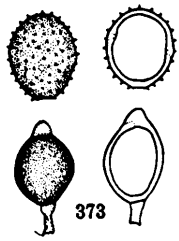
On Fabaceae (*Leguminosae*): **Glycyrrhiza glutinosa** Nutt., Calif.—**G. lepidota** Nutt., Ariz., Colo., Ida., Kans., Mont., Neb., Nev., N.M., N.D., Ore., S.D., Tex., Utah, Wash., Wyo.; Alta. **Range:** North Dakota to Alberta, southward to New Mexico and southern California; also in Europe and Asia.

248. UROMYCES HYALINUS. Fig. 373.

(N. A. F. 7: 479, 800.)

Uromyces hyalinus Peck, Bot. Gaz. **3:** 34. 1878.
Klebahnia hyalina Arth., N. Am. Flora **7:** 479. 1921.

Pycnia amphigenous, scattered, abundant. Aecia amphigenous, uredinoid, systemic, cinnamon-brown; aeciospores ellipsoid or obovoid, 19–23 by 23–30 μ; wall light cinnamon-brown, 1–2 μ thick, echinulate, the pores 5 or 6, scattered or nearly equatorial. Uredia wanting, or if present indistinguishable from the aecia. Telia amphigenous, systemic, usually abundant, dark cinnamon-brown; teliospores ellipsoid or obovoid, 14–19 by 23–31 μ; wall cinnamon-brown, 1.5–2.5 μ thick, slightly thicker with a paler umbo above, smooth; pedicel colorless, short, fragile.


373

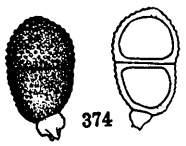
On Fabaceae (*Leguminosae*): **Sophora sericea** Nutt., Ariz., Colo., Kans., Neb., N.M., S.D., Tex., Wyo. **Range:** South Dakota to Wyoming, southward to Texas and Arizona; also in Mexico.

249. PUCCINIA LEVEILLEI. Fig. 374.

(N. A. F. 7: 540, 803.)

Puccinia geranii Lév., Ann. Sci. Nat. III. **5:** 270. 1846. Not *P. geranii* Cda., 1840.
Puccinia leveillei Mont., in Gay, Fl. Chil. **8:** 41. 1852.
Puccinia geranii-silvatici Karst., Not. Sällsk. Fauna Flora Fennica **8:** 220. 1869.
Micropuccinia leveillei A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, often producing hypertrophy, chestnut-brown; teliospores ellipsoid, 16–22 by 26–34 μ, rounded at both ends or narrowed below, not constricted at septum; wall chestnut-brown, uniformly 1.5–3 μ thick, with an inconspicuous papilla over the pores, pore of the upper cell apical, of the lower much depressed, strongly verrucose above, less so below; pedicel colorless, short, fragile.


374

On Geraniaceae: **Geranium erianthum** DC., Alas.—**G. fremontii** T.&G., Wyo.—**G. incisum** Nutt., Wash.—**G. nervosum** Rydb., Utah.—**G. richardsonii** Fisch.&Trautv., Colo., Utah.—**G. viscosissimum** Fisch.&Mey., Mont. **Range:** Mountains of Montana to eastern Washington, southward to Colorado and Utah, and in southern Alaska; also in South America and Europe.

250. PUCCINIA ARGENTATA. Fig. 375.

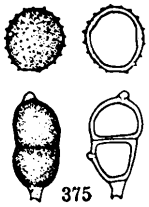
(N. A. F. 7: 392, 790, 841.)

Aecidium argentatum Schultz, Prodr. Fl. Starg. 454. 1806.
Caeoma (Uredo) impatientis Link, Handb. **3:** 439. 1833.
Puccinia nolitangeris Cda., Ic. Fung. **4:** 16. 1840.
Puccinia argentata (Schultz) Wint., in Rab., Krypt. Fl. **1:** 194. 1881.
Dicaeoma nolitangeris Arth., N. Am. Flora **7:** 392. 1920.

Pycnia hypophyllous, numerous, among the aecia. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 15–19 by 16–20 μ; wall colorless, about 1 μ thick, verrucose.

On Adoxaceae: **Adoxa moschatellina** L., Iowa.

Uredia amphigenous, cinnamon-brown; urediospores globoid, 15–19 by 17–21 μ; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 6–8, scattered. Telia amphigenous, dark chestnut-brown; teliospores ellipsoid or oblong, 14–21 by 26–37 μ, rounded at both ends or narrowed below, slightly constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, with a hyaline papilla over pore of upper cell, the pore of upper cell usually apical, of the lower at


375

septum or more or less depressed, smooth or very minutely verrucose; pedicel colorless, short, fragile.

On Balsaminaceae: **Impatiens biflora** Walt.(*I. fulva* Nutt., *I. maculata* Muhl.), Del., D.C., Ga., Ill., Ind., Iowa, Mass., Minn., N.J., N.Y., Ohio, Va., W.Va., Wis.; Sask.—**I. pallida** Nutt.(*I. aurea* Wats.), Ill., Ind., Iowa, Tenn.; Alta.

Range: Massachusetts to Alberta, southward to Georgia and Illinois; also in Europe and Japan.

Cultures were made in 1903 by Bubák (Centr. Bakt. II. **10:** 574. 1903; same **12:** 411–419. 1904), in which *Impatiens nolitangere* was infected by aeciospores from *Adoxa moschatellina*, and in 1904 (same **16:** 150. 1906) the reverse culture was made. In 1910 cultures were made by Arthur (Mycol. **4:** 20. 1912), infecting *Impatiens pallida* with aeciospores from *Adoxa moschatellina*. The aecia bearing material was obtained from Decorah, Iowa. Schultz's description of the rust on *Impatiens nolitangere* is not that of an *Aecidium*, as amply shown by brown spores and other characters. Although the aecia are systemic, the mycelium is not perennial.

Puccinia adoxae.

(N. A. F. 7: 570, 847.)

Puccinia adoxae Hedw. f.; DC., Fl. Fr. **2:** 220. 1805.
Micropuccinia adoxae A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia systemic, otherwise and teliospores as in *Puccinia argentata*.

On Adoxaceae: **Adoxa moschatellina** L., Colo., Utah, Wyo. **Range:** Northwestern Wyoming, southward to central Colorado and southeastern Utah; also in Europe and Japan.

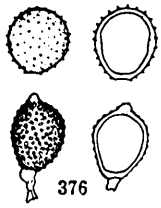
The correlation of this microcyclic species was pointed out by Dietel (Centr. Bakt. **48:** 493. 1918).

251. UROMYCES PROËMINENS. Fig. 376.

(N. A. F. 7: 259, 765, 831.)

Uredo proëminens DC., Fl. Fr. **2:** 235. 1805.
Trichobasis euphorbiaecola B. & C., Jour. Linn. Soc. **10:** 357. 1869.
Uromyces proëminens (DC.) Pass.; Rab., Fungi Eur. *1795*. 1873.
Uromyces euphorbiae C. & P.; Peck, Ann. Rep. N. Y. State Mus. **25:** 90. 1873.
Uromyces myristica B. & C.; Berk., Grev. **3:** 57. 1874.
Uromyces euphorbiicola Tranz., Ann. Myc. **8:** 8. 1910.
Uromyces poinsettiae Tranz., Ann. Myc. **8:** 11. 1910.
Nigredo proëminens Arth., N. Am. Flora **7:** 259. 1912.

Pycnia hypophyllous, scattered among the aecia. Aecia chiefly hypophyllous, systemic, cupulate; aeciospores globoid, 12–16 by 15–19 μ; wall nearly or quite colorless, 1 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid, 15–20 by 19–23 μ; wall pale golden-brown, 1.5–2 μ thick, echinulate, the pores 3–6, nearly equatorial or scattered. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 15–19 by 18–26 μ; wall cinnamon-brown, uniformly 1.5 μ thick, with a hyaline papilla over the pore, evenly verrucose or indistinctly striate; pedicel colorless, short, fragile.


376

On Euphorbiaceae: Hosts as given under the varieties.

(1). **Uromyces proëminens euphorbiicola** (Tranz.) n. comb., with urediospore-pores 3–5, usually 4, somewhat equatorial; teliospores 15–19 by 19–26 μ, usually not or only slightly striate; On **Chamaesyce hirta** (L.)Millsp. (*Euphorbia h.*), Fla.—**C. humistrata** (Engelm.)Small(*E. h.*), Ill., Ind., Iowa, Kans., Ky., Mich., Mo., Neb., Ohio, Okla., Pa.; Ont.—**C. maculata** (L.)Small (*E. m.*), Colo., Conn., Del., Fla., Ind., Iowa, Kans., Mass., Mich., Minn., Neb., N.J., N.Y., Pa., S.C., Tex., Va., W.Va., Wis.—**C. prostrata** (Ait.)Small(*E. p.*), Miss., Tex.—**C. stictospora** (Engelm.)Small(*E. s.*), Ariz., N.M., Okla.—**C. tracyi** Small, Miss. **Range:** Massachusetts to Minnesota, southward to Florida and New Mexico; also in Mexico, Central and South America, West Indies, Europe and Hawaii.

Aeciospores from *Chamaesyce humistrata* were sown in 1902 by Arthur (Bot. Gaz. **35:** 12. 1903) on the same host with abundant infection, and on *C. preslii* and *Euphorbia marginata* without infection.

(2). **Uromyces proëminens typica** n. nom., with urediospore-pores 5 or 6, widely scattered; teliospores 14–17 by 18–22 μ, finely verrucose, usually in evident striae; On **Chamaesyce albomarginata** (T. & G.) Small(*Euphorbia a.*), Ariz., Calif., N.M., Tex.—**C. arizonica** (Engelm.)Arth.(*E. a.*), Ariz.—**C. fendleri** (T.&G.)Small(*E. f.*), Ariz., Colo., Utah.—**C. geyeri** (Engelm.)Small(*E. g.*), Ill., Kans., Miss., Neb., Wyo.—**C. glyptosperma** (Engelm.)Small(*E. g.*), Colo., Iowa, Minn., Neb., N.M., N.D., Ore., S.D.—**C. hirsuta** (Torr.)Arth.(*E. h.* Wieg.), N.Y.; Ont.—**C. hypericifolia** (L.)Millsp.(*E. h.*), Fla.—**C. hyssopifolia** (L.)Small(*C. preslii* Arth., *E. p.* Guss., *E. nutans* Lag.), Ark., Del., D.C., Ill., Ind., Iowa, Kans., Ky., Mich., Minn., Miss., Mo., Neb., N.J., N.Y., N.C., Ohio, Okla., Pa., Tenn., Tex., Va., W.Va., Wis.—**C. nuttallii** (Engelm.) Small(*E. n., E. zygophylloides* Boiss.), Kans.—**C. oregonensis** Millsp., Ore.—**C. petaloidea** (Engelm.)Small(*E. p.*), Colo., Neb., S.D., Tex., Wyo.—**C. polycarpa** (Benth.)Millsp.(*E. p.*), Ariz., Calif.—**C. polygonifolia** (L.)Small(*E. p.*), Ill.—**C. serpens** (H.B.K.)Small(*E. s.*), Kans., La., Neb.—**C. serpyllifolia** (Pers.)Small(*E. s.*), Ariz., Calif., Colo., Iowa, Miss., Mont., Nev., N.M., N.D., S.D., Tex., Utah, Wash.; B.C. **Range:** New York to British Columbia, southward to Florida and southern California; also in Central America, West Indies, and Europe.

Cultures in 1899 and 1900 by Arthur (Bot. Gaz. **29:** 270. 1900; Jour. Myc. **8:** 51. 1902), using aeciospores from *Chamaesyce preslii* (under name of "*Euphorbia nutans*"), gave infection on *C. preslii*, but no infection on *C. maculata*. Again in 1902 (Bot. Gaz. **35:** 13. 1903) aeciospores from *C. preslii* gave infection on same host, but not on *C. humistrata* or on *Euphorbia marginata*.

(3). **Uromyces proëminens myristica** (B. & C.) n. comb., with urediospore-pores 5 or 6, widely scattered; teliospores 15–18 by 18–24 μ, finely verrucose in evident striae; On **Dichrophyllum bicolor** (Engelm.&Gray)K.&G. (*Euphorbia b.*), Tex.—**D. marginatum** (Pursh)K.&G.(*E. m., Lepadena m.* Nieuwl.), Colo., Iowa, Kans., Neb., Okla., S.D., Tex. **Range:** Central Iowa to South Dakota, southward to Texas.

(4). **Uromyces proëminens poinsettiae** (Tranz.) n. comb., with urediospore-pores 5 or 6, widely scattered; teliospores 14–18 by 19–24 μ, coarsely and uniformly verrucose, or rarely indistinctly striate; On **Poinsettia barbellata**

(Engelm.)Small(*Euphorbia b.*), N.M.—**P. cuphusperma** (Boiss.)Small(*E. c.*), Ariz., N.M.—**P. cyathophora** (Murr.)S.Brown(*E. c.*), Fla.—**P. dentata** (Michx.)Small(*E. d.*), Colo., Ill., Ind., Iowa, Kans., Ky., Mo., Neb., N.M., Ohio, Okla., Tenn., Tex., Utah, Va., W.Va.—**P. heterophylla** (L.)K.&G.(*E. h.*), Fla., Ill., Ind., Iowa, Kans., Miss., Mo., Tex.—**Zygophyllidium bilobatum** (Engelm.)Standl.(*E. b.*), N.M. **Range:** Indiana to Nebraska, southward to Tennessee and New Mexico, and in southern Florida; also in Bahamas, West Indies, Mexico, and South America.

Uromyces mayorii.

Uromyces mayorii Tranz.; Mayor, Mém. Soc. Neuch. Sci. Nat. **5:** 463. 1913.
Uromyces largus Arth. & Cumm., Ann. Myc. **31:** 44. 1933.

Pycnia as in *Uromyces proëminens.* Aecia and uredia wanting. Telia and teliospores as in *U. proëminens.*

On Euphorbiaceae: **Chamaesyce lata** (Engelm.)Small(*Euphorbia l.*), Colo., Kans., Tex.—**C. serpens** (H.B.K.)Small(*E. s.*), Calif. **Range:** Kansas to western Texas and southern California; also in South America.

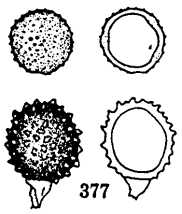
Correlated with *Uromyces proëminens typica,* with which it has been confused, as pointed out by Arthur and Cummins (*l. c.*).

252. UROMYCES DICTYOSPERMA. Fig. 377.

(N. A. F. 7: 766.)

Uromyces dictyosperma E. & E., N. Am. Fungi *2882,* hyponym. 1893.
Uromyces dictyosperma E. & E.; Tranz., Ann. Myc. **8:** 12. 1910.
Nigredo dictyosperma Arth., N. Am. Flora **7:** 766. 1926.

Pycnia hypophyllous, scattered among the aecia. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 12–16 by 16–20 μ; wall colorless, 1–2 μ thick, finely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid, 16–20 μ in diameter; wall nearly colorless, 1.5–2 μ thick, verrucose-echinulate, the pores about 6, scattered. Telia chiefly hypophyllous, blackish-brown; teliospores globoid, 18–24 by 24–30 μ, rounded above and below; wall chestnut-brown, uniformly 2–2.5 μ thick, coarsely tuberculate, the tubercles 3–3.5 μ high; pedicel colorless, short, fragile.


377

On Euphorbiaceae: **Tithymalus arkansanus** (Engelm.&Gray)K.&G. (*Euphorbia a.*), Colo., Kans., Neb., Okla., S.D., Tex.—**T. dictyosperma** (Fisch. &Mey.)Heller(*E. d.*), Calif., Wash.—**T. missouriensis** (Norton)Small(*E. m.*), Colo., Kans., Mont., Neb., N.D., S.D., Wyo.—**T. obtusatus** (Pursh)Small(*E. o.*), Calif. **Range:** Plains, North Dakota to Montana, southward to Texas, and from southern Washington to southern California.

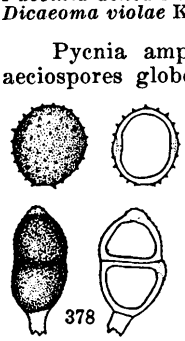
*. **Uromyces agnatus** Arth., with pycnia and aecia unknown; uredia hypophyllous, cinnamon-brown, urediospores ellipsoid, 18–23 by 21–29 μ, wall golden-brown, 1.5–2.5 μ thick, echinulate, the pores 2, equatorial; telia hypophyllous, chocolate-brown, teliospores ellipsoid, 23–29 by 29–35 μ, often narrowed above, the wall chestnut-brown, uniformly 3–4 μ thick or slightly thicker above, coarsely and irregularly verrucose, more so above, the pedicel colorless, short, fragile; occurs on Euphorbiaceae: **Cnidoscolus stimulosus** Gray(*Jatropha s.* Michx., *Bivonea s.* Raf.), southern South Carolina and Florida. (N. A. F. **7:** 589.)

253. PUCCINIA VIOLAE. Fig. 378.

(N. A. F. 7: 392, 790, 841.)

(*Aecidium violae* Schum., Enum. Pl. Saell. **2**: 224. 1803.)
Uredo violae Schum., Enum. Pl. Saell. **2**: 233. 1803.
Puccinia violae (Schum.) DC., Fl. Fr. **6**: 62. 1815.
Puccinia densa D. & H.; Diet., Hedw. **36**: 298. 1897.
Dicaeoma violae Ktze., Rev. Gen. **3**[3]: 471. 1898.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, cupulate; aeciospores globoid, 14–19 by 16–26 μ; wall nearly or quite colorless, 1–1.5 μ thick, minutely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid or ellipsoid, 18–25 by 21–32 μ; wall cinnamon-brown, 1.5–3 μ thick, echinulate, the pores 2, rarely 3, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid or oblong, 17–26 by 27–41 μ (western forms 17–28 by 27–45 μ), rounded or narrowed at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, sometimes 2–3 μ, with hyaline papilla over the pores, the pore of upper cell apical, of the lower at septum, or both more or less depressed, smooth or more often faintly or distinctly verrucose, especially on upper cell in western forms; pedicel colorless, short, fragile.


378

On Violaceae: **Viola adunca** J.E.Sm.(*V. arenaria* Am.auth.), Calif., Colo., Mont., Nev., N.H., N.D., Ore., S.D., Utah, Wash.—**V. affinis** LeConte, Del., N.Y.—**V. blanda** Willd., Conn., Ky., N.Y., Pa., W.Va.—**V. brittoniana** Pollard, N.J.—**V. canadensis** L., Colo., Ky., Mich., Mont., N.M., N.Y., Ore., S.D., Tenn., Utah; Alta., B.C.—**V. conspersa** Reichenb.(*V. muhlenbergii* Torr.), Mass., N.Y., Wis.; Queb.—**V. cucullata** Ait., Me., Neb., N.J., N.Y., N.C., Pa., Vt., Va.—**V. eriocarpa** Schw.(*V. scabriuscula* Schw.), Ark., Ill., Ind., Iowa, Me., Mich., Miss., Mo., N.H., N.Y., Ohio, Pa., Tenn.; Ont.—**V. fimbriatula** J.E.Sm., Conn., Me., Mass.—**V. glabella** Nutt., Calif., Ida., Ore., Wash.—**V. hastata** Michx., N.C., Ohio, Tenn., W.Va.—**V. hirsutula** Brain., N.Y., W.Va.—**V. howellii** Gray, Wash.—**V. incognita** Brain., Conn., Me., Mich., Minn., N.H., N.Y., Ohio, Pa.—**V. lanceolata** L., Del., Me., Mich., N.Y.—**V. langsdorfii** Fisch., Alas.—**V. missouriensis** Greene, Ind., Mo.—**V. montanensis** Rydb., Colo., Mont., Wash.—**V. monticola** Rydb., Mont.—**V. nephrophylla** Greene, Calif., N.M., Ore., Wash.; Alta.—**V. ocellata** T.&G., Calif.—**V. pallens** (Banks)Brain., N.H., N.Y.—**V. palmata** L., Miss.—**V. palustris** L., Alas., Wash.—**V. papilionacea** Pursh(*V. palmata cucullata* Gray), Ala., Ill., Ind., Iowa, Kans., Mass., Mo., N.Y., N.C., N.D., Okla., S.D., Va., Wis.—**A. pedatifida** G.Don(*V. delphinifolia* Nutt.), Colo., N.M.—**V. primulifolia** L., Ala., Fla., Me., Miss., N.Y., Pa., Va.—**V. pubescens** Ait., Ind., Iowa, Mich., N.Y., N.D., Vt., Wis.; Ont.—**V. renifolia** Gray, Me., Mich., Minn., N.Y., Wis.—**V. rostrata** Pursh, N.Y.—**V. rugulosa** Greene(*V. rydbergii* Greene), Colo., Mont., N.D., Ore., Wyo.—**V. sagittata** Ait., Va., Wis.—**V. scopulorum** (Gray)Greene, Colo.—**V. selkirkii** Pursh, N.Y., Vt.—**V. septentrionalis** Greene, Me., N.Y.; N.S., Ont.—**V. sororia** Willd., Ind., Iowa, Kans., Mo.; Ont.—**V. striata** Ait., Ill., Ind., Mo., Ohio, W.Va.—**V. villosa** Walt., Ala.—**V. vittata** Greene, Fla. **Range:** Nova Scotia to southeastern Alaska, southward to Florida, New Mexico and central California; also in Mexico, Central and South America, Europe, Asia, Formosa and Japan. A cosmopolitan species.

Puccinia effusa.

(N. A. F. 7: 460, 798.)

Puccinia effusa D. & H.; Diet., Erythea **3:** 81. 1895.
Allodus effusa Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia and aecia as in *Puccinia violae*. Uredia wanting; urediospores occasionally in the telia as in *P. violae*, 18–25 by 21–32 μ, the wall usually 3–3.5 μ thick. Telia as in *P. violae*, the spores 20–30 by 32–51 μ, the wall uniformly 2.5–3 μ thick, with pores of both cells usually much depressed.

On Violaceae: **Viola cuneata** Wats., Calif.—**V. lobata** Benth., Calif.—**V. praemorsa** Dougl., Wash.—**V. purpurea** Kellogg, Calif. **Range:** Southern Washington and northern California.

Puccinia ornatula.

(N. A. F. 7: 547.)

Puccinia ornatula Holw., N. Am. Ured. **1:** 67. 1907.
Micropuccinia ornatula A. & J., N. Am. Flora **7:** 547. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chestnut-brown; teliospores as in *Puccinia violae*, sometimes angular, the wall cinnamon-brown, smooth except for two to four obscure longitudinally verrucose lines, or evenly and minutely verrucose, otherwise as in *P. violae*.

On Violaceae: **Viola canadensis** L., B.C.—**V. glabella** Nutt., B.C.—**V. rugulosa** Greene(*V. rydbergii* Greene), B.C. **Range:** Vicinity of Glacier, British Columbia.

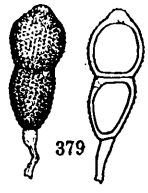
This microcyclic species is correlated with *Puccinia violae*, both in its main morphologic features and hosts. It is distinctive, however, in the somewhat irregular teliospores, often having the verrucose markings in lines. It is closely related to the European *Puccinia alpina* Fckl.

254. PUCCINIA CANADENSIS. Fig. 379.

(N. A. F. 7: 548.)

Puccinia canadensis Arth., Bull. Torrey Club **31:** 2. 1904.
Micropuccinia canadensis A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chestnut-brown; teliospores narrowly oblong, 12–16 by 30–56 μ, obtuse or narrowed at both ends, noticeably constricted at septum; wall cinnamon-brown, uniformly 1–2 μ thick, with a hyaline papilla over the pore of upper cell, the pores not depressed, closely verrucose in striae; pedicel colorless, short, fragile.


379

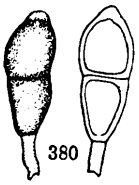
On Violaceae: **Viola orbiculata** Geyer, Alta., B.C. **Range:** A restricted area in the Selkirk Mountains, near Laggan and Glacier.

255. PUCCINIA FERGUSSONI. Fig. 380.

(N. A. F. 7: 547.)

Puccinia fergussoni B. & Br., Ann. Nat. Hist. IV. **15:** 35. 1875.
Micropuccinia fergussoni A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, very small, in dense orbicular groups, chestnut-brown;


380

teliospores oblong, 13–18 by 26–42 μ, obtuse above, narrowed below, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, with a broad hyaline papilla over the pore of upper cell, the pores not depressed, smooth; pedicel colorless, short, fragile.

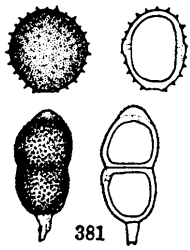
On Violaceae: **Viola langsdorfii** Fisch., B.C.—**V. mackloskeyi** Lloyd, B.C.—**V. nephrophylla** Greene, Utah; B.C.—**V. palustris** L., Alas., Colo., Mont. **Range:** High mountains from southeastern Alaska to Colorado and Utah; also in Europe and Japan.

256. PUCCINIA VAGANS. Fig. 381.

(N. A. F. 7: 394, 790, 841.)

Uredo vagans a epilobii-tetragoni DC., Fl. Fr. **2:** 228. 1805.
(*Aecidium epilobii* DC., Fl. Fr. **2:** 238. 1805.)
Puccinia pulverulenta Grev., Fl. Edin. 432. 1824.
Puccinia gayophyti Billings, in Wats., Bot. King's Expl. 414. 1871.
Puccinia epilobii-tetragoni Wint., in Rab., Krypt.-Fl. **1:** 214. 1881.
Puccinia intermedia D. & H.; Diet., Bot. Gaz. **18:** 254. 1893.
Dicaeoma epilobii-tetragoni Arth., N. Am. Flora **7:** 394. 1920.
Puccinia vagans (DC.) n. comb.

Pycnia amphigenous, among the aecia. Aecia chiefly amphigenous, systemic, cupulate; aeciospores globoid, 13–20 by 13–23 μ; wall colorless, 1 μ thick, finely verrucose. Uredia chiefly amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 15–26 by 19–31 μ; wall cinnamon-brown, 1.5–3 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 14–23 by 26–40 μ, rounded at both ends, slightly constricted at septum; wall dark cinnamon-brown, uniformly 1.5–3 μ thick, with a broad hyaline papilla or umbo over pore of upper cell, the pore of upper cell apical, of the lower (rarely two pores) at septum or depressed, smooth or minutely rugose; pedicel colorless, short, fragile.


381

On Onagraceae: Hosts given under the varieties.

(1). **Puccinia vagans epilobii-tetragoni** DC., with teliospores ellipsoid or somewhat oblong, 14–21 by 26–38 μ, the pore (sometimes two pores) in the lower cell much depressed; On **Boisduvalia glabella** (Nutt.)Walp., Ida.—**B. stricta** (Gray)Greene(*B. torreyi* Wats.), Ore.—**Chylismia scapoidea** Nutt. (*Oenothera s.* Nutt.), Ida.—**Epilobium adenocaulon** Haussk., Mont., N.M., Wash.—**E. americanum** Haussk., Ida., Wash.—**E. anagallidifolium** Lam., Wyo.—**E. franciscanum** Barbey, Calif.—**E. jucundum** Gray, Wash.—**E. minutum** Lindl., Ore.—**E. paniculatum** Nutt., Calif., Colo., Ida., Mont., Nev., N.D., Ore., S.D., Utah, Wash., Wyo.—**Gayophytum diffusum** T.&G., Ida.—**G. pumilum** Wats., Utah.—**G. racemosum** T.&G., Ariz., Colo.—**G. ramosissimum** T.&G., Wash. **Range:** North Dakota to Washington, southward to New Mexico and southern California; also in South America, Europe, Asia, Japan, Australia and New Zealand.

(2). **Puccinia vagans gayophyti** (Billings) n. comb., with teliospores ellipsoid, 16–23 by 27–40 μ, the pore in lower cell at septum; On **Gayophytum caesium** T.&G., Ida., Nev., Utah, Wash., Wyo.—**G. diffusum** T.&G., Calif., Ida., Utah.—**G. helleri** Rydb., Ida.—**G. lasiospermum** Greene,

Utah.—**G. nuttallii** T.&G., Ida.—**G. pumilum** Wats., Calif., Ida.—**G. racemosum** T.&G., Ariz., Colo., Ida., Wyo.—**G. ramosissimum** T.&G., Calif., Colo., Ida., Mont., N.M., Ore., Utah, Wyo. **Range:** Montana to Washington, southward to New Mexico and central California.

Puccinia scandica.

(N. A. F. 7: 550.)

Puccinia scandica Johans., Bot. Notiser **1886:** 175. 1886.
Micropuccinia scandica A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, systemic, simulating the habit of the aecia in *P. vagans;* teliospores as in *P. vagans.*

On Onagraceae: **Epilobium clavatum** Trel., Utah, Wash.—**E.** sp., B.C. **Range:** From British Columbia southward to Washington and central Utah; also in Sweden.

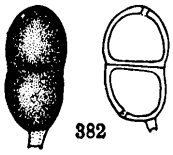
This systemic microcyclic species is closely correlated with *P. vagans.*

257. PUCCINIA ARALIAE. Fig. 382.

(N. A. F. 7: 550.)

Puccinia araliae E. & E., Jour. Myc. **6:** 120. 1891.
Micropuccinia araliae A. & J., N. Am. Flora **7:** 550. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid or oblong, 16–23 by 30–38 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1–1.5 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, smooth, or with a few striately verrucose markings; pedicel colorless, short, fragile.


382

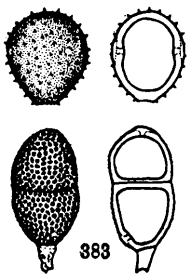
On Araliaceae: **Panax trifolium** L., Mass., Pa. **Range:** Only two localities known, one in eastern Massachusetts, the other in central Pennsylvania.

258. PUCCINIA MARYLANDICA. Fig. 383.

(N. A. F. 7: 398, 790, 842.)

Puccinia marylandica Lindr., Medd. Stockh. Högsk. Bot. Inst. **4°:** 2. 1901.
Dicaeoma marylandicum Arth., N. Am. Flora **7:** 398. 1920.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, cylindric; aeciospores globoid, 15–23 by 16–25 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 19–28 by 23–30 μ; wall pale cinnamon-brown, 2–4 μ thick, echinulate, the pores 2 or 3, equatorial. Telia amphigenous, chestnut-brown; teliospores ellipsoid, 19–26 by 28–42 μ, rounded above and below, slightly constricted at septum; wall dark cinnamon-brown, uniformly 1.5–2 μ thick, the pore of upper cell usually apical, of the lower much depressed, finely reticulate; pedicel colorless, short, fragile.


383

On Ammiaceae (*Umbelliferae*): **Sanicula canadensis** L., Mo., Tenn., W.Va.—**S. floridana** Bickn., Fla.—**S.**

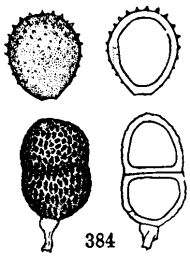
marilandica L., Colo., Pa., Tenn.; Alta., Man., Sask.—**S. trifoliata** Bickn., Pa.—**S.** sp., Del., Ind., Iowa, Mo., N.Y., S.C., S.D., Wis.; N.S. **Range:** Nova Scotia to Saskatchewan, southward east of the Rocky Mountains to Florida and Missouri, and in southwestern British Columbia.

259. PUCCINIA PIMPINELLAE. Fig. 384.

(N. A. F. 7: 396, 790, 841.)

Uredo pimpinellae Str., Ann. Wett. Ges. **2:** 102. 1810.
Puccinia pimpinellae (Str.) Mart., Fl. Mosq. ed. 2. 226. 1817.
Puccinia osmorrhizae C. & P.; Peck, Ann. Rep. N. Y. State Mus. **29:** 73. 1878.
Dicaeoma pimpinellae Ktze., Rev. Gen. **3**[3]: 470. 1898.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, opening by a pore, bullate; aeciospores globoid, 15–21 by 19–29 μ; wall nearly or quite colorless, 2–2.5 μ thick, finely verrucose. Uredia hypophyllous, golden-brown; urediospores globoid or obovoid, 16–24 by 21–30 μ; wall pale cinnamon-brown, 1.5–3 μ thick, echinulate, more strongly above, the pores indistinct, 3, nearly equatorial. Telia amphigenous, chestnut-brown; teliospores ellipsoid or oblong, 18–26 by 26–37 μ, rounded above and below, slightly constricted at septum; wall chestnut-brown, uniformly 2–3 μ thick, the pore of upper cell near or at apex, of the lower much depressed, finely reticulate; pedicel colorless, short, fragile.



384

On Ammiaceae (*Umbelliferae*): **Chaerophyllum procumbens** (L.)Crantz, D.C., Ky., Mo., Ohio, Pa.—**C. tainturieri** Hook., Tenn.—**Osmorrhiza ambigua** C.&R., Ore.—**O. brachypoda** Torr., Calif.—**O. brevipes** C.&R., Calif., Ore., Wash.—**O. claytoni** (Michx.)Clarke(*O. brevistylis* DC.), Conn., Del., Iowa, Mass., Mich., Mo., N.H., N.Y., Ohio, Pa., W.Va., Wis.; Ont., Queb.—**O. divaricata** Nutt., Ida., Mich., Mont., Ore., Wash.—**O. intermedia** (Rydb.)Blank., Alas., Mont., Wash., Wyo., Utah.—**O. leibergii** (C.&R.)Blank., Ore.—**O. longistylis** (Torr.)DC., Conn., Ind., Iowa, Ky., Md., Mich., Mo., Neb., N.Y., N.D., Ohio, Pa., Va., W.Va., Wis.; Man., Ont., Sask.—**O. nuda** Torr., Calif., Ida., Mont., Utah, Wash.—**O. obtusa** (C.&R.)Fern., Utah.—**O. occidentalis** Nutt.(*Glycosma o.*), Calif., Colo., Mont., Ore., Utah. **Range:** Quebec to Saskatchewan, southward to Virginia and Missouri, and from southeastern Alaska, southward to Colorado and central California; also in Europe, Asia Minor, India, Japan and Algeria.

Puccinia erigeniae.

(N. A. F. 7: 462, 798.)

Allodus erigeniae Orton, Mem. N. Y. Bot. Gard. **6:** 191. 1916.
Puccinia erigeniae (Orton) Arth., Bull. Torrey Club **48:** 33. 1921.

Pycnia and aecia as in *Puccinia pimpinellae*. Uredia wanting. Telia as in *P. pimpinellae*. All spores slightly more delicate than in *P. pimpinellae*.

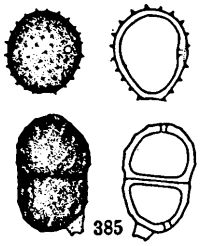
On Ammiaceae (*Umbelliferae*): **Erigenia bulbosa** (Michx.)Nutt., Ohio; Ont. **Range:** Southern Ontario and northern Ohio, represented only by two collections.

260. PUCCINIA CICUTAE. Fig. 385.

(N. A. F. 7: 398, 790, 842.)

Puccinia cicutae Lasch; Klotzsch, Herb. Viv. Myc. 787. 1845.
Dicaeoma cicutae Ktze., Rev. Gen. 3³: 468. 1898.

Pycnia amphigenous or petiolicolous, few, associated with the aecia. Aecia chiefly amphigenous, in small groups, pustulate; aeciospores globoid or ellipsoid, 15–20 by 18–27 μ; wall pale-yellow, 1–1.5 μ thick, minutely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid or ellipsoid, 16–23 by 21–30 μ; wall cinnamon-brown, 1–2 μ thick, echinulate, the pores 3, equatorial. Telia chiefly hypophyllous, chestnut-brown; teliospores ellipsoid, 19–26 by 28–40 μ, rounded at both ends, slightly constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, faintly and coarsely verrucose, inclined to be striate; pedicel colorless, short, fragile, often oblique.


385

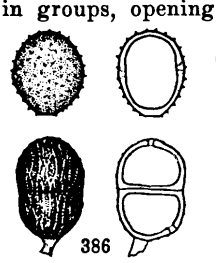
On Ammiaceae (*Umbelliferae*): **Cicuta bolanderi** Gray, Calif.—**C. californica** Gray, Calif.—**C. curtisii** C.&R., Fla.—**C. maculata** L., Me., N.Y., Wis.; Man., N.S.—**C. occidentalis** Greene, Calif., Colo., Ida., Ore., Utah; Sask.—**C. vagans** Greene, Nev. **Range:** Locally from Nova Scotia to Saskatchewan, southward to Florida, and from Idaho and Oregon, southward to Colorado and central California; also in Europe, Asia and Japan.

261. PUCCINIA PSEUDOCYMOPTERI. Fig. 386.

(N. A. F. 7: 397.)

Puccinia pseudocymopteri Holw., N. Am. Ured. 1: 91. 1913.
Dicaeoma pseudocymopteri Arth., N. Am. Flora 7: 397. 1920.

Pycnia amphigenous, few, associated with the aecia. Aecia amphigenous, in groups, opening by a pore, expanding into shallow cups; aeciospores globoid or ellipsoid, 16–23 by 19–27 μ; wall nearly or quite colorless, 1.5 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 16–26 by 23–32 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores indistinct, 3 or 4, equatorial. Telia amphigenous, chestnut- or chocolate-brown; teliospores ellipsoid, 19–24 by 27–39 μ, rounded above and below, slightly or not constricted at septum; wall chestnut-brown, uniformly 1–2 μ thick, the pores of both cells, especially of the lower, more or less depressed, rugosely verrucose, inclined to be striate; pedicel colorless, short, fragile.


386

On Ammiaceae (*Umbelliferae*): **Pseudocymopterus anisatus** (Gray)C.&R.(*Pseudopteryxia a.* Rydb.), Utah.—**P. bipinnatus** (Wats.)C.&R.(*Pseudoreoxis b.* Rydb., *Cymopterus b.*), Mont.—**P. montanus** (Gray)C.&R., Colo., N.M., Utah.—**P. multifidus** Rydb., Colo., N.M. **Range:** Mountains of Montana, southward to New Mexico.

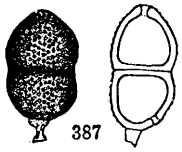
262. PUCCINIA JONESII. Fig. 387.

(N. A. F. 7: 463, 464, 798, 844.)

Puccinia jonesii Peck, Bot. Gaz. 6: 226. 1881.
Puccinia cymopteri D. & H.; Diet., Bot. Gaz. 18: 255. 1893.

Puccinia lindrothii Syd.; Lindr., Acta Soc. Fauna Flora Fennica **22**[1]: 62. 1902.
Allodus jonesii Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.
Allodus lindrothii Orton, Mem. N. Y. Bot. Gard. **6**: 192. 1916.

Pycnia amphigenous, associated with the aecia. Aecia chiefly hypophyllous, bullate, the peridium at first incurved; aeciospores globoid or ellipsoid, 16–24 by 18–30 μ; wall nearly or quite colorless, 1–2 μ thick, finely verrucose. Uredia wanting. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid, 18–26 by 29–43 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–3.5 μ thick, the pore of upper cell nearly or quite apical, of the lower cell much depressed, faintly to conspicuously verrucose, inclined to be striate; pedicel colorless, short, fragile.


387

On Ammiaceae (*Umbelliferae*): Hosts as given under the varieties.

(1). **Puccinia jonesii typica** n. nom., with teliospore-wall uniformly 1.5–2.5 μ thick, finely verrucose, often in striae; On **Cogswellia ambigua** (Nutt.)Jones, Wyo.—**C. angustata** C.&R., Ore.—**C. daucifolia** (Nutt.)Jones (*Peucedanum d.*), Kans.—**C. foeniculacea** (Nutt.)C.&R.(*P. f.*, *Lomatium f.* C.&R.), Kans., Neb.—**C. gormani** (Howell)Jones(*L. g.* C.&R.), Wash.—**C. grayi** C.&R., Utah.—**C. macrocarpa** (Nutt.)Jones(*P. m.*), Mont., Nev., Wash.—**C. montana** (C.&R.)Jones, Mont.—**C. nevadensis** (Wats.)Jones, Nev.—**C. orientalis** (C.&R.)Jones, Ariz., Colo., Neb., Okla.—**C. simplex** (Nutt.) Jones(*C. platycarpa* Jones, *P. p.* C.&R., *L. p.* C.&R.), Utah.—**C. suksdorfii** (Wats.)Jones (*P. s.*), Wash.—**C. tritemata** (Pursh)Jones(*P. t.* Nutt.), Ore., Wash.—**C. villosa** (Raf.)Schult.(*P. v.* Nutt.), Mont.—**Cynomarathrum parryi** (Wats.)C.&R., Calif.—**Leptotaenia eatonii** C.&R., Colo., Mont.—**L. multifida** Nutt., Ariz., Colo., Ida., Mont., Utah, Wash., Wyo.—**L. purpurea** (Wats.) C.&R., Wash.—**Musineon divaricatum** (Pursh)C.&R., Colo., Mont.—**M. trachyspermum** Nutt.(*M. hookeri* Nutt.), Colo. **Range:** Montana to Washington, southward to Oklahoma and central California.

(2). **Puccinia jonesii cymopteri** (D.&H.) n. comb., with teliospore-wall uniformly 1.5–2 μ thick, minutely verrucose, often appearing smooth, rarely in striae; On **Aulospermum betheli** Osterh.(*Coriophyllus b.* Rydb.), Colo.—**A. longipes** (Wats.)C.&R.(*Cymopterus l.*), Utah.—**A. purpureum** (Wats.)C.&R. (*Cym. p.*, *Cor. p.* Rydb.), Colo.—**Cymopterus acaulis** (Pursh)Rydb., Colo., Neb.—**C. fendleri** Gray, Utah.—**C. lapidosus** Jones(*Cogswellia l.* Rydb.), Utah.—**Oreoxis alpina** (Gray)C.&R.(*Cym. a.*), Colo.—**Phellopterus montanus** Nutt. (*Cym. m.* T.&G.), Colo., N.M.—**Pteryxia calcarea** (Jones)C.&R.(*Cym. c.*), Wyo.—**P. foeniculacea** Nutt.(*Cym. f.* T.&G.), Wyo.—**P. terebinthina** (Hook.) C.&R.(*Cym. t.* T.&G.), Calif. **Range:** Northern Wyoming to central California, southward to northern New Mexico.

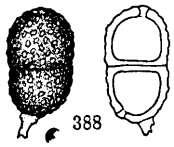
(3). **Puccinia jonesii lindrothii** (Syd.) n. comb., with teliospore-wall dark cinnamon-brown, uniformly 3–3.5 μ thick, strongly verrucose in evident striae; On **Euryptera hassei** C.&R., Calif.—**E. lucida** Nutt., Calif.—**E. parvifolia** (H.&A.)C.&R., Calif.—**Velaea arguta** (Nutt.)C.&R.(*Deweya a.* T.&G.), Calif.—**V. hartwegii** (Gray)C.&R.(*Drudeophytum h.* C.&R., *Araccacea h.* Wats.), Calif.—**V. parishii** C.&R.(*Drud. p.* C.&R.), Calif. **Range:** Central to southern California.

263. PUCCINIA ASPERIOR. Fig. 388.

(N. A. F. 7: 462.)

Puccinia asperior E. & E., Bull. Washb. Lab. Nat. Hist. **1:** 3. 1884.
Allodus asperior Orton, Mem. N. Y. Bot. Gard. **6:** 193. 1916.

Pycnia chiefly hypophyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 18–22 by 20–29 μ; wall colorless, 1.5–2 μ thick, finely verrucose. Uredia wanting. Telia hypophyllous, chocolate-brown; teliospores ellipsoid or oblong, 21–26 by 29–40 μ, usually rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2.5–3.5 μ thick, or slightly thicker above, the pore of upper cell nearly or quite apical, of the lower much depressed, coarsely and sparsely verrucose; pedicel colorless, short, fragile.


388

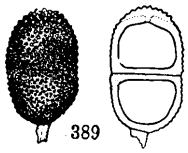
On Ammiaceae (*Umbelliferae*): **Leptotaenia dissecta** Nutt., Calif., Ore., Wash. **Range:** Southern Washington to central California.

264. PUCCINIA MUSENII. Fig. 389.

(N. A. F. 7: 551.)

Puccinia musenii E. & E., Bull. Torrey Club **27:** 61. 1900.
Micropuccinia musenii A. & J., N. Am. Flora **7:** 551. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, often confluent into large groups, dark chocolate-brown; teliospores ellipsoid, 18–25 by 29–42 μ, rounded at both ends, slightly or not constricted at septum; wall chocolate-brown, uniformly 2–3 μ thick, or somewhat thicker above, the pore of upper cell apical, covered by a broad hyaline umbo, of the lower at or near the septum, finely verrucose, more prominent above; pedicel colorless, usually short, fragile.


389

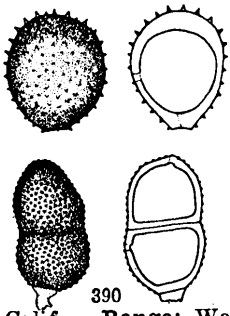
On Ammiaceae (*Umbelliferae*): **Daucophyllum tenuifolium** (Nutt.) Rydb. (*Musineon t.*), Neb., Wyo.—**Eulophus parishii** C.&R., Calif.—**Oreoxis humilis** Raf., Colo.—**Pseudocymopterus anisatus** (Gray) C.&R. (*Pseudopteryxia a.* Rydb.), Colo., Wyo.—**P. bipinnatus** (Wats.) C.&R. (*Pseudoreoxis b.* Rydb., *Cymopterus b.*), Mont. **Range:** Southeastern Montana to Colorado, and in central California.

265. PUCCINIA ELLISII. Fig. 390.

(N. A. F. 7: 491, 800, 845.)

Puccinia angelicae E. & E., Bull. Washb. Lab. Nat. Hist. **1:** 3. 1884. Not *P. angelicae* Fckl., 1870.
Puccinia ellisii De-T., in Sacc., Syll. Fung. **7:** 651. 1888.
Puccinia cynomarathri Holw., N. Am. Ured. **1:** 94. 1913.
Bullaria cynomarathri Arth. & Mains, N. Am. Flora **7:** 491. 1922.
Bullaria (?) *ellisii* Arth. & Mains, N. Am. Flora **7:** 491. 1922.

Pycnia amphigenous, in groups. Aecia amphigenous, surrounding the pycnia, uredinoid, light cinnamon-brown; aeciospores globoid or ellipsoid, 24–27 by 27–31 μ; wall light cinnamon-brown, uniformly 2 μ thick, or slightly thicker above, moderately echinulate, the pores 3, equatorial. Uredia amphigenous, scattered, cinnamon-brown; urediospores obovoid or ellipsoid, 27–32 by 32–40 μ; wall 2.5 μ thick at sides, 5–9 μ above and below, strongly echinulate,



390

especially above, the pores 3, large, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid or oblong, 22–29 by 35–48 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, the pore of upper cell nearly or quite apical, with indistinct papilla, of the lower usually depressed, closely verrucose; pedicel colorless, short, fragile.

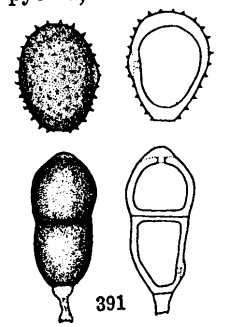
On Ammiaceae (*Umbelliferae*): **Angelica breweri** Gray, Calif.—**A. genuflexa** Nutt., Ida., Ore., Wash.—**A. tomentosa** Wats., Calif.—**Cynomarathrum nuttallii** Gray, Utah, Wyo.—**Sphenosciadium capitellatum** (B.&H.)Gray, Calif. **Range:** Washington, southward to Wyoming and central California.

266. PUCCINIA ANGELICAE. Fig. 391.

(N. A. F. 7: 490.)

Uredo angelicae Schum., Enum. Pl. Saell. **2:** 233. 1803.
Puccinia angelicae (Schum.) Fckl., Jahrb. Nass. Ver. Nat. **23–24:** 52. 1870.
Bullaria angelicae Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia amphigenous. Aecia amphigenous, uredinoid, surrounding the pycnia, otherwise like the uredia. Uredia chiefly hypophyllous, scattered, cinnamon-brown; urediospores ellipsoid or obovoid, 19–29 by 27–39 μ; wall cinnamon-brown, 1.5–4 μ thick at sides, 3–10 μ above, echinulate, the pores 3, rarely 4, equatorial, covered by more or less swollen cuticle. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid or oblong, 19–27 by 30–50 μ, rounded at both ends, slightly constricted at septum; wall chestnut-brown, uniformly 2–3.5 μ thick, or sometimes slightly thicker above, smooth, the pore of upper cell usually apical, of the lower cell much depressed; pedicel colorless, short, fragile.



391

On Ammiaceae (*Umbelliferae*): **Angelica atropurpurea** L., N.Y.—**A. genuflexa** Nutt., Wash.—**A. lyallii** Wats., Ore.—**A. villosa** (Walt.)B.S.P., Pa.—**Taenidia intergerrima** (L.)Drude (*Zizia i.* DC., *Pimpinella i.* Gray), Ind., Mich., Mo., N.Y., Wis.—**Zizia aurea** (L.)Koch, Man. **Range:** New York to Manitoba, southward to Pennsylvania and Indiana, and in Washington and Oregon; also in Europe and Asia.

Puccinia ziziae.

(N. A. F. 7: 489.)

Puccinia ziziae E. & E., Bull. Torrey Club **22:** 60. 1895.
Bullaria ziziae Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia, aecia and uredia unknown; urediospores in the telia as in *Puccinia angelicae.* Telia chiefly epiphyllous, chestnut-brown; teliospores oblong or ellipsoid, 16–22 by 29–45 μ; wall cinnamon-brown, uniformly 1–1.5 μ thick, with a hyaline papilla over pores, smooth or with a few irregular longitudinal ridges, the pore of upper cell apical, of lower cell near septum; otherwise as in *P. angelicae.*

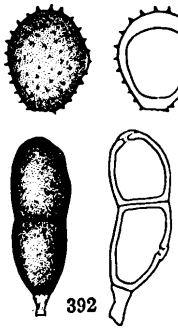
On Ammiaceae (*Umbelliferae*): **Zizia cordata** (Walt.)Koch, Wash.; Sask. **Range:** Central Saskatchewan and eastern Washington.

267. PUCCINIA COELOPLEURI. Fig. 392.

(N. A. F. 7: 489.)

Puccinia coelopleuri Arth., Bull. Torrey Club **46:** 116. 1919.
Bullaria coelopleuri Arth. & Mains, N. Am. Flora **7:** 489. 1922.

Pycnia amphigenous, in groups. Aecia amphigenous, surrounding the pycnia, uredinoid, otherwise like the uredia. Uredia amphigenous, scattered, cinnamon-brown; urediospores ellipsoid or obovoid, 22–26 by 27–35 μ; wall cinnamon-brown, 2–2.5 μ thick at sides, 3–7 μ above, echinulate, the pores 3, equatorial, covered by swollen cuticle. Telia chiefly hypophyllous, chocolate-brown; teliospores oblong or cylindric, 15–20 by 37–63 μ, rounded at both ends or narrowed below, slightly or not constricted at septum; wall dark cinnamon-brown, 1–2 μ thick at sides, 3–4 μ above, the pore in upper cell apical, in lower cell much depressed, smooth; pedicel colorless, short, fragile.


392

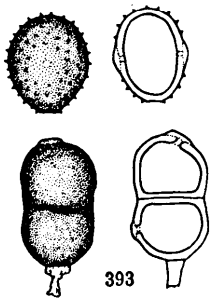
On Ammiaceae (*Umbelliferae*): **Coelopleurum gmelini** (DC.)Ledeb., Alas. **Range:** Southeastern Alaska.

268. PUCCINIA HYDROCOTYLES. Fig. 393.

(N. A. F. 7: 489, 800.)

Caeoma hydrocotyles Link, in Willd., Sp. Pl. **6**[2]**:** 22. 1825.
Puccinia hydrocotyles (Link) Cooke, Grev. **9:** 14. 1880.
(*Aecidiolum hydrocotyles* Speg., Anal. Soc. Ci. Argent. **12:** 80. 1881.)
(*Aecidium hydrocotylinum* Speg., Anal. Mus. Nac. Buenos Aires **19:** 321. 1909.)
Bullaria hydrocotyles Arth. & Mains, N. Am. Flora **7:** 489. 1922.

Pycnia epiphyllous, associated with the aecia. Aecia amphigenous, cupulate; aeciospores globoid, 16–20 by 20–25 μ; wall colorless, 1 μ thick, minutely verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid, 19–28 by 24–32 μ; wall 1.5–2.5 μ thick, echinulate, the pores 2, nearly equatorial. Telia chiefly epiphyllous, dark chestnut-brown; teliospores ellipsoid, 19–26 by 30–42 μ, rounded at both ends, slightly constricted at septum; wall cinnamon-brown, uniformly 2–2.5 μ thick, or slightly thicker above, the pore of upper cell apical, of the lower much depressed, each with small hyaline papilla, smooth, or rarely (in New Zealand) with a few coarse warts; pedicel colorless, short, fragile.


393

On Ammiaceae (*Umbelliferae*): **Hydrocotyle bonariensis** Lam., S.C.—**H. cambyi** C.&R., Md.—**H. prolifera** Kellogg, Ariz., Calif., Utah.—**H. ranunculoides** L.f., Nev.—**H. umbellata** L., Ala., Calif., Fla., Tex.—**H. verticillata** Thunb., La., Miss., Nev. **Range:** Border states from Maryland to Florida and central California, and in Utah; also in Bermuda, West Indies, Mexico, Central and South America, Hawaii, Europe and New Zealand.

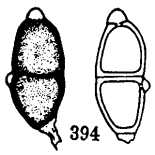
The life history is not fully established. No pycnia or aecia (except those associated with *Uromyces scirpi*) have been found in North America. Teliospores are abundant in New Zealand but rare elsewhere. Aecia on the same plants as uredia and telia occur sparingly in New Zealand, where *Uromyces scirpi* is unknown. The description of pycnia and aecia is taken from Cunningham's Uredinales of New Zealand (Trans. N. Z. Inst. **54:** 667. 1923). No cultures have been made.

269. PUCCINIA MICROICA. Fig. 394.

(N. A. F. 7: 462, 798.)

Puccinia microica Ellis, Jour. Myc. **7:** 274. 1893.
Allodus microica Orton, Mem. N. Y. Bot. Gard. **6:** 192. 1916.

Pycnia not seen. Aecia hypophyllous, in groups, cylindric; aeciospores globoid, 14–19 μ in diameter; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia wanting. Telia chiefly hypophyllous, first formed about the aecia, bullate, opening by a pore, cinnamon-brown; teliospores irregularly ellipsoid or fusiform-ellipsoid, 13–20 by 27–45 μ, narrowed at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore of upper cell apical, of the lower near septum, with a conspicuous hyaline papilla over each pore, smooth; pedicel colorless, short, fragile.


394

On Ammiaceae (*Umbelliferae*): **Cryptotaenia canadensis** (L.)DC.(*Deringa c.* Ktze.), D.C., Iowa, Md.; Queb. **Range:** Locally in eastern United States along the Potomac River, in Quebec, and in northern Iowa.

Puccinia cryptotaeniae.

(N. A. F. 7: 551.)

Puccinia cryptotaeniae Peck, Bull. Buffalo Soc. Nat. Hist. **1:** 66. 1873.
Micropuccinia cryptotaeniae A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia amphigenous, numerous, preceding or among the telia. Aecia and uredia wanting. Telia and teliospores as in *Puccinia microica.*

On Ammiaceae (*Umbelliferae*): **Cryptotaenia canadensis** (L.)DC.(*Deringa c.* Ktze.), Conn., Del., Iowa, Mass., N.J., N.Y., Pa., Wis.; Canada. **Range:** Southeastern Canada to northern Iowa, southward to Delaware.

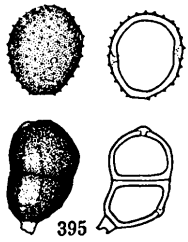
The correlation of this microcyclic species was recorded in the N. Am. Flora **7:** 551. 1922.

270. PUCCINIA ORTONII. Fig. 395.

(N. A. F. 7: 400, 790.)

Puccinia ortonii Jacks., Brooklyn Bot. Gard. Mem. **1:** 259. 1918.
Dicaeoma ortonii Arth., N. Am. Flora **7:** 400. 1920.

Pycnia epiphyllous, few, in small groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 18–19 by 19–25 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or obovoid, 19–26 by 23–32 μ; wall cinnamon-brown, 2–3 μ thick, minutely echinulate, the pores 3–5, scattered. Telia amphigenous, tardily naked, chestnut-brown; teliospores ellipsoid, 18–26 by 30–42 μ, rounded or somewhat narrowed at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell nearly or quite apical, of the lower more or less depressed, with a hyaline papilla over the upper pore, smooth, except for a few verrucose lines; pedicel colorless, short, fragile.


395

On Primulaceae: **Dodecatheon alpinum** (Gray)Greene, Calif., Utah.—**D. frigidum** C.&S., Alas.—**D. hendersoni leptophyllum** Suks., Ore.—**D. jeffreyi** Moore, Alas.; B.C.—**D. radicatum** Greene, S.D.—**D. tetrandrum** Suks., Wash. **Range:** Southeastern Alaska to southern California, and in western South Dakota and Utah.

Puccinia melanconioides.

(N. A. F. 7: 464, 798.)

Puccinia melanconioides Ellis & Hark., Bull. Calif. Acad. **1:** 27. 1884.
Allodus melanconioides Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia chiefly epiphyllous, surrounded by aecia. Aecia as in *Puccinia ortonii*. Uredia wanting. Telia as in *P. ortonii*, but the spores more nearly or quite smooth.

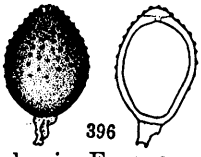
On Primulaceae: **Dodecatheon cruciatum** Greene, Calif.—**D. latifolium** (Hook.)Piper, Calif., Ore. **Range:** Oregon to central California.

271. UROMYCES APIOSPORUS. Fig. 396.

(N. A. F. 7: 518.)

Uromyces apiosporus Hazsl., Ungar. Akad. Wiss. **10:** 44. 1873.
Uromyces nevadensis Harkn., Bull. Calif. Acad. **1:** 36. 1884.
Teleutospora nevadensis Arth. & Bisby, N. Am. Flora **7:** 518. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chestnut-brown; teliospores globoid or ellipsoid, 22–27 by 29–38 μ; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, with a broad hyaline umbo over the pore, finely verrucose, more noticeable above; pedicel colorless, short, fragile.


396

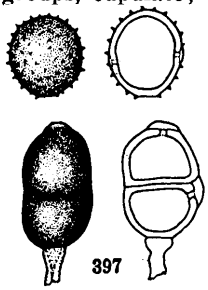
On Primulaceae: **Primula suffrutescens** Gray, Calif., Nev. **Range:** Central California and adjacent Nevada; also in Europe.

272. PUCCINIA GENTIANAE. Fig. 397.

(N. A. F. 7: 400, 790.)

Uredo gentianae Str., Ann. Wett. Ges. **2:** 102. 1810.
Puccinia gentianae (Str.) Link, in Willd., Sp. Pl. **6**[2]: 73. 1825.
Dicaeoma gentianae Ktze., Rev. Gen. **3**[3]: 468. 1898.

Pycnia amphigenous, few, in groups. Aecia chiefly hypophyllous, in large groups, cupulate; aeciospores globoid, 13–19 by 16–24 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose. Uredia chiefly epiphyllous, cinnamon-brown; urediospores broadly ellipsoid, 19–24 by 24–29 μ; wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 2, rarely 3, nearly equatorial. Telia chiefly epiphyllous, chocolate-brown; teliospores ellipsoid, 21–27 by 31–43 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–3 μ thick, the pore of upper cell apical or somewhat depressed, of the lower near the septum, usually with a small hyaline papilla over each, smooth, or rarely somewhat verrucose toward apex; pedicel colorless, short, fragile.


397

On Gentianaceae: **Gentiana affinis** Griseb.(*Dasystephana a.* Rydb.), Colo., Mont., Nev., N.D., Utah, Wyo.; Sask.—**G. andrewsii** Griseb.(*D. a.* Small), Ind., Mich., Minn., Neb., N.Y., Wis.; Ont.—**G. bigelovii** Gray(*D. b.*

Rydb.), Colo., N.M.—**G. interrupta** Greene(*D. i.* Rydb.), N.M.; Sask.—**G. linearis** Fröl.(*D. l.* Britt.), N.Y.—**G. menziesii** Griseb.(*D. m.* Arth.), Calif.—**G. newberryi** Gray(*D. n.* Arth.), Calif.—**G. oregana** Engelm.(*D. o.* Rydb.), Calif., Ida., Ore., Wash.—**G. parryi** Engelm.(*D. p.* Rydb.), Colo., Ida.—**G. plebia** Cham.(*Amarella p.* Greene), Colo.—**G. puberula** Michx.(*D. p.* Small), Iowa, S.D.—**G. romanzovii** Ledeb.(*D. r.* Rydb., *G. frigida* Gray, not Haenke), Alas., Colo.—**G. sceptrum** Griseb.(*D. s.* Arth.), Calif., Wash.—**G. villosum** L.(*D. v.* Small), Tenn. **Range:** New York to southeastern Alaska, southward to Tennessee, northern New Mexico and central California; also in Mexico, Europe, and central Asia.

The characters of smooth teliospores and position of pores ally the species with the *eupuccinia* section.

Puccinia swertiae.

(N. A. F. 7: 465, 798, 844.)

(*Aecidium swertiae* Opiz, Seznam 111, hyponym. 1852.)
Puccinia swertiae Wint., in Rab., Krypt.-Fl. **1:** 205. 1881.
(*Aecidium fraseri* Trel., Harriman Alas. Exp. Crypt. 36. 1904.)
Allodus swertiae Orton, Mem. N. Y. Bot. Gard. **6:** 195. 1916.

Pycnia and aecia as in *Puccinia gentianae*, but aeciospores somewhat larger, 16–23 by 21–27 μ. Uredia wanting. Telia as in *P. gentianae*.

On Gentianaceae: **Swertia fritillaria** Rydb., Utah.—**S. ovalifolia** Greene, Ida.—**S. perennis** L., Alas.—**S. scopulina** Greene, Colo., Wyo. **Range:** Idaho to Colorado, and in southern Alaska; also in Europe and Asia.

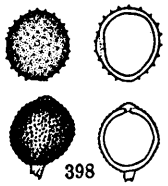
A culture with over-wintered teliospores from *Swertia perennis* was made in 1927 by Klebahn (Zeits. Pflanzenkr. **41:** 220. 1931), sowing on same species of host and producing pycnia and aecia, followed by telia.

273. UROMYCES GENTIANAE. Fig. 398.

(N. A. F. 7: 264, 769, 832.)

Uromyces gentianae Arth., Bot. Gaz. **16:** 227. 1891.
Nigredo gentianae Arth., N. Am. Flora **7:** 264. 1912.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid, 16–20 by 18–23 μ; wall pale cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 3 or 4, equatorial. Telia amphigenous, resembling the uredia, cinnamon-brown; teliospores globoid, 15–18 by 18–21 μ; wall cinnamon-brown, uniformly 1.5 μ thick, with a hyaline papilla over the pore, finely verrucose; pedicel colorless, short, fragile.


398

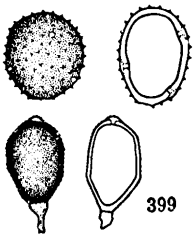
On Gentianaceae: **Gentiana heterosepala** Engelm.(*Amarella h.* Greene), N.M.—**G. quinquefolia** L., Vt.—**G. quinquefolia occidentalis** Hitchc.(*A. o.* Greene), Iowa.—**G. strictiflora** (Rydb.) Nels.(*A. s.* Greene), Colo., Nev., N.M., Wash., Wyo.; Sask.—**Pleurogyne rotata** (L.)Griseb.(*Swertia r.*), Queb. **Range:** Locally from eastern Quebec to Saskatchewan and northern Washington, southward to Vermont, northern New Mexico and Nevada; also in Mexico.

274. UROMYCES SPECIOSUS. Fig. 399.

(N. A. F. 7: 264, 769.)

Uromyces speciosus Holw., Ann. Myc. **3:** 23. 1905.
Nigredo ? speciosa Arth., N. Am. Flora **7:** 264. 1912.

Pycnia and aecia unknown. Uredia amphigenous, very small, dark cinnamon-brown; urediospores globoid or oblong, 19–24 by 26–35 μ; wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 3–6, scattered or sometimes nearly equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, somewhat angular, 15–19 by 21–29 μ; wall chestnut-brown, uniformly 1 μ thick, with hyaline papilla over the pore, minutely verrucose; pedicel colorless, short, fragile.


399

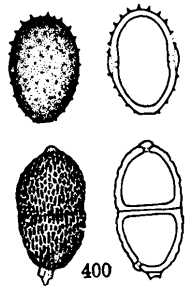
On Gentianaceae: **Frasera speciosa** Dougl., N.M.—**F. stenopetala** Rydb., Colo. **Range:** Central Colorado to New Mexico.

275. PUCCINIA VINCAE. Fig. 400.

(N. A. F. 7: 492, 801, 845.)

Uredo vincae DC., Fl. Fr. **6:** 70. 1815.
Puccinia vincae (DC.) Berk., in Smith, Engl. Fl. **5**[2]**:** 364. 1836.
Bullaria vincae Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia hypophyllous, scattered among the aecia. Aecia hypophyllous, systemic, uredinoid, cinnamon-brown; aeciospores ellipsoid or oblong, 19–23 by 24–30 μ; wall cinnamon-brown, 1.5–2 μ thick, finely echinulate, the pores 3 or 4, equatorial. Uredia hypophyllous, dark cinnamon-brown, scattered, often among the aecia; urediospores ellipsoid or oblong, 19–24 by 27–35 μ; wall dark cinnamon-brown, 2–2.5 μ thick, echinulate, the pores 3 or 4, equatorial. Telia chiefly hypophyllous, chestnut-brown; teliospores ellipsoid or oblong, 19–26 by 31–40 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell nearly or quite apical, covered with a hyaline papilla, of the lower much depressed, reticulate in more or less evident striae; pedicel colorless, short, fragile.


400

On Apocynaceae: **Vinca major** L., Mass., Mich.; Ont. **Range:** In greenhouses from Massachusetts to Michigan; adventive from Europe.

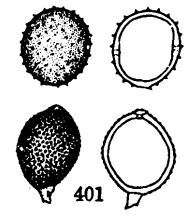
In Europe a correlated microcyclic species, *Puccinia cribrata* Arth. & Cumm., occurs on *Vinca minor*, having telia accompanied by pycnia, and the teliospores larger than in *P. vincae*, 21–29 by 37–77 μ. It has not been reported from America, although the host is common in the United States.

276. UROMYCES ASCLEPIADIS. Fig. 401.

(N. A. F. 7: 264, 769, 832.)

Uredo asclepiadis Schw.; B. & C., Jour. Acad. Sci. Phila. II. **2:** 282. 1853.
Trichobasis howei Peck, Ann. Rep. N. Y. State Mus. **23:** 58. 1873.
Uromyces asclepiadis (Schw.) Cooke, Grev. **5:** 152. 1877.
Uromyces howei Peck, Ann. Rep. N. Y. State Mus. **30:** 75. 1879.
Nigredo ? *howei* Arth., N. Am. Flora **7:** 264. 1912.

Pycnia unknown. Aecia uncertain. Uredia hypophyllous, cinnamon-brown; urediospores globoid, 18–25 by 23–28 μ; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 4, equatorial. Telia hypophyllous, chestnut-brown; teliospores globoid, 18–23 by 20–30 μ; wall chestnut-brown, uniformly 1.5 μ thick, with a hyaline papilla over the pore, finely reticulately verrucose; pedicel colorless, short, fragile.


401

On Asclepiadaceae: **Asclepias amplexicaulis** J.E. Sm.(*A. obtusifolia* Michx.), W.Va.—**A. arenaria** Torr., Neb.—**A. curassavica** L., Fla.—**A. decumbens** L., Fla.—**A. ex-**

altata (L.)Muhl.(*A. phytolaccoides* Pursh), Ill., S.D., Va.—**A. incarnata** L., Conn., Ind., Iowa, Ky., Mo., Pa., Va., W.Va., Wis.; Ont.—**A. latifolia** (Torr.) Raf.(*A. jamesii* Torr.), Tex.—**A. pulchra** Ehrh., Del., Ill., Va.—**A. purpurascens** L., Mo.—**A. quadrifolia** Jacq., Ohio.—**A. rolfsii** Britt., Fla.—**A. speciosa** Torr., Kans.—**A. syriaca** L.(*A. cornuti* Dec.), Conn., Del., D.C., Ill., Ind., Iowa, Kans., Ky., Mass., Mich., Minn., Miss., Mo., Neb., N.J., N.Y., Ohio, Pa., Tenn., Va., W.Va.; Ont.—**A. tuberosa** L., Iowa, Kans.—**Asclepiodora decumbens** (Nutt.)Gray, N.M., Tex.—**A. viridis** (Walt.)Gray, Kans.—**Vincetoxicum gonocarpos** Walt.(*Gonolobus macrophyllus* Michx.), W.Va.—**V. shortii** (Gray) Britt., Ind. **Range:** Massachusetts to South Dakota, southward to Florida and Texas; also in Bermuda, West Indies, Central and South America.

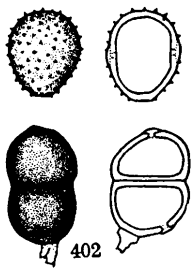
The life history of this very common rust is imperfectly understood. Some collections from the warm regions of the southern border of the United States and southward often have the appearance of a systemic aecial development, but no pycnia can be found. The Schweintz collection from Surinam does not differ from many other collections in southern regions. In northern regions the drawn chlorotic appearance of young shoots has not been seen, and uredia are not as abundant as telia, both of which occur late in the season.

277. PUCCINIA CRESSAE. Fig. 402.

(N. A. F. 7: 403, 791, 842.)

(*Aecidium cressae* DC., Fl. Fr. **6**: 89. 1815.)
Puccinia cressae [DC.] Lagerh., Bol. Soc. Brot. **7**: 131. 1889.
Puccinia cretica Holw., Erythea **5**: 31. 1897.
Dicaeoma cressae Ktze., Rev. Gen. **3**[3]: 468. 1898.

Pycnia not seen. Aecia hypophyllous, systemic, cupulate; aeciospores globoid, 15–22 by 18–26 μ; wall nearly or quite colorless, 1–1.5 μ thick, minutely verrucose. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or obovoid, 19–23 by 27–33 μ; wall golden-brown, 1.5–2 μ thick, echinulate, the pores 2 or 3, equatorial. Telia amphigenous, dark-brown; teliospores ellipsoid or oblong, 19–26 by 32–42 μ, rounded above and below, somewhat constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell apical, of the lower much depressed, sometimes a low papilla over the pores, smooth; pedicel colorless, short, fragile.

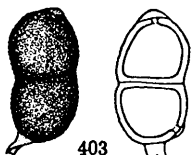

402

On Convolvulaceae: **Cressa aphylla** Heller, Tex.—**C. depressa** Goodd., Ariz., Calif., Utah.—**C. erecta** Rydb., Utah.—**C. truxillensis** H.B.K., Calif., Nev., N.M., Tex. **Range:** Utah to central California, southward to Texas and Arizona; also in Mexico, Europe and northern Africa.

278. PUCCINIA PLUMBARIA. Fig. 403.

(N. A. F. 7: 468, 799, 844.)

(*Aecidium giliae* Peck, Bot. Gaz. **4**: 230. 1879.)
Puccinia plumbaria Peck, Bot. Gaz. **6**: 228. 1881.
Puccinia giliicola P. Henn., Hedw. **37**: 270. 1898.
Allodus giliae Orton, Mem. N. Y. Bot. Gard. **6**: 199. 1916.


403

Pycnia amphigenous, scattered among the aecia. Aecia chiefly hypophyllous, systemic, cupulate; aeciospores globoid, 13–19 by 14–22 μ; wall colorless, about 1 μ thick, minutely verrucose. Uredia wanting. Telia chiefly hypophyllous,

tardily naked, chocolate-brown; teliospores ellipsoid, 19–25 by 31–45 μ, usually rounded at both ends, slightly or not constricted at septum; wall light chestnut-brown, uniformly 2–2.5 μ thick, often thicker and paler above, 4–7 μ, the pore of upper cell nearly or quite apical, of the lower much depressed, finely verrucose; pedicel colorless, short, fragile.

On Polemoniaceae: **Leptodactylon californica** H.&A.(*Gilia c.* Benth.), Calif.—**L. hookeri**(Dougl.)Nutt.(*G. pungens h.* Gray), Calif.—**L. nuttallii** (Gray)Rydb.(*G. n.*), Calif., Colo., Nev., Utah, Wyo.—**Linanthus ciliatus** (Benth.)Greene(*G. c.*), Calif.—**Microsteris gracilis** (Dougl.)Greene(*Collomia g.*), Calif., Mont., Ore., Utah, Wash.—**M. humilis** Greene, Ida., Utah.—**M. micrantha** (Kellogg)Greene(*C. m.*), Calif., Colo., Ida., Mont., Utah.—**Phlox depressa** (Nels.)Rydb., Colo.—**P. divaricata** L., Ill., Iowa, Mo.—**P. longifolia** Nutt., Colo., Ida., Nev., N.M., Utah.—**P. multiflora** Nels., Colo., Wyo.—**P. pilosa** L., Iowa, Tex.—**P. speciosa** Pursh, Calif., Ore.—**P. standburyi** (Torr.) Heller, Nev. **Range:** Iowa to Washington, southward to Texas and southern California; also in South America and Asia.

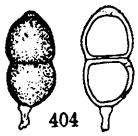
The collections of this species in herbaria bear many different names for both the rust and its hosts, which space prohibits mentioning. This variety of names has resulted from the diversity in form and appearance of both rusts and hosts.

279. PUCCINIA GULOSA. Fig. 404.

(N. A. F. 7: 556.)

Puccinia gulosa Jacks.; Arth., Bull. Torrey Club **47:** 470. 1920.
Micropuccinia gulosa A. & J., N. Am. Flora **7:** 556. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly caulicolous, cinnamon-brown; teliospores oblong, 15–18 by 26–35 μ, rounded at both ends, much constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore of upper cell apical, with a small hyaline papilla, of the lower near septum, finely verrucose, somewhat striate; pedicel colorless, short, fragile.


404

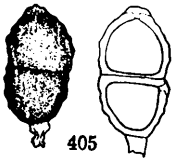
On Polemoniaceae: **Polemonium pulcherrimum** Hook., Calif. **Range:** Only one collection known, from Yosemite National Park, central California.

280. PUCCINIA ROMANZOFFIAE. Fig. 405.

(N. A. F. 7: 557.)

Puccinia romanzoffiae Jacks., Brooklyn Bot. Gard. Mem. **1:** 268. 1918.
Micropuccinia romanzoffiae A. & J., N. Am. Flora **7:** 557. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chestnut-brown; teliospores oblong, 19–24 by 34–42 μ, rounded or somewhat narrowed above and below, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–3 μ thick, the pore of upper cell apical, covered with a hyaline papilla, of the lower at septum, sparsely tuberculate with large irregular warts; pedicel colorless, short, fragile.


405

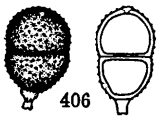
On Hydrophyllaceae: **Romanzoffia sitchensis** Bong., Ore. **Range:** Represented by a single collection from Mt. Jefferson, western Oregon.

281. PUCCINIA HYDROPHYLLI. Fig. 406.

(N. A. F. 7: 557, 804.)

Puccinia hydrophylli P. & C.; Peck, Ann. Rep. N. Y. State Mus. **30:** 54. 1878.
Micropuccinia hydrophylli A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chestnut-brown; teliospores ellipsoid, 11–20 by 23–30 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1–1.5 μ thick, the pore of upper cell apical or somewhat depressed, sometimes covered with a small hyaline papilla, of the lower much depressed, closely verrucose with conic warts, less prominent below; pedicel colorless, short, fragile.


406

On Hydrophyllaceae: **Hydrophyllum capitatum** Dougl., Colo., Utah.—**H. fendleri** (Gray)Heller, Colo.—**H. occidentale** Gray, Calif.—**H. virginianum** L., Iowa, Neb., N.Y., N.D., S.D., Wis.—**H. watsonii** (Gray)Rydb., Utah. **Range:** Northwestern New York to North Dakota, southward to Iowa and central California.

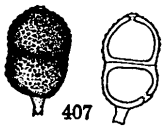
A species closely resembling the following one, *P. mertensiae.*

282. PUCCINIA MERTENSIAE. Fig. 407.

(N. A. F. 7: 558, 804.)

Puccinia mertensiae Peck, Bot. Gaz. **6:** 227. 1881.
Micropuccinia mertensiae A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid, 18–21 by 24–32 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore of upper cell apical or somewhat depressed, sometimes covered with a small hyaline papilla, of the lower much depressed, closely verrucose with flat warts, less prominent below; pedicel colorless, short, fragile.


407

On Boraginaceae: **Lappula floribunda** (Lehm.)Greene, Utah.—**Mertensia arizonica** Greene, Utah.—**M. bakeri** Greene, Colo.—**M. ciliata** (James)G. Don, Colo., Utah, Wyo.—**M. coronata** Nels., Wyo.—**M. foliosa** Nels., Utah. **Range:** Mountain regions of Colorado, Utah and Wyoming.

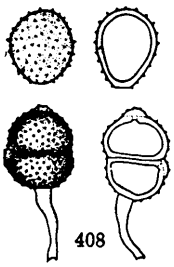
This species and the preceding one, *P. hydrophylli,* are very similar in gross appearance and microscopic characters, the chief difference, which is well marked, is in the form of the warts on the teliospores.

283. PUCCINIA MENTHAE. Fig. 408.

(N. A. F. 7: 405, 406, 791, 842.)

Uredo menthae Pers., Syn. Fung. 220. 1801.
Puccinia menthae Pers., Syn. Fung. 227. 1801.
Dicaeoma menthae S. F. Gray, Nat. Arr. Brit. Pl. **1:** 542. 1821.
Puccinia pycnanthemi Schw., Trans. Am. Phil. Soc. II. **4:** 295. 1832.
Puccinia monardellae Dudl. & Thomps., Jour. Myc. **10:** 53. 1904.
Puccinia micromeriae Dudl. & Thomps., Jour. Myc. **10:** 54. 1904.
Dicaeoma micromeriae Arth., N. Am. Flora **7:** 406. 1921.
Dicaeoma monardellae Arth., N. Am. Flora **7:** 406. 1921.

Pycnia chiefly hypophyllous, associated with the aecia. Aecia chiefly hypophyllous, often causing hypertrophy, giving a systemic appearance, bul-



408

late; aeciospores globoid, 15–23 by 18–30 μ (on western hosts 16–25 by 24–39 μ); wall pale-yellow, 1.5–2.5 μ thick, closely verrucose. Uredia hypophyllous, golden- or cinnamon-brown; urediospores globoid or ellipsoid, 16–22 by 20–29 μ; wall pale-yellow, 1.5–3 μ thick, echinulate, the pores about 3, equatorial, indistinct. Telia chiefly hypophyllous, chestnut- or chocolate-brown; teliospores ellipsoid, 18–24 by 19–30 μ (on western hosts 19–25 by 25–36 μ), rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–3 μ thick, the pore of upper cell apical, of the lower at septum, each with a small hyaline papilla, noticeably verrucose; pedicel nearly colorless, short, fragile, or sometimes length of spore and persistent.

On Lamiaceae (*Labiatae*): **Blephilia ciliata** (L.)Raf., Ind.—**B. hirsuta** (Pursh)Torr., Ill., Ind., Iowa, Mo., Tenn., W.Va.—**Clinopodium vulgare** L. (*Satureja v.* Fritsch), Conn., Mass., N.Y., Pa., Va., W.Va., Wis.; Ont.—**Cunila origanoides** (L.)Britt.(*C. mariana L.*), Ark., Ill., Ind., Ky., Md., Mo., N.J., N.Y., Pa., Va.—**Hedeoma drummondii** Benth., Mont.—**H. nana** (Torr.) Greene, Ariz.—**H. oblongifolia** (Gray)Heller, N.M.—**H. pulegioides** (L.) Pers., Ill., Ind., Pa.—**Madronella lanceolata** (Gray)Greene(*Monardella l.*), Calif.—**M. macrantha** (Gray)Greene (*M. m.*), Calif.—**M. nana** (Gray)Greene (*M. n.*), Calif.—**M. odoratissima** (Benth.)Greene(*M. o.*), Calif., Ore.—**M. parvifolia** (Greene)Rydb.(*M. p.*), N.M.—**M. rubella** Greene(*M. oblongifolia* Rydb.), Utah.—**M. undulata** (Benth.)Greene(*M. u.*), Calif.—**M. villosa** (Benth.)Greene(*M. v.*), Calif., Ore.—**M. viridis** (Jepson)Arth.(*M. v.*), Calif. —**Mentha arvensis** L., Fla., N.Y.; N.S.—**M. canadensis** L., Colo., Ill., Ind., Iowa, Me., Mass., Mich., Minn., Mont., Neb., N.Y., N.D., Ore., Pa., S.D., Utah, Wash., Wis., Wyo.; Alta., N.S., Ont., Queb.—**M. c. lanata** Piper, Calif., Ore.—**M. cardiaca** L., Mich.—**M. gentilis** L.(*M. sativa* L.), Me.—**M. glabrior** (Hook.)Rydb.(*M. borealis* Michx.), Colo., Utah.—**M. penardi** (Briq.)Rydb., Ariz., Colo., N.M., Utah.—**M. piperita** L., N.H., Mo., N.Y., Ore.—**M. spicata** L., Calif., Conn., Ind., Ky., Md., Mass., Mich., N.M., N.Y., Ore., Pa., Utah, Va., Wash., W.Va., Ont.—**Micromeria chamissonis** (Benth.)Greene(*M. douglasii* Benth.), Calif., Ida., Ore., Wash.—**Monarda bradburiana** Beck, Ark.—**M. clinopodia** L., N.Y.—**M. comata** Rydb., Colo., N.M.—**M. didyma** L., Conn., Ind., Mass., N.Y., N.C., Pa., W.Va., Wis.; Ont.—**M. fistulosa** L., Colo., Conn., Ida., Ill., Ind., Iowa, Kans., Mich., Minn., Miss., Mo., Mont., Neb., N.Y., N.D., Ohio, Pa., S.D., Va., W.Va., Wis., Wyo.; Alta., Man., Ont.—**M. media** Willd., N.Y., W.Va.—**M. menthaefolia** Benth., Ariz., Colo., Mont., Utah; Alta.—**M. mollis** L.(*M. scabra* Beck), Mont., Neb., N.Y., Okla., S.D.; Alta., Man., Yukon.—**M. punctata** L., Del., Ill., Ind., N.J., Tex., Wis.—**M. ramaleyi** Nels., Colo., S.D.—**M. stricta** Woot., Colo., N.M., Wyo.—**Pycnanthemum albescens** T.&G.(*Koellia a.* Ktze.), Ark.—**P. californicum** Torr., Calif.—**P. clinopodioides** T.&G., Pa.—**P. flexuosum** (Walt.)B.S.P.(*K. f.* MacM.), Ark., Conn., Mich., Mo., N.Y., Pa., Va.; Ont.—**P. incanum** (L.)Michx.(*K i.* Ktze.), Conn., N.Y., Pa., W.Va.—**P. muticum** (Michx.)Pers.(*K. m.* Britt.), Conn., Del., N.J., N.Y., Pa., W.Va.—**P. pilosum** Nutt.(*K. p.* Britt.), Ill., Ind., Iowa, Kans., Mo., W.Va.—**P. pycnanthemoides** (Leavenw.)Fern.(*K. p.* Ktze.), Tenn.—**P. verticillatum** (Michx.)Pers.(*K. v.* Ktze.), N.Y., W.Va.—**P. virginianum** (L.)

Dur.&Jacks.(*K. v.* MacM., *P. lanceolatum* Pursh), Conn., Ind., Iowa, Miss., Mo., Neb., N.J., N.Y., N.D., Pa., Wis.; Ont. **Range:** Nova Scotia to Yukon, southward to Virginia, northern Mississippi and southern California; also in South America, Europe, Asia, Japan and Africa.

A widely distributed and variable species. In America the spores become larger, thicker walled, and more strongly sculptured westward, which is especially noticeable in the teliospores. Such western forms are sometimes designated var. *americana* (Sydow, Monog. Ured. **1:** 284. 1902), while the most pronounced variation occurs on species of *Madronella* along the Pacific coast, and is usually separated as *Puccinia monardellae.* All variations intergrade.

*. **Puccinia salviicola** D. & H. (*Dicaeoma s.* Arth.), with pycnia epiphyllous; aecia hypophyllous, in groups, cupulate, aeciospores ellipsoid, 13–21 by 24–32 μ, wall cinnamon-brown, 1–2.5 μ thick, finely verrucose; uredia amphigenous, cinnamon-brown, urediospores globoid, 19–24 by 21–29 μ, wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2 or 3, equatorial; telia amphigenous, chocolate-brown, teliospores ellipsoid, 26–32 by 32–45 μ, rounded at both ends, slightly or not constricted at septum, wall chestnut-brown, laminate, uniformly 3–6 μ thick, the pore of upper cell nearly or quite apical, covered with a hyaline papilla, of the lower at septum, minutely verrucose, often appearing smooth, pedicel colorless, often longer than spore, delicate; occurs on LAMIACEAE (*Labiatae*): **Salvia coccinia** Juss., in southern Florida and Texas; also in Mexico and South America. (N. A. F. **7:** 411, 792.)

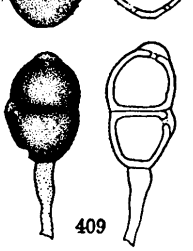
*. **Puccinia ballotaeflorae** Long (*Dicaeoma b.* Arth.), with pycnia and aecia unknown; uredia hypophyllous, cinnamon-brown, urediospores obovoid, 19–23 by 23–26 μ, wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, nearly equatorial or partly above; telia amphigenous, chocolate-brown, teliospores ellipsoid, 23–27 by 32–43 μ, rounded at both ends, slightly or not constricted at septum, wall chocolate-brown, uniformly 2–3.5 μ thick, the pore in upper cell nearly or quite apical, covered with a pale umbo, of the lower at septum, noticeably verrucose, pedicel nearly colorless, often longer than spore, delicate; occurs on LAMIACEAE (*Labiatae*): **Salvia ballotaeflora** Benth., in southern Texas. (N. A. F. **7:** 412.)

284. PUCCINIA CAULICOLA. Fig. 409.

(N. A. F. 7: 410, 815.)

Puccinia nigrescens Peck, Bot. Gaz. **3:** 35. 1878. Not. *P. nigrescens* Kirchn. 1856.
Puccinia caulicola T. & G., Jour. Myc. **4:** 20. 1888.
Dicaeoma caulicola Ktze., Rev. Gen. **3²:** 468. 1898.
Puccinia salviae-lanceolatae Bubák, in Syd., Monog. Ured. **1:** 294. 1902.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 16–21 by 19–26 μ; wall nearly or quite colorless, 1–2 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid, 19–23 by 20–24 μ, or oblate-spheroid and shorter than broad; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2 or 3, near the hilum. Telia amphigenous, blackish-brown; teliospores oblong or ellipsoid, 16–26 by 29–48 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–3 μ thick, the pore of upper cell nearly or quite apical, with a broad semihyaline umbo over the pore, of the lower near the septum, minutely verrucose; pedicel somewhat colored, often two or three times length of spore, delicate.



409

ON LAMIACEAE (*Labiatae*): **Salvia lanceolata** Willd.(*S. lanceaefolia* Auth., not Poir.), Colo., Iowa, Kans., Neb., N.M., S.D., Tex. **Range:** South Dakota to Texas and New Mexico; also in Mexico.

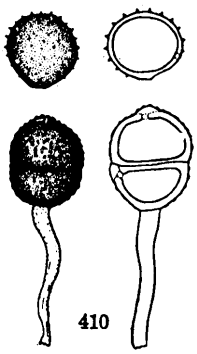
A culture was made in 1903 by Kellerman (Jour. Myc. **9:** 227. 1903), and also by Arthur (Jour. Myc. **10:** 14. 1904) by applying teliospores from *Salvia lanceolata* to the same host, resulting in pycnia and aecia. A similar open-air culture was made in 1921 by Bethel, using aeciospores and producing uredia. The data are in the Arthur Herbarium, but were never published.

285. PUCCINIA FARINACEA. Fig. 410.

(N. A. F. 7: 411, 792.)

Puccinia farinacea Long, Bull. Torrey Club **29:** 115. 1902.
Dicaeoma farinaceum Arth., N. Am. Flora **7:** 411. 1921.

Pycnia epiphyllous. Aecia chiefly hypophyllous, cupulate; aeciospores globoid, 15–21 by 19–32 μ; wall pale cinnamon-brown or colorless, 1–2 μ thick, verrucose. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid, 16–21 by 20–23 μ, or oblate-spheroid and shorter than broad; wall cinnamon-brown, 1–2 μ thick, echinulate, the pores 2 or 3, usually subequatorial. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid, 21–28 by 27–35 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–3 μ thick, the pore of upper cell nearly or quite apical, with a broad hyaline umbo over the pore, of the lower near the septum, finely rugose or irregularly verrucose; pedicel colorless, usually longer than the spore, delicate.


410

On Lamiaceae (*Labiatae*): **Salvia azurea** Lam., Ala. —**S. farinacea** Benth., Tex.—**S. pitcheri** Torr., Kans., Neb., Okla. **Range:** Nebraska to central Alabama and Texas; also in Mexico and Central America.

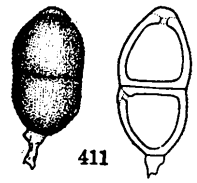
*. **Puccinia vertisepta** T. & G. (*Allodus v.* Arth.), with pycnia epiphyllous; aecia chiefly epiphyllous, in groups, cupulate, aeciospores ellipsoid or oblong, 17–20 by 28–40 μ, wall pale cinnamon-brown, 2–2.5 μ thick at sides, 5–9 μ above and below, noticeably verrucose; uredia wanting; telia amphigenous, chocolate-brown, teliospores globoid, usually flattened laterally, 26–28 by 25–31 μ, wall chocolate-brown, uniformly 2.5–3 μ thick, with a broad hyaline umbo over apex, the pores variable, usually near septum, which is often oblique or nearly vertical, finely verrucose, pedicel colorless, usually attached laterally, often longer than spore, delicate and fragile; occurs on Lamiaceae (*Labiatae*): **Salvia pinguifolia** (Fern.) W.&S., New Mexico; also in Mexico. (N. A. F. **7:** 470.)

286. PUCCINIA PHYSOSTEGIAE. Fig. 411.

(N. A. F. 7: 560.)

Puccinia physostegiae P. & C.; Peck, Ann. Rep. N. Y. State Mus. **29:** 50. 1878.
Micropuccinia physostegiae A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, systemic, chocolate-brown; teliospores ellipsoid or oblong, 19–26 by 32–48 μ, rounded at both ends, not constricted at septum; wall chestnut-brown, uniformly 2.5–3 μ thick, the pore of upper cell nearly or quite apical, covered with a thick broad umbo, of the lower usually much depressed, finely and striately verrucose; pedicel colorless, short, fragile.


411

On Lamiaceae (*Labiatae*): **Physostegia parviflora** Nutt. (*Dracocephalum nuttallii* Britt.), Mont.—**P. virginiana** (L.) Benth. (*D. v.*), Ind., N.Y. **Range:** Locally in New York, Indiana and Montana.

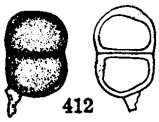
287. PUCCINIA SCHNEIDERI. Fig. 412.

(N. A. F. 7: 560.)

Puccinia caulincola W. G. Schneid., Jahresb. Schles. Ges. **48:** 120. 1870. Not *Caeoma caulincola* Nees 1816, or *P. caulincola* Spreng. 1828.

Puccinia schneideri Schroet.; W. G. Schneid., Herb. Schles. Pilze *448*. 1879.
Micropuccinia schneideri A. & J., N. Am. Flora **7:** 560. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia caulicolous, systemic, pulverulent, cinnamon-brown; teliospores ellipsoid, 18–21 by 26–31 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore of both cells usually depressed, both pores covered with a hyaline umbo, minutely verrucose, appearing smooth in water; pedicel colorless, often longer than spore, delicate, fragile. Mesospores common, 18–20 by 21–25 μ.


412

On Lamiaceae (*Labiatae*): **Thymus serpyllum** L., Greenl. **Range:** Southern Greenland; also in Europe.

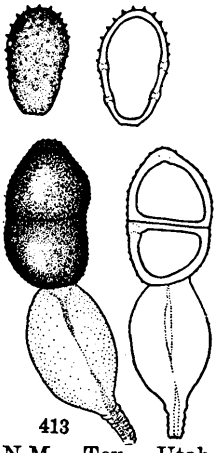
*. **Puccinia distorta** Holw. (*Micropuccinia d.* A. & J.), with pycnia epiphyllous, in groups; aecia and uredia wanting; telia chiefly hypophyllous, chocolate-brown, teliospores ellipsoid, 20–27 by 29–40 μ, rounded at both ends, slightly or not constricted at septum, wall chestnut-brown, uniformly 2–3 μ thick, the pores of both cells more or less depressed, finely verrucose, pedicel colorless, often longer than spore, delicate, fragile; occurs on Lamiaceae (*Labiatae*): **Hyptis emoryi** Torr., in southern Arizona and California; also in Mexico and South America. (N. A. F. **7:** 560.)

288. PUCCINIA TUMIDIPES. Fig. 413.

(N. A. F. 7: 495, 801, 845.)

Puccinia tumidipes Peck, Bull. Torrey Club **12:** 34. 1885.
Bullaria tumidipes Arth., Mycol. **8:** 136. 1916.

Pycnia epiphyllous, in groups. Aecia epiphyllous, surrounding the pycnia, uredinoid, cinnamon-brown; aeciospores globoid, 26–29 by 29–32 μ; wall light cinnamon-brown, 1.5–2 μ thick, prominently echinulate above, less so below, the pores in two transverse bands of 4 each. Uredia amphigenous, cinnamon-brown; urediospores oblong, 16–25 by 27–42 μ; wall cinnamon-brown, 1.5–2.5 μ thick, prominently echinulate above, less so or smooth below, the pores in two transverse bands of 4 each. Telia amphigenous, blackish-brown; teliospores ellipsoid, 23–30 by 37–55 μ, rounded or slightly narrowed at both ends, slightly or not constricted at septum; wall chocolate-brown, uniformly 2.5–4 μ thick, the pore of upper cell apical, with a broad hyaline umbo, of the lower at septum, finely verrucose, appearing smooth when wet; pedicel colorless, inflated, usually longer than spore, swelling in water to fusiform-oblong.


413

On Solanaceae: **Lycium halimifolium** Mill. (*L. vulgare* Dunal), Ala., Ind., Iowa, Kans., Miss., Neb., N.Y., Ohio, Pa., S.D., Tex.—**L. pallidum** Miers, Ariz., Colo., N.M., Tex., Utah.—**L. parviflorum** Gray, Ariz. **Range:** Pennsylvania to South Dakota, southward to Alabama and Arizona; also in Cuba.

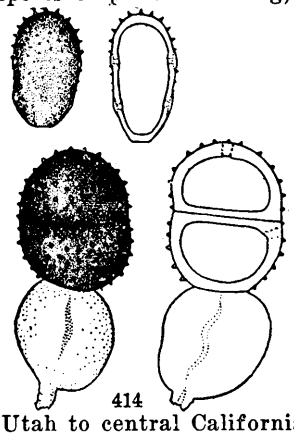
Teliospores on *Lycium pallidum* received from New Mexico were sown on *L. halimifolium* in 1915 by Arthur (Mycol. **8:** 136. 1916), producing pycnia and uredinoid aecia. The above description of pycnia and aecia is taken from the culture material, no field collections having been reported.

289. PUCCINIA GLOBOSIPES. Fig. 414.

(N. A. F. 7: 494, 845.)

Puccinia globosipes Peck, Bull. Torrey Club **12:** 34. 1885.
Bullaria globosipes Jacks., Proc. Ind. Acad. Sci. **1915:** 437. 1916.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores ellipsoid or oblong, 16–26 by 27–48 μ; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, or slightly thicker above, echinulate above, less so or smooth below, the pores in two transverse bands of 4 each. Telia amphigenous, blackish-brown; teliospores globoid or broadly ellipsoid, 29–39 by 33–50 μ, rounded at both ends, slightly or not constricted at septum; wall chocolate-brown, uniformly 3–5 μ thick, the pore of upper cell apical, sometimes with a thin hyaline umbo, of the lower at septum, sparsely and coarsely verrucose; pedicel colorless, about length of spore, swelling in water to globoid.


414

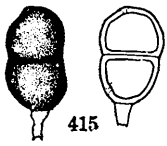
On Solanaceae: **Lycium andersonii** Gray, Calif., Nev., Utah.—**L. californicum** Nutt., Calif.—**L. fremontii** Gray (*L. gracilipes* Gray), Ariz., Calif.—**L. torreyi** Gray, Ariz., N.M., Utah. **Range:** Utah to central California, southward to New Mexico and southern California; also in Mexico.

290. PUCCINIA CHAMAESARACHAE. Fig. 415.

(N. A. F. 7: 471, 799.)

Puccinia chamaesarachae Syd., Monog. Ured. **1:** 263. 1902.
Allodus chamaesarachae Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia not seen. Aecia chiefly hypophyllous, systemic, cupulate; aeciospores globoid, 16–20 by 20–26 μ; wall nearly or quite colorless, 1.5–2 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, arising among and within the aecia, chocolate-brown; teliospores ellipsoid, 17–21 by 25–32 μ, usually rounded at both ends, slightly constricted at septum; wall light chestnut-brown, uniformly 2 μ thick, the pore of upper cell nearly apical, of the lower much depressed, minutely verrucose; pedicel colorless, short, fragile.


415

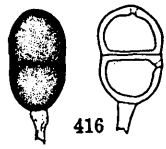
On Solanaceae: **Chamaesaracha nana** Gray, Calif., Nev. **Range:** Northern California to Nevada.

291. PUCCINIA PHYSALIDIS. Fig. 416.

(N. A. F. 7: 562, 804, 847.)

Puccinia physalidis Peck, Bot. Gaz. **4:** 218. 1879.
Micropuccinia physalidis A. & J., N. Am. Flora **7:** 562. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, systemic, chestnut-brown; teliospores ellipsoid, 16–26 by 28–38 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–3 μ thick, the pore of upper cell apical, of the lower at septum, minutely rugose or smooth, pedicel colorless, short, fragile. Mesospores occasionally present.


416

On Solanaceae: **Physalis heterophylla** Nees (*P. viscosa* Pursh, not L.), Colo., Neb.; Man., Ont.—**P. lanceolata** Michx., Iowa.—**P. virginiana** Mill., Wis.; Man. **Range:** Southwestern Ontario to Manitoba, southward to eastern Colorado.

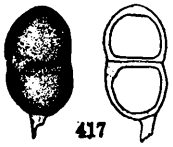
*. **Puccinia incondita** Arth. (*Micropuccinia i.* A. & J.), with pycnia unknown, probably not formed; aecia and uredia wanting; telia hypophyllous, in more or less pulvinate groups, cinnamon-brown, teliospores irregularly ellipsoid, 16–20 by 23–28 μ, rounded at both ends, or somewhat narrowed below, slightly or not constricted at septum, wall cinnamon-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell apical, of the lower at septum, smooth, pedicel colorless, short, fragile; occurs on SOLANACEAE: **Solanum triquetrum** Cov., in southern Texas. (N. A. F. **7**: 563.)

292. PUCCINIA PALMERI. Fig. 417.

(N. A. F. 7: 472, 799, 844.)

Puccinia palmeri D. & H.; Diet., Erythea **7**: 98, excl. synonymy. 1899.
Allodus complicata Arth. & Orton, N. Am. Flora **7**: 472. 1921.

Pycnia chiefly epiphyllous, inconspicuous, in groups. Aecia chiefly hypophyllous, surrounding the pycnia, at first bullate, opening by a pore; aeciospores globoid, 17–23 by 19–28 μ; wall golden-yellow when mature, 1.5–2 μ thick, the pores 4–6, scattered, often evident, finely verrucose. Uredia wanting. Telia amphigenous, often associated with aecia, chocolate-brown; teliospores ellipsoid, 16–25 by 30–43 μ, rounded at both ends, somewhat constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, the pore of upper cell apical, of the lower at septum, minutely verrucose, appearing smooth when wet; pedicel nearly or quite colorless, short, fragile.


417

ON SCROPHULARIACEAE: **Pentstemon attenuatus** Dougl., Ida.—**P. chionophilus** Greene, Nev.—**P. comarrhenus** Gray, Colo.—**P. confertus** Dougl., Ida., Wash.—**P. davidsonii** Greene, Ore.—**P. ellipticus** Coult.&Fisher, Mont.—**P. harbourii** Gray, Colo.—**P. newberryi** Gray, Calif.—**P. pinetorum** Piper, Ida., Ore., Wash.—**P. procerus** Dougl., Calif., Ida., Wyo.—**P. strictus** Benth., Wyo.—**P. venustus** Dougl., Wash.—**P. virens** Pennell(*P. humilis* Gray, not Nutt.), Colo. **Range:** Mountains of Montana to Washington, southward to Colorado and central California.

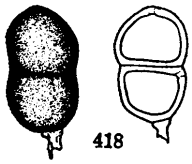
*. **Puccinia confraga** Arth. & Cumm. (Ann. Myc. **31**: 43. 1933), with pycnia unknown, probably not formed; aecia and uredia wanting; telia amphigenous, small, pulverulent, blackish-brown, teliospores ellipsoid, 27–31 by 33–40 μ, rounded at both ends, slightly or not constricted at septum, wall chocolate-brown, uniformly 3–3.5 μ thick, the pore of upper cell apical, of the lower at or near septum, coarsely rugose-verrucose, pedicel colorless, as long as spore or longer, rugose in lower half; occurs on SCROPHULARIACEAE: **Pentstemon antirrhinoides** Benth., in Estrella Mountains, southern Arizona.

293. PUCCINIA CHELONIS. Fig. 418.

(N. A. F. 7: 564.)

Puccinia chelonis D. & H.; Diet., Hedw. **36**: 297. 1897.
Micropuccinia chelonis A. & J., N. Am. Flora **7**: 564. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, pulverulent, chestnut-brown; teliospores ellipsoid, 20–26 by 32–38 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell nearly or quite apical, of the lower near septum, minutely rugose-verrucose, appearing smooth in water; pedicel colorless, short, fragile.


418

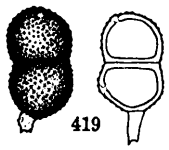
ON SCROPHULARIACEAE: **Chelone nemorosa** Dougl., Ore., Wash. **Range:** Mountains of southern Washington and northern Oregon.

294. PUCCINIA ACROPHILA. Fig. 419.

(N. A. F. 7: 563, 805.)

Puccinia acrophila Peck, Bot. Gaz. **6**: 227. 1881.
Micropuccinia acrophila A. & J., N. Am. Flora **7**: 563. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, tardily naked, cinnamon-brown; teliospores ellipsoid, 16–21 by 24–34 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell nearly or quite apical, of the lower more or less depressed, finely verrucose; pedicel colorless, short, fragile.


419

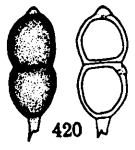
On Scrophulariaceae: **Besseya alpina** (Gray)Rydb. (*Synthyris a.*), Wyo.—**B. ritteriana** (Eastw.)Rydb.(*S. r.*), Colo.—**B. rubra** (Dougl.)Rydb.(*S. r.*), Mont.—**Synthyris dissecta** Rydb., Wyo.—**S. laciniata** (Gray)Rydb., Utah.—**S. pinnatifida** Wats., Utah. **Range**: Southern Montana, southward to Colorado and Utah.

295. PUCCINIA WULFENIAE. Fig. 420.

(N. A. F. 7: 567.)

Puccinia wulfeniae D. & H.; Diet., Erythea **3**: 79. 1895.
Puccinia synthyridis E. & E., Bull. Torrey Club **27**: 61. 1900.
Micropuccinia wulfeniae A. & J., N. Am. Flora **7**: 567. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia at first hypophyllous, later amphigenous, cinnamon-brown, pulverulent, or germinating sori pulvinate, becoming cinereous; teliospores ellipsoid or oblong, 14–18 by 26–35 μ, rounded or obtuse at both ends, noticeably constricted at septum; wall golden-brown, uniformly 1–1.5 μ thick, the pore of upper cell apical, with a hyaline papilla over the pore, of the lower at septum, smooth, or minutely rugose-verrucose above; pedicel nearly or quite colorless, in pulvinate sori once length of spore or more, in pulverulent sori short, fragile.


420

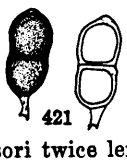
On Scrophulariaceae: **Besseya rubra** (Dougl.)Rydb.(*Synthyris r.*), Wash. —**B. wyomingensis** (Nels.)Rydb.(*S. w.* Heller), Wyo.—**Synthyris major** (Hook.)Heller, Ida.—**S. reniformis** (Dougl.)Benth.(*Wulfenia r., S. rotundifolia* Gray), Calif., Ida., Ore. **Range**: Idaho to Washington, southward to central California.

296. PUCCINIA ALBULENSIS. Fig. 421.

(N. A. F. 7: 566.)

Puccinia veronicae Schum.; Wint., Hedw. **19**: 164. 1880. Not *P. veronicae* Schroet., 1879.
Puccinia albulensis Magn., Ber. Deuts. Bot. Ges. **8**: 169. 1890.
Micropuccinia albulensis A. & J.; Arth., Bull. Torrey Club **48**: 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, systemic, pulverulent in resting form, cinnamon-brown, pulvinate in germinating form, becoming cinereous by germination; teliospores ellipsoid, 14–18 by 24–34 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1–1.5 μ thick, the pore of upper cell apical, covered by a hyaline umbo or papilla, of the lower at septum, minutely rugose-verrucose, appearing smooth when wet; pedicel colorless, in pulvinate sori twice length of spore, in pulverulent sori short, fragile.


421

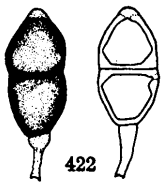
On Scrophulariaceae: **Veronica cusickii** Gray, Wash.—**V. wormskjoldii** R.&S., Colo., Mont., Ore., Utah, Wyo.; Greenl.; B.C. **Range:** Southern British Columbia, southward to western Colorado and central Utah, and in eastern Greenland; also in Europe.

297. PUCCINIA RHAETICA. Fig. 422.

(N. A. F. 7: 564.)

Puccinia rhaetica Fisch., Bull. Herb. Boiss. **7:** 420. 1899.
Micropuccinia rhaetica A. & J., N. Am. Flora **7:** 564. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, pulverulent, chestnut-brown; teliospores oblong or ellipsoid, 16–20 by 30–40 μ, rounded at both ends, slightly or not constricted at septum; wall dark cinnamon-brown, uniformly 2–3 μ thick or often thicker at the angles, with a hyaline papilla over apical pore, the pore of lower cell at the septum, smooth or somewhat rugose especially on upper cell; pedicel colorless, short, fragile.

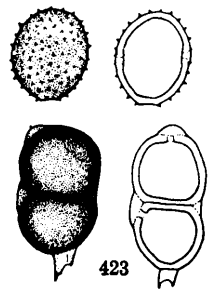

422

On Scrophulariaceae: **Veronica cusickii** Gray, Wash. **Range:** Only known from Mount Tacoma in Washington; also in Europe.

298. PUCCINIA PROBABILIS. Fig. 423.

Puccinia probabilis Arth. & Cumm., Ann. Myc. **31:** 42. 1933.

Pycnia and aecia unknown. Uredia hypophyllous, cinnamon-brown; urediospores ellipsoid or globoid, 19–24 by 23–27 μ; wall light golden-brown, 2–2.5 μ thick, finely echinulate, the pores 2 or 3, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 23–27 by 34–40 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2.5–3 μ thick, the pore of upper cell apical, of the lower at septum, with a hyaline umbo or papilla over each pore, smooth; pedicel colorless, short, fragile.


423

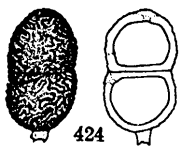
On Scrophulariaceae: **Veronica serpyllifolia** L., N.M. **Range:** Only known from one collection, Tunicha Mountains, New Mexico.

299. PUCCINIA RUFESCENS. Fig. 424.

(N. A. F. 7: 472, 799.)

Puccinia rufescens D. & H.; Holw., Bot. Gaz. **18:** 253. 1893.
Allodus rufescens Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia not seen. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 17–23 by 20–29 μ; wall golden-yellow, 1–1.5 μ thick, finely verrucose. Uredia wanting. Telia amphigenous, often closely associated with aecia, chocolate-brown; teliospores ellipsoid, 19–29 by 29–45 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 2–3 μ thick, the pore of upper cell nearly or quite apical, covered with a thin hyaline umbo, of the lower at septum or rarely depressed, rugose-verrucose; pedicel colorless, short, fragile.


424

On Scrophulariaceae: **Pedicularis canadensis** L., Colo.—**P. centranthera** Gray, Colo.—**P. densiflora** Benth., Calif.—**P. semibarbata** Gray, Calif. **Range:** Colorado to northern and central California.

300. PUCCINIA CLINTONII. Fig. 425.

(N. A. F. 7: 564, 847.)

Puccinia clintonii Peck, Ann. Rep. N. Y. State Mus. **28**: 61. 1876.
Micropuccinia clintonii A. & J., N. Am. Flora **7**: 564. 1922.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, resting form tardily naked, pulverulent, chestnut-brown, germinating form pulvinate, cinnamon-brown, becoming cinereous by germination; teliospores oblong, 15–18 by 26–36 μ, obtuse at both ends, considerably constricted at septum; wall cinnamon-brown in resting form, golden-brown or nearly colorless in germinating form, uniformly 1.5–2 μ thick, the pore of upper cell apical, with a hyaline papilla, of the lower at septum, finely verrucose in striae in resting form, becoming smooth in germinating form; pedicel colorless, short, fragile.


425

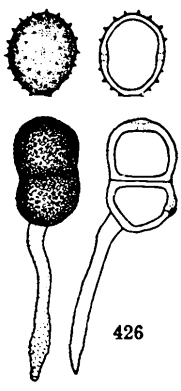
On Scrophulariaceae: **Pedicularis bracteosa** Benth., Colo., Ore.—**P. canadensis** L., Mich., N.Y., Wis.—**P. fluviatilis** Heller, N.M.—**P. groenlandica** Retz.(*Elephantella g.* Rydb.), Ida., Wash. **Range:** Northwestern New York to mountains of Alberta and Oregon, with one locality in New Mexico; also in Japan.

301. PUCCINIA RUELLIAE. Fig. 426.

(N. A. F. 7: 415, 792, 842.)

Uredo ruelliae B. & Br., Jour. Linn. Soc. **14**: 92. 1873.
Puccinia lateripes Berk. & Rav.; Berk., Grev. **3**: 52. 1874.
Puccinia ruelliae (B. & Br.) Lagerh., Tromsø Mus. Aarsh. **17**: 71. 1895.
Dicaeoma ruelliae Ktze., Rev. Gen. **3**[3]: 470. 1898.
Puccinia ruelliae-bourgaei D. & H., Bot. Gaz. **31**: 329. 1901.

Pycnia amphigenous, in groups. Aecia amphigenous, often causing hypertrophy, especially on stems, cylindric; aeciospores globoid or ellipsoid, 15–21 by 20–30 μ; wall pale-yellow, 1–2 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid or obovoid, 16–24 by 22–32 μ (southern forms up to 26 by 37 μ); wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 19–29 by 31–41 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–3.5 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, finely rugose-verrucose; pedicel nearly colorless, once to thrice length of spore, roughened below, often inserted obliquely.


426

On Acanthaceae: **Ruellia ciliosa** Pursh, D.C., Ill., Ind., Kans., Ky., Mo., W.Va.—**R. drummondii** (Nees)Gray, Tex.—**R. nudiflora** (E.&G.)Urban, Tex.—**R. pedunculata** Torr., Mo.—**R. strepens** L., Ark., Ill., Ind., Kans., Ky., Miss., Mo., Ohio, Tenn., Tex.—**R. tuberosa** L., Tex. **Range:** District of Columbia to Kansas, southward to Mississippi and Texas; also in West Indies, Mexico, Central and South America, and Asia.

Cultures were made in 1903 by Kellerman (Jour. Myc. **9**: 107. 1903), by sowing both aeciospores and teliospores on *Ruellia strepens*. In 1905 teliospores from *R. ciliosa* were sown by Arthur (Jour. Myc. **12**: 18. 1906) on both *R. strepens* and *R. ciliosa* with equally positive results. The spores are larger on the succulent *R. strepens* than on the wiry stemmed *R. ciliosa*.

*. **Uromyces ruelliae** Holw. (*Nigredo* (?) *r.* Arth.), with epiphyllous pycnia and aecia, aeciospores globoid or ellipsoid, 19–24 by 21–26 μ, wall yellowish, 1.5–2 μ thick at sides, 4–6 μ above, striately verrucose; uredia at first epiphyllous, in circinnating groups, cinnamon- or chestnut-brown, urediospores globoid or obovoid, 20–26 by 26–35 μ, wall 2–2.5 μ thick, sparsely and strongly echinulate, with 2 equatorial pores; secondary uredia chiefly hypophyllous, scattered, chestnut-brown, urediospores globoid, 16–23 by 21–27 μ, wall 1.5–2.5 μ thick, moderately echinulate, with 2 indistinct equatorial pores; telia chiefly epiphyllous, scattered, or forming large fusiform swellings on stems, chocolate-brown, teliospores ellipsoid, 20–32 by 30–40 μ, wall chocolate-brown, uniformly 3–4 μ thick, with a hyaline umbo over the pore, coarsely rugose-verrucose, pedicel colorless, once to twice length of spore, rugose below, fragile; occurs on ACANTHACEAE: **Beloperone californica** Benth., in southern Arizona and California; also in Mexico. (N. A. F. **7:** 265, 769, 832.)

*. **Puccinia anisacanthi** [Peck] D. & H. (*Aecidium a., Dicaeoma a.* Arth.), with amphigenous pycnia and aecia, aeciospores globoid, 18–23 by 23–32 μ, wall yellowish, 1.5–2 μ thick, verrucose; uredia amphigenous, pale cinnamon-brown, urediospores ellipsoid, 19–25 by 22–29 μ, wall golden-brown, 1–2 μ thick, echinulate, the pores 2 or 3, equatorial; telia amphigenous, chocolate-brown, teliospores ellipsoid, 26–32 by 39–48 μ, rounded at both ends, slightly constricted at septum, wall chocolate-brown, uniformly 3–5 μ thick, with a broad semihyaline umbo over the upper pore, the pore of upper cell apical, of the lower at septum, obscurely verrucose, pedicel nearly or quite colorless, two to three times length of spore, roughened below, often oblique; occurs on ACANTHACEAE: **Anisacanthus thurberi** Gray, in southern Arizona; also in Mexico. (N. A. F. **7:** 415, 792.)

*. **Puccinia tetramerii** Seym. (*Dicaeoma t.* Arth.), with amphigenous pycnia and aecia, aeciospores globoid or ellipsoid, 18–21 by 24–32 μ, wall colorless, 1.5–2 μ thick, finely verrucose; uredia hypophyllous, cinnamon-brown, urediospores ellipsoid, 18–24 by 23–29 μ, wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial; telia amphigenous, chocolate-brown, teliospores broadly ellipsoid, 24–30 by 35–42 μ, rounded above and below, not constricted at septum, wall chestnut-brown, uniformly 3–5 μ thick, with a broad semihyaline umbo over the upper pore, the pore of upper cell apical, of the lower at septum, obscurely rugose or verrucose, pedicel nearly or quite colorless, about as long as spore, swollen into a collar next the spore, roughened below, fragile; occurs on ACANTHACEAE: **Tetramerium hispidum** Nees, in southern Arizona; also in Mexico. (N. A. F. **7:** 417.)

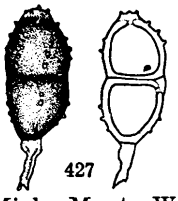
*. **Puccinia bouvardiae** Griff. (*Allodus scaberistipes* Arth. & Orton), with pycnia and aecia chiefly hypophyllous, aeciospores globoid, 19–23 by 23–26 μ, wall pale-yellow, 1.5 μ thick, finely verrucose; uredia wanting; telia chiefly epiphyllous, chocolate-brown, teliospores ellipsoid, 25–30 by 35–45 μ, rounded at both ends, slightly or not constricted at septum, wall chestnut-brown, uniformly 3–4 μ thick, with a hyaline papilla over the pores, the pore of upper cell apical, of the lower near or at septum, finely verrucose, pedicel nearly or quite colorless, twice length of spore, roughened below, swollen into a small collar next to spore, fragile; occurs on RUBIACEAE: **Bouvardia ternifolia** (Cav.)Schl. (*B. triphylla* Salisb.), in southern Arizona. (N. A. F. **7:** 473, 800.)

302. PUCCINIA LINKII. Fig. 427.

(N. A. F. **7:** 569.)

Puccinia linkii Klotzsch, Linnaea **8:** 490. 1833.
Micropuccinia linkii A. & J.; Arth., Bull. Torrey Club **48:** 42. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, dark chocolate-brown; teliospores ellipsoid or oblong, 18–22 by 32–44 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–3 μ thick, with a hyaline umbo over upper pore, the pore of upper cell apical, of the lower at septum, striately verrucose in 3–5 longitudinal or oblique lines, prominent; pedicel colorless, short, fragile.



427

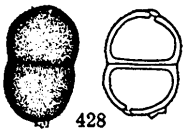
ON CAPRIFOLIACEAE: **Viburnum pauciflorum** Pylaie, Ida., Mich., Mont., Wash.; Man., Queb., Sask. **Range:** Eastern Quebec to Washington along the international boundary.

303. PUCCINIA INTERMIXTA. Fig. 428.

(N. A. F. 7: 474, 800.)

Puccinia intermixta Peck, Bot. Gaz. **4**: 218. 1879.
Allodus intermixta Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia amphigenous. Aecia chiefly hypophyllous, systemic, cupulate; aeciospores globoid, 17–22 by 21–29 μ; wall colorless, 1.5 μ thick, verrucose. Uredia wanting. Telia amphigenous, usually among the aecia, chestnut-brown; teliospores ellipsoid, 20–26 by 31–40 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, finely verrucose; pedicel colorless, short, fragile.


428

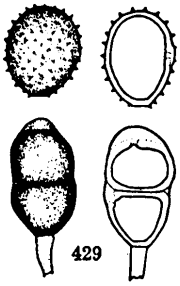
On Ambrosiaceae: **Iva axillaris** Pursh, Calif., Colo., Ida., Mont., Nev., N.M., Ore., S.D., Utah, Wash., Wyo.; Sask. **Range:** Southern Saskatchewan to Washington, southward to New Mexico and central California.

304. PUCCINIA VERNONIAE. Fig. 429.

(N. A. F. 7: 497, 801, 845.)

Puccinia bullata Schw., Schr. Nat. Ges. Leipzig **1**: 74. 1822. Not *P. bullata* Link, 1815.
Puccinia vernoniae Schw., Trans. Am. Phil. Soc. II. **4**: 296. 1832.
Bullaria vernoniae Arth., Mycol. **9**: 302. 1917.

Pycnia epiphyllous, few, scattered among the aecia. Aecia epiphyllous, uredinoid, pale cinnamon-brown; aeciospores globoid or obovoid, 19–24 by 21–30 μ; wall golden-yellow, 1.5–2 μ thick, echinulate, the pores 3, equatorial. Uredia chiefly hypophyllous, cinnamon-brown; urediospores ellipsoid or obovoid, 20–26 by 22–30 μ; wall cinnamon-brown, 1.5–3 μ thick, echinulate, the pores 3, equatorial. Telia amphigenous, on stems producing fusiform sori 1–3 cm. long, on leaves small, 0.5 mm. across, chocolate-brown; teliospores ellipsoid or oblong, 20–28 by 30–45 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, 1.5–3 μ thick at sides, 5–10 μ above, minutely verrucose, often appearing smooth; pedicel colorless, once or twice length of spore.


429

On Carduaceae (tribe *Vernonieae*): **Vernonia altissima** Nutt. (*V. maxima* Small), Ind., Mich.—**V. baldwinii** Torr., Iowa, Ill., Mich., Miss., Mo., Okla., Tex.—**V. corymbosa** Schw., N.D.—**V. crinita** Raf., Ark., Okla.—**V. fasciculata** Michx., Ill., Iowa, Neb., S.D., Wis.—**V. guadalupensis** Heller, Tex.—**V. interior** Small, Kans., Mo., Neb., Okla., Tex.—**V. marginata** (Torr.) Raf., N.M., Tex.—**V. missurica** Raf. (*V. drummondii* Shuttl.), Mich., Mo.—**V. noveboracensis** (L.) Willd., Del., Pa.—**V. pulchella** Small, Ga. **Range:** Delaware to North Dakota, southward to Georgia and New Mexico; also in northern Mexico.

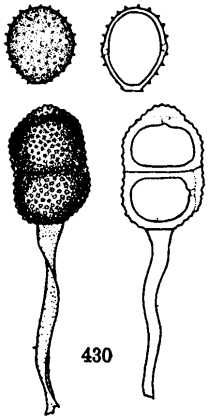
A culture, by using teliospores from the large caulicolous sori, was made in 1916 by Arthur, and resulted in pycnia and uredinoid aecia on leaves. Both hosts were undetermined species of *Vernonia*. No publication was made, data in Arthur Herbarium.

305. PUCCINIA CONOCLINII. Fig. 430.

(N. A. F. 7: 500, 801, 845.)

Puccinia conoclinii Seym.; Burr., Bot. Gaz. **9**: 191. 1884.
Bullaria (?) *conoclinii* Arth. & Mains, N. Am. Flora **7**: 500. 1922.

Pycnia and aecia unknown. Uredia chiefly hypophyllous, cinnamon-brown; urediospores globoid or obovoid, 16–24 by 18–32 μ; wall pale cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, rarely 3, equatorial. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid, 22–32 by 34–45 μ, rounded at both ends, slightly or not constricted at septum; wall dark chestnut-brown, uniformly 2.5–4 μ thick, with a broad pale umbo over the pores, the pore of upper cell apical, of the lower at the septum, verrucose; pedicel nearly or quite colorless, twice length of spore or more, delicate.



430

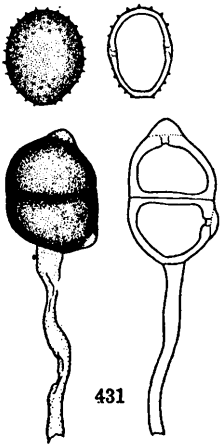
On Carduaceae (tribe *Eupatorieae*): **Ageratum conyzoides** L., Ga., N.C.—**Conoclinium coelestinum** L.(DC.) (*Eupatorium c.*), Ala., D.C., Ill., Ind., Ky., La., Miss., Mo., Okla., S.C., Tenn., Tex., W.Va.—**C. dichotomum** Chapm., Fla.—**Eupatorium incarnatum** Walt., Ind., La.—**E. solidaginifolium** Gray, Ariz. **Range:** District of Columbia to southern Illinois, southward to Florida, Texas and southern Arizona; also in West Indies, Mexico, Central and South America, and Hawaii.

306. PUCCINIA KUHNIAE. Fig. 431.

(N. A. F. 7: 503, 801, 845.)

Puccinia kuhniae Schw., Trans. Am. Phil. Soc. II. **4:** 296. 1832.
Puccinia brickelliae Peck, Bull. Torrey Club **12:** 34. 1885.
Puccinia barroetiae Syd., Monog. Ured. **1:** 28. 1902.
Bullaria kuhniae Kern, Trans. Am. Micr. Soc. **32:** 65. 1913.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, uredinoid; aeciospores globoid, 23–26 by 24–29 μ, flattened laterally; wall pale cinnamon-brown, 1.5–2 μ thick, echinulate, except around the 2 equatorial pores on the flattened sides. Uredia amphigenous, scattered, cinnamon-brown; urediospores globoid, 24–29 by 24–32 μ, flattened laterally; wall cinnamon-brown, 1.5–2.5 μ thick, echinulate, except around the 2 equatorial pores on the flattened sides. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid, 26–40 by 32–58 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 3–6 μ thick, with a lighter umbo over the pores, the pore of upper cell nearly or quite apical, of the lower usually much depressed, smooth; pedicel colorless, once to several times length of spore, flexuous, fragile.



431

On Carduaceae (tribe *Eupatorieae*): **Brickellia coulteri** Gray(*Coleosanthus c.* Ktze.), Ariz.—**Kuhnia eupatorioides** L., Ala., Ill., Ind., Iowa, Miss., Mo., Neb.—**K. hitchcockii** Nels., Colo., Mont.—**K. leptophylla** Scheele(*K. gooddingii* Nels.), Colo.—**K. reticulata** Nels., Mont.—**K. rosmarinifolia** Vent., N.M., Tex.—**K. suaveolens** Fresen.(*K. glutinosa* Auth., not Ell.), Kans., Mo., Neb., N.D., S.D., Wis., Wyo. **Range:** Wisconsin to Montana, southward to Alabama and Arizona; also in Mexico.

Although credited to Pennsylvania by Schweinitz (Trans. Am. Phil. Soc. II. **4:** 296), it is highly probable that his material was obtained when on a journey to Hope, Indiana. No other collections have been reported from a locality so far east. A culture was made in 1905 by Arthur (Jour. Myc. **12:** 23. 1906) by sowing teliospores

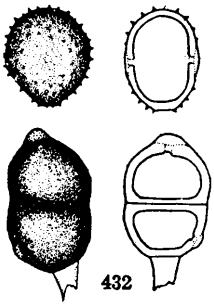
from *Kuhnia eupatorioides* on same host, and again in 1908 (Mycol. **1**: 233. 1909) by sowing teliospores from *K. hitchcockii* on *K. eupatorioides*, and in both instances pycnia and uredinoid aecia were obtained.

307. PUCCINIA SUBDECORA. Fig. 432.

(N. A. F. 7: 504.)

Puccinia subdecora Syd. & Holw.; Syd., Ann. Myc. **1**: 17. 1903.
Bullaria subdecora Arth. & Mains, N. Am. Flora **7**: 504. 1922.

Pycnia epiphyllous, in groups. Aecia epiphyllous, encircling the pycnia, uredinoid, cinnamon-brown; aeciospores globoid, 19–23 by 23–27 μ, somewhat flattened on pore-surfaces; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial. Uredia chiefly hypophyllous, scattered, cinnamon-brown; urediospores globoid or obovoid, 19–26 by 26–34 μ, somewhat flattened on pore-surfaces; wall cinnamon-brown, 1.5–3.5 μ thick, echinulate, except about the 2 equatorial pores. Telia chiefly hypophyllous, chocolate-brown; teliospores ellipsoid or oblong, 21–30 by 35–52 μ, rounded above and below, slightly constricted at septum; wall chestnut-brown, uniformly 2–5 μ thick, with a pale umbo over the pores, the pore of upper cell apical, of lower much depressed, inconspicuously verrucose-rugose; pedicel colorless, short, fragile.

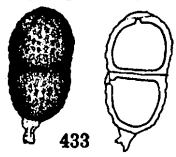

432

On Carduaceae (tribe *Eupatorieae*): **Brickellia grandiflora** (Hook.) Nutt. (*Coleosanthus g.* Ktze.), Colo., Utah. **Range**: Central Colorado to central Utah.

308. PUCCINIA RUSSA. Fig. 433.

Puccinia russa Arth. & Cumm., Ann. Myc. **31**: 44. 1933.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia amphigenous, chocolate-brown; teliospores ellipsoid or oblong, 18–23 by 30–42 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, with a hyaline papilla over apical pore, the pore in lower cell at septum, striately verrucose; pedicel colorless, short, fragile.


433

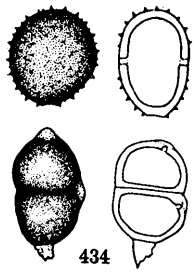
On Carduaceae (tribe *Astereae*): **Erigeron salsuginosa** Gray, Calif. **Range**: Known only from one collection, Garnet Lake, west-central California.

309. PUCCINIA HELIANTHELLAE. Fig. 434.

(N. A. F. 7: 429.)

Trichobasis helianthellae Peck, Bot. Gaz. **7**: 45. 1882.
Puccinia helianthellae (Peck) Arth., Bull. Torrey Club **31**: 4. 1904.
Dicaeoma helianthellae Arth., Rés. Sci. Congr. Bot. Vienne, 344. 1906.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in groups, cupulate; aeciospores globoid, 16–20 by 16–22 μ; wall colorless, 1.5–2 μ thick, minutely verrucose, usually appearing smooth. Uredia hypophyllous, chestnut-brown; urediospores globoid or obovoid, 26–32 by 30–34 μ, much flattened on pore surfaces; wall dark cinnamon-brown, 2.5–3.5 μ thick, echinulate, the pores 2, equatorial. Telia amphigenous, dark chestnut-brown; teliospores ellipsoid, 20–24 by 32–36 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall light chestnut-brown, uniformly 2–2.5 μ thick, with a hyaline papilla over the pores, the pore of upper cell


434

apical, of the lower at septum, smooth; pedicel nearly or quite colorless, short, fragile.

On Carduaceae (tribe *Heliantheae*): **Helianthella californica** Gray(*H. nevadensis* Greene), Calif.—**H. quinquenervis** (Hook.)Gray, Colo., Utah.—**H. uniflora** (Nutt.)T.&G., Utah, Wyo. **Range:** Central Wyoming to eastern California.

*. **Puccinia enceliae** D. & H. (*Bullaria e.* Arth.), with pycnia amphigenous, in groups; aecia amphigenous, uredinoid, surrounding the pycnia, dark cinnamon-brown, aeciospores globoid, 19–25 by 23–30 μ, the wall 1.5–2 μ thick, echinulate; uredia hypophyllous, scattered, light cinnamon-brown, urediospores globoid, slightly flattened laterally, 18–23 by 21–26 μ, the wall 1–1.5 μ thick, echinulate, with 2 equatorial pores, indistinct; telia hypophyllous, blackish-brown, teliospores ellipsoid, 22–29 by 30–42 μ, rounded at both ends, slightly constricted at septum, the wall chestnut-brown, 2–3 μ thick at sides, 6–9 μ above, smooth, with colorless pedicel, once to twice length of spore; occurs on Carduaceae (tribe *Heliantheae*): **Encelia viscida** Gray(*Geraea v.* Blake), southern California; also in Mexico and Central America. (N. A. F. **7:** 507, 801.)

*. **Puccinia parthenii** (Speg.) Arth., with pycnia and aecia unknown; uredia amphigenous, dark cinnamon-brown, urediospores globoid, 20–24 by 23–32 μ, the wall cinnamon-brown, 2–3.5 μ thick, finely echinulate, with 2 or 3 nearly equatorial pores; telia not seen, teliospores in the uredia ellipsoid, 28–32 by 38–48 μ, rounded or obtuse at both ends, not constricted at septum, the wall chocolate-brown, uniformly 4–5 μ thick, with a broad hyaline papilla over the pores, the pore of upper cell apical or nearly so, of the lower at septum, smooth, with colorless, fragile pedicel, about length of spore; occurs on Carduaceae (tribe *Heliantheae*): **Parthenium incanum** H.B.K., in southern Texas; also in Mexico. (N. A. F. **7:** 599.)

*. **Puccinia turgidipes** Jacks., with pycnia and aecia unknown; uredia epiphyllous, dark cinnamon-brown, urediospores globoid, 24–27 by 26–29 μ, much flattened on pore surfaces, the wall cinnamon-brown, 2.5–3 μ thick, echinulate, with 2 equatorial pores; telia amphigenous, blackish-brown, teliospores globoid, 30–32 by 32–38 μ, rounded at both ends, not constricted at septum, the wall chestnut-brown, uniformly 3–4 μ thick, with a broad hyaline papilla over the pores, the pore of upper cell apical, of the lower at septum, smooth, with colorless pedicel once to twice length of spore, having thick walls above, and thin, much inflated walls below; occurs on Carduaceae (tribe *Heliantheae*): **Viguiera deltoidea parishii** (Greene)Vasey&Rose, in southern Arizona and California. (N. A. F. **7:** 597, 848.)

*. **Puccinia abrupta** D. & H. (*Dicaeoma a.* A. & J.), with pycnia and aecia unknown; uredia chiefly epiphyllous, cinnamon-brown, urediospores globoid or obovoid, 19–26 by 22–32 μ; wall cinnamon-brown, 1.5–3 μ thick, echinulate, except around the 2 equatorial pores; telia chiefly epiphyllous, causing fusiform hypertrophy when caulicolous, chocolate-brown, teliospores ellipsoid, 24–32 by 36–48 μ, rounded at both ends, slightly or not constricted at septum, wall dark chestnut-brown, laminate, uniformly 3–5 μ thick, with a large hyaline papilla or umbo over the pores, the pore of upper cell nearly or quite apical, of the lower usually more or less depressed, smooth, pedicel colorless, once to twice length of spore, slender; occurs on Carduaceae (tribe *Heliantheae*): **Verbesina dissita** Gray, in southern California, **Viguiera annua** (Jones) Blake, in southern Arizona, **V. dentata** (Cav.)Spreng., **V. helianthoides** H.B.K. and **Ximenesia encelioides** Cav., in southern Texas, and **Zexmenia podocephala** Gray, in southern Arizona; also in Mexico, Central America and Cuba. (N. A. F. **7:** 433, 794.)

*. **Puccinia massalis** Arth. (*Dicaeoma m.* A. & J.), with amphigenous pycnia, in large groups; aecia amphigenous, in large groups, causing hypertrophy, cupulate, aeciospores ellipsoid, 16–18 by 22–27 μ, wall colorless, 1.5–2 μ thick, finely verrucose; uredia amphigenous, cinnamon-brown, urediospores ellipsoid or oblong, 18–24 by 27–35 μ, wall light cinnamon-brown, 1–1.5 μ thick, somewhat flattened on pore surfaces, echinulate, except around the 2 equatorial pores; telia amphigenous, chocolate-brown, teliospores ellipsoid, 23–32 by 39–48 μ, rounded at both ends, slightly or not constricted at septum, wall chestnut-brown, laminate, uniformly 3–5 μ thick, with a large hyaline papilla or umbo over the pores, the pore of upper cell nearly or quite apical, of the lower usually much depressed, smooth, pedicel colorless, once to twice length of spore, slender; occurs on Carduaceae (tribe *Heliantheae*): **Helianthus ciliaris** DC., in southern Texas and New Mexico. (N. A. F. **7:** 429.)

*. **Uromyces columbianus** Mayor (*Nigredo c.* Arth.), with pycnia chiefly epiphyllous, in groups; aecia hypophyllous, in groups or along veins, with rudimentary peridium, aeciospores ellipsoid, 14–18 by 20–24 μ, the wall colorless, 1.5 μ thick, finely verrucose; uredia amphigenous, cinnamon-brown, urediospores globoid, 16–18 by

18–22 μ, the wall cinnamon-brown, 1–1.5 μ thick, echinulate, with 2 equatorial pores; telia amphigenous, light chestnut-brown, cinereous by germination, teliospores narrowly ellipsoid or obovoid, 12–20 by 22–34 μ, rounded or obtuse above, usually narrowed below, the wall light chestnut-brown, nearly colorless below, uniformly 1–1.5 μ thick, with an abrupt, hyaline umbo above, 5–6 μ thick, smooth, with short, colorless, fragile pedicel; occurs on CARDUACEAE (tribe *Heliantheae*): **Melanthera angustifolia** A. Rich., in southern Florida; also in West Indies, Central and South America. (N. A. F. **7:** 771.)

*. **Uromyces bidenticola** (P. Henn.) Arth. (*Uredo b.*, *Uredo bidentis* P. Henn., *Klebahnia bidentis* Arth.), with pycnia amphigenous, in groups; uredinoid aecia and uredia indistinguishable, amphigenous, cinnamon-brown, urediospores globoid or obovoid, 19–27 by 27–35 μ, the wall cinnamon-brown, 1.5–3 μ thick, echinulate, with 2 nearly equatorial pores; telia amphigenous, light cinnamon-brown, cinereous by germination, teliospores obovoid, 16–24 by 29–45 μ, the wall pale cinnamon-brown, uniformly 1 μ thick, with an abrupt, hyaline umbo above, 5–10 μ thick, smooth, with colorless pedicel, about length of spore; occurs on CARDUACEAE (tribe *Heliantheae*): **Bidens expansa** Greene and **B. pilosa** L., in southern California and **B. leucantha** L., in southern Florida; also in Bermuda, West Indies, Central and South America, Africa and Asia. (N. A. F. **7:** 481, 800, 844.)

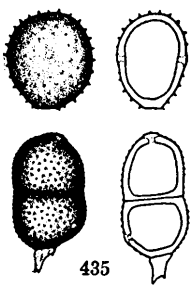
Uromyces bidentis Lagerh. (*Teleutospora b.* Arth. & Bisby), is the correlated microcyclic species occurring in the West Indies, Central and South America. (N. A. F. **7:** 520.)

310. PUCCINIA BALSAMORHIZAE. Fig. 435.

(N. A. F. 7: 506, 801.)

Trichobasis balsamorhizae Peck, Bot. Gaz. **6:** 276. 1881.
Puccinia balsamorhizae Peck, Bull. Torrey Club **11:** 49. 1884.
Puccinia wyethiae Peck; Hark., Bull. Calif. Acad. **2:** 442. 1887.
Bullaria balsamorhizae Arth. & Mains, N. Am. Flora **7:** 506. 1922.

Pycnia petiolicolous or costal. Aecia amphigenous, uredinoid, associated with the pycnia, otherwise like the uredia. Uredia amphigenous, scattered, or gregarious and confluent, chestnut-brown; urediospores globoid, 20–30 by 26–32 μ, slightly flattened laterally; wall chestnut-brown, 2–3 μ thick, echinulate, the pores 2, nearly equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 20–27 by 30–45 μ, rounded or rarely obtuse at both ends, slightly or not constricted at septum; wall dark chestnut-brown, uniformly 2–3 μ thick, the pore of upper cell apical, of the lower much depressed, minutely verrucose, often in striae; pedicel colorless, short, fragile.


435

ON CARDUACEAE (tribe *Heliantheae*): **Balsamorhiza deltoidea** Nutt., Calif., Ida., Ore., Wash.—**B. hirsuta** Nutt., Ida.—**B. incana** Nutt., Mont., Wyo.—**B. macrophylla** Nutt., Utah.—**B. sagittata** (Pursh)Nutt., Calif., Colo., Ida., Mont., Nev., Ore., Utah, Wash., Wyo.; B.C.—**Wyethia amplexicaulis** Nutt., Colo., Utah.—**W. angustifolia** Nutt., Calif.—**W. arizonica** Gray, Colo., Utah.—**W. mollis** Gray, Calif. **Range:** Montana to British Columbia, southward to southern Colorado and central California.

*. **Puccinia triannulata** (B. & C.) Jacks. (*P. mirifica* D. & H., *Bullaria t.* Arth. & Mains), with pycnia and uredinoid aecia chiefly hypophyllous, systemic, aeciospores ellipsoid, 19–24 by 24–32 μ, wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, nearly equatorial; uredia wanting, urediospores in the telia like the uredinoid aeciospores, but larger, 21–26 by 26–32 μ, with wall 2–3 μ thick; telia hypophyllous, systemic, dark cinnamon-brown, teliospores ellipsoid, irregular, 23–30 by 40–52 μ, rounded at both ends, slightly or not constricted at septum, wall dark cinnamon-brown, uniformly 3 μ thick, the pore in upper cell nearly or quite apical, in the lower much depressed, verrucose, pedicel colorless, short, fragile; occurs on CARDUACEAE (tribe *Heliantheae*): **Borrichia arborescens** (L.)DC., in southern Florida, and **B. frutescens** (L.)DC., in southern South Carolina, Florida and southern Texas; also in Bahama and Bermuda Islands. (N. A. F. **7:** 505.)

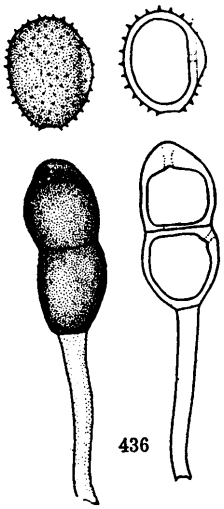
*. **Uromyces martinii** Farl. (*Nigredo m.* Arth.), with pycnia epiphyllous; aecia hypophyllous, in groups, cupulate, aeciospores globoid, 15–22 by 18–24 μ, wall yellowish, 1–1.5 μ thick, verrucose; uredia amphigenous, cinnamon-brown, urediospores globoid, 18–21 by 19–23 μ, wall pale cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, equatorial; telia amphigenous, chocolate-brown, teliospores globoid, 20–26 by 23–29 μ, wall chestnut-brown, uniformly 2.5–3 μ thick, with a semihyaline umbo over the pore, finely verrucose, pedicel colorless, short, fragile; occurs on CARDUACEAE (tribe *Heliantheae*): **Melanthera hastata** Michx. and **M. parvifolia** Small in southern Florida. (N. A. F. **7:** 267, 771.)

311. PUCCINIA ABSINTHII. Fig. 436.

(N. A. F. 7: 508, 801, 845.)

Uredo (*Puccinia*) *absinthii* Hedw. f.; Poir., in Lam., Encyl. **8:** 245. 1808.
Puccinia absinthii (Hedw. f.) DC., Fl. Fr. **6:** 56. 1815.
Puccinia similis E. & E., Bull. Torrey Club **25:** 508. 1898.
Puccinia artemisiella Syd., Monog. Ured. **1:** 14. 1902.
Bullaria absinthii Arth. & Mains, N. Am. Flora **7:** 508. 1922.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous, uredinoid, cinnamon-brown; aeciospores ellipsoid, 17–24 by 27–31 μ; wall pale cinnamon-brown, 1–2 μ thick, sparsely echinulate, the pores 3, equatorial. Uredia chiefly hypophyllous, dark cinnamon-brown; urediospores ellipsoid or obovoid, 20–26 by 24–34 μ; wall golden-brown, 1.5–2.5 μ thick, minutely echinulate, the pores 3, equatorial, sometimes each covered with much inflated cuticle. Telia chiefly hypophyllous, blackish-brown; teliospores oblong, 20–28 by 40–60 μ, obtuse or rounded at both ends, slightly constricted at septum; wall chestnut-brown, 1.5–2.5 μ thick at sides, 6–12 μ above, smooth or minutely verrucose, especially in upper part; pedicel nearly colorless, once to once and a half length of spore.



436

ON CARDUACEAE (tribe *Anthemideae*): **Artemisia arbuscula** Nutt., Wyo.—**A. aromatica** Nels., Colo., Ida., Mont., Utah, Wyo.—**A. bigelovii** Gray, Utah.—**A. brittonii** Rydb., Colo.—**A. californica** Less., Calif.—**A. cana** Pursh, Colo., Mont., N.M., N.D., Ore., S.D., Utah, Wyo.—**A. camporum** Rydb.(*A. forwoodii* Rydb., not Wats.), Colo.—**A. carruthii** Wood(*A. kansana* Britt.), Tex.—**A. coloradensis** Osterh., Colo.—**A. cuneata** Rydb., Colo.—**A. diversifolia** Rydb., Colo.—**A. douglasiana** Bess., Calif., Ore.—**A. dracunculoides** Pursh, Ariz., Calif., Colo., Iowa, Mont., Neb., Nev., N.M., N.D., Ore., S.D., Utah, Wash., Wis., Wyo.—**A. elatior** (T.&G.)Rydb., Calif.—**A. frigida** Willd., Ore.; Alta., Sask.—**A. gnaphalodes** Nutt., Colo., Iowa, Kans., Mo., Mont., Neb., Okla., Ore.—**A. heterophylla** Nutt., Calif.—**A. longifolia** Nutt., S.D.—**A. ludoviciana** Nutt., Ariz., Calif., Colo., Kans., Mont., Neb., N.D., Ore., S.D., Wash., Wis.; B.C.—**A. mexicana** Willd.(*A. silvicola* Osterh.), N.M., Tex.—**A. nova** Nels., N.M., Utah.—**A. pabularis** (Nels.)Rydb., S.D.—**A. parishii** Gray, Nev.—**A. purshiana** Bess., Mont.—**A. pycnocephala** DC., Calif.—**A. redolens** Gray, N.M.—**A. rigida** (Nutt.)Gray, Calif., Ore., Wash.—**A. serrata** Nutt., Iowa.—**A. spinescens** Eaton, Ida.—**A. suksdorfii** Piper, Calif.—**A. tridentata** Nutt., Calif., Colo., Ida., Mont., Nev., N.M., Ore., S.D., Utah, Wash., Wyo.—**A. tripartita** Rydb.(*A. trifida* Nutt.), Ida., Wyo.—**A. viscidula** Osterh., Colo.—**A. vulgaris** L., Calif.—**A. wrightii** Gray, Ariz., N.M.—**Sphaeromeria capitata**

Nutt., Wyo.—**S. diversifolia** (Eaton)Rydb., Utah. **Range:** Wisconsin to British Columbia, southward to Texas and southern California; also in Mexico, Central America, Europe and Japan.

Cultures were made in 1908 and 1910 by Arthur (Mycol. **1:** 243. 1909; same **4:** 21. 1912) by sowing teliospores from *Artemisia dracunculoides*, and from one other species, on *A. dracunculoides* with the production of pycnia followed directly by uredinoid aecia, showing the species to be autoecious.

Uromyces oblongisporus.

(N. A. F. 7: 589.)

Uromyces oblongisporus E. & E., Bull. Torrey Club **25:** 507. 1898.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia as in *Puccinia absinthii;* teliospores oblong, 18–21 by 28–35 μ, rounded at both ends; wall as in *P. absinthii*, except more strongly verrucose and 3–5 μ thick above; pedicel fragile.

On Carduaceae (tribe *Anthemideae*): **Artemisia tridentata** Nutt., Wyo. **Range:** Only one collection known, from South Butte, Wyoming.

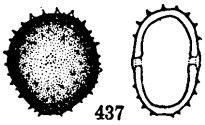
The spores are somewhat narrower than in *Puccinia absinthii*, and appear more delicate, but the correlation is otherwise marked.

312. PUCCINIA GAILLARDIAE. Fig. 437.

(N. A. F. 7: 507.)

Uredo gaillardiae D. & H.; Diet., Erythea **7:** 98. 1899.
Bullaria gaillardiae Arth. & Mains, N. Am. Flora **7:** 507. 1922.
Puccinia gaillardiae (D. & H.) Barth., Handb. N. Am. Ured. 115. 1928.

Pycnia amphigenous, scattered. Aecia hypophyllous, uredinoid, systemic, cinnamon-brown; aeciospores globoid, 24–30 by 28–33 μ, somewhat flattened laterally; wall cinnamon-brown, uniformly 2–3 μ thick, echinulate, the pores 2, equatorial, on the flattened sides. Uredia and telia unknown.


437

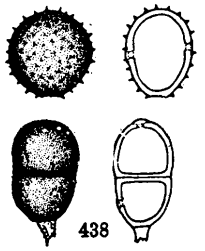
On Carduaceae (tribe *Helenieae*): **Gaillardia aristata** Pursh, Calif. **Range:** Only one collection known, made at Dunsmuir, northern California.

313. PUCCINIA ERIOPHYLLI. Fig. 438.

(N. A. F. 7: 603, 809.)

Puccinia eriophylli Jacks., Brooklyn Bot. Gard. Mem. **1:** 246. 1918.
Uredo abdita Jacks., Mycol. **14:** 120. 1922.

Pycnia and aecia unknown. Uredia amphigenous, chestnut-brown; urediospores globoid, 21–27 by 26–29 μ; wall chestnut-brown, 2–3 μ thick, echinulate, the pores 2, equatorial Telia amphigenous, chocolate-brown; teliospores ellipsoid, 18–21 by 26–30 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, the pore of upper cell apical, of the lower depressed, minutely verrucose; pedicel colorless, short, fragile.


438

On Carduaceae (tribe *Helenieae*): **Eriophyllum integrifolium** (Hook.)Greene, Wyo.—**E. lanatum** (Pursh) Forbes, Ore.—**E. leucophyllum** (DC.)Rydb., Ore.—**E.**

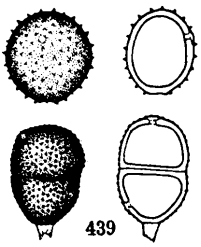
nevinii Gray, Calif.—**E. staechadifolium** Lag., Calif.—**E. trifidum** (Nutt.) Rydb., Calif. **Range:** Western Wyoming and northern Oregon to southern California.

314. PUCCINIA ARNICALIS. Fig. 439.

(N. A. F. 7: 603.)

Puccinia arnicalis Peck, Bot. Gaz. **6**: 227. 1881.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid, 20–26 by 26–32 μ, often flattened laterally; wall cinnamon-brown 1.5–2 μ thick, minutely echinulate, the pores 2 or 3, superequatorial. Telia amphigenous, chestnut-brown; teliospores ellipsoid, 18–26 by 28–38 μ, rounded at both ends, or narrowed below, slightly or not constricted at septum; wall light chestnut-brown, uniformly 1–2 μ thick, the pores of both cells usually much depressed, minutely verrucose; pedicel colorless, short, fragile.


439

On Carduaceae (tribe *Senecioneae*): **Arnica cordifolia** Hook., Colo., Mont., Ore., Utah.—**A. diversifolia** Greene(*A. latifolia viscidula* Gray), Calif., Ore.—**A. foliosa** Nutt.(*A. rhizomata* Nels.), Utah.—**A. fulgens** Pursh(*A. pedunculata* Rydb.), Utah.—**A. latifolia** Bong., Mont.—**A. subplumosa** Greene, Colo. **Range:** Northwestern Montana to Oregon, southward to Colorado and central California.

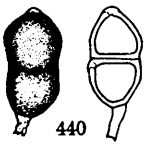
This may be a systemic species, as the sori occur on the stem and scale-leaves below the surface of the soil, and especially along stems and midribs. It has much the habit of *Puccinia minussensis*, and pycnia and aecia similar to that species may yet be discovered.

315. PUCCINIA SUBCIRCINATA. Fig. 440.

(N. A. F. 7: 477, 800, 844.)

Puccinia subcircinata E. & E., Jour. Myc. **3**: 56. 1887.
Allodus subcircinata Arth., Rés. Sci. Congr. Bot. Vienne 345. 1906.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, surrounding the pycnia, or scattered, cupulate; aeciospores globoid, 16–19 by 17–21 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia wanting. Telia amphigenous, associated with aecia or scattered, dark chestnut-brown; teliospores ellipsoid or oblong, 15–21 by 25–32 μ, rounded at both ends, slightly constricted at septum; wall light chestnut-brown, uniformly 1.5–2 μ thick, often with a hyaline papilla over upper pore, the pore of upper cell apical, of the lower at septum, smooth; pedicel colorless, short, fragile.


440

On Carduaceae (tribe *Senecioneae*): **Senecio crassulus** Gray, Colo., Utah, Wyo.—**S. fremontii** T.&G., Utah.—**S. hydrophilus** Nutt., Calif., Wash.—**S. integerrimus** Nutt., N.D.—**S. taraxacoides** (Gray)Greene, Colo.—**S. triangularis** Hook., Ida., Utah, Wash.; Alta.—**S.** sp., N.M., S.D. **Range:** North Dakota to western Alberta, southward to central New Mexico and central California; also in Japan.

Puccinia expansa.

(N. A. F. 7: 583, 806.)

Puccinia expansa Link, in Willd., Sp. Pl. **6**[2]: 75. 1825.
Micropuccinia expansa A. & J.; Arth., Bull. Torrey Club **48**: 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia hypophyllous, dark chocolate-brown; teliospores as in *Puccinia subcircinata*, but slightly larger, 18–26 by 30–38 μ.

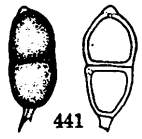
On Carduaceae (tribe *Senecioneae*): **Senecio aronicoides** DC., Calif.—**S. dimorphophyllus** Greene, Wyo.—**S. columbianus** Greene, Wash.—**S. lugens** Richards., Calif.—**S. perplexus** Nels.(*S. dispar* Nels.), Utah. **Range:** Washington to central Utah and northern California; also in Europe.

316. PUCCINIA CONGLOMERATA. Fig. 441.

(N. A. F. 7: 583.)

Uredo conglomerata Str., Ann. Wett. Ges. **2:** 100. 1810.
Puccinia conglomerata (Str.) S. & K., Deuts. Schwämme **8:** 4. 1818.
Puccinia nardosmiae E. & E., Jour. Myc. **1:** 85. 1885.
Micropuccinia conglomerata A. & J.; Arth., Bull. Torrey Club **48:** 40. 1921.

Pycnia unknown, probably not formed. Aecia and uredia wanting. Telia chiefly hypophyllous, chestnut-brown; teliospores ellipsoid or oblong, 14–18 by 20–35 μ, obtuse or rounded at both ends, not constricted at septum; wall cinnamon-brown, uniformly 1 μ thick, with a small hyaline papilla over upper pore, the pore of upper cell apical, of the lower at septum, smooth; pedicel colorless, short, fragile.


441

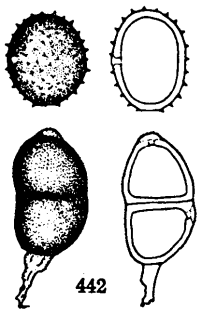
On Carduaceae (tribe *Senecioneae*): **Petasites frigidus** (L.)Fries, Alta., B.C.—**P. palmatus** (Ait.)Gray, Mich., Minn., N.Y.; Alta., Ont., Sask. **Range:** Northern New York to British Columbia.

317. PUCCINIA ONOPORDI. Fig. 442.

(N. A. F. 7: 604.)

Puccinia onopordi Syd., Monog. Ured. **1:** 128. 1902.

Pycnia and aecia unknown. Uredia amphigenous, cinnamon-brown; urediospores globoid or ellipsoid, 23–26 by 26–32 μ; wall cinnamon-brown, 2 μ thick, echinulate, the pores 3, nearly equatorial. Telia amphigenous, chestnut-brown; teliospores ellipsoid or oblong, 22–26 by 32–48 μ, rounded at both ends, or narrowed below, slightly or not constricted at septum; wall dark cinnamon-brown, uniformly 1.5–2 μ thick, or slightly thicker above, the pore of upper cell apical, of the lower at or near septum, minutely verrucose, inclined to be striate; pedicel colorless, short, fragile.


442

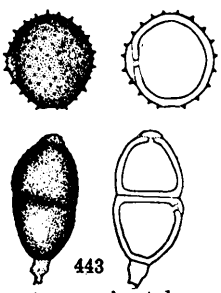
On Carduaceae (tribe *Cynareae*): **Onopordon acanthium** L., N.S. **Range:** Adventive in Nova Scotia; also in western Asia.

318. PUCCINIA CNICI. Fig. 443.

(N. A. F. 7: 435, 794, 843.)

Puccinia cnici Mart., Fl. Mosq. 226. 1817.
Puccinia cirsii-lanceolati Schroet.; Cohn, Krypt.-Fl. Schl. **3**[1]: 317. 1887.
Dicaeoma cnici Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia epiphyllous, in groups. Aecia chiefly hypophyllous, long covered by epidermis, opening by pore or slit, with peridium obsolescent, or want-


443

ing; aeciospores globoid or ellipsoid, 20–27 by 25–35 μ; wall colorless, 2–3 μ thick, finely verrucose. Uredia amphigenous, dark cinnamon-brown; urediospores globoid or ellipsoid, 23–29 by 27–35 μ; wall cinnamon-brown, 1.5–3 μ thick, echinulate, the pores 3, rarely 2 or 4, equatorial, covered by swollen cuticle. Telia amphigenous, chestnut-brown; teliospores ellipsoid or oblong, 20–29 by 32–45 μ, rounded or obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–3 μ thick, with a small hyaline papilla over the pores, the pore of upper cell nearly or quite apical, rarely at septum, of the lower at or near septum, minutely verrucose; pedicel colorless, short, fragile.

On Carduaceae (tribe *Cynareae*): **Cirsium lanceolatum** (L.)Hill, Colo., Conn., Del., Ida., Ind., Iowa, Me., Mass., Mich., Miss., Mont., N.J., N.Y., Ohio, Ore., Pa., R.I., Utah, Wash., W.Va., Wis.; B.C., Ont. **Range:** Maine to British Columbia, southward to West Virginia, northern Mississippi and Utah; also in Europe.

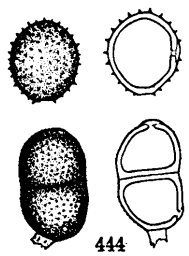
Successful cultures were made in 1903 by Kellerman (Jour. Myc. **9:** 229. 1903), who applied teliospores from *C. lanceolatum* to plants of the same species and produced aecia.

319. PUCCINIA OBTEGENS. Fig. 444.

(N. A. F. 7: 511, 845.)

(*Uredo suaveolens* Pers., Obs. Myc. **2:** 24. 1799; Syn. Fung. 221. 1801.)
(*Hypodermium* (*Uredo*) *obtegens* Link, Ges. Nat. Fr. Berlin Mag. **7:** 27. 1815.)
Puccinia obtegens [Link] Tul., Ann. Sci. Nat. Bot. IV. **2:** 87. 1854.
Puccinia suaveolens Rostr., Forh. Skand. Nat. **11:** 339. 1874.
Bullaria suaveolens Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia hypophyllous, scattered. Aecia chiefly hypophyllous, systemic, uredinoid, cinnamon-brown; aeciospores globoid or ellipsoid, 22–26 by 24–30 μ; wall cinnamon-brown, 1.5 μ thick, echinulate, the pores 3, equatorial. Uredia from a localized mycelium; urediospores resembling the aeciospores. Telia either associated with uredia from a localized mycelium or systemic, chestnut-brown; teliospores ellipsoid, 20–24 by 30–38 μ, rounded at both ends, slightly or not constricted at septum; wall light chestnut-brown, uniformly 1.5–2 μ thick, the pore of upper cell nearly or quite apical, occasionally with a small hyaline papilla, of the lower much depressed, finely verrucose; pedicel colorless, short, fragile.


444

On Carduaceae (tribe *Cynareae*): **Cirsium arvense** (L)Scop., Calif., Me., Mass., Mich., Mont., N.J., N.Y., Ohio, Pa., R.I., S.D., Utah, Vt., Wash., Wis.; N.S., Ont., Queb. **Range:** Nova Scotia to south-central Montana, southward to New Jersey and Ohio, and in Washington, California and Utah; also in Europe, Japan and New Zealand.

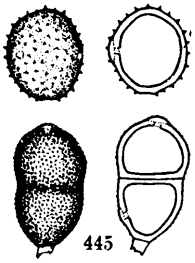
A culture was made by C. R. Orton in 1912 by sowing the uredinoid aeciospores on leaves of *C. arvense*, producing a localized mycelium bearing at first uredia and later telia. The results were not published, but the data are in the Arthur Herbarium. The succession of spore-forms is clearly stated by Olive (Ann. Myc. **11:** 304. 1913), who also studied the nuclear condition of the mycelium. The earlier authors especially mention the fragrance, characteristic of the aecial condition.

320. PUCCINIA CIRSII. Fig. 445.

(N. A. F. 7: 509, 801, 845.)

Puccinia cirsii Lasch; Rab., Fungi Eur. *89*. 1859.
Puccinia inclusa Syd., Monog. Ured. **1**: 56. 1902.
Bullaria cirsii Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia chiefly epiphyllous, in groups. Aecia chiefly epiphyllous, encircling the pycnia, uredinoid, otherwise like the uredia. Uredia chiefly hypophyllous, scattered, chestnut-brown; urediospores globoid, 22–28 by 24–32 μ; wall golden-brown, 1.5–2.5 μ thick, echinulate, the pores 3, rarely 4, equatorial. Telia chiefly hypophyllous, chestnut-brown; teliospores broadly ellipsoid, 22–28 by 28–45 μ, rounded at both ends, not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, sometimes slightly thicker above, minutely verrucose, often in striae, or smooth, the pores of both cells usually much depressed; pedicel colorless, short, fragile.



445

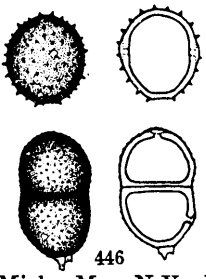
On Carduaceae (tribe *Cynareae*): **Circium acaulescens** (Gray)Schum., Calif., Colo., Ore., Utah, Wyo.—**C. altissimum** (L.) Spreng., Del., Iowa, Kans., Minn., Mo., Neb., Pa., S.D., Tenn.—**C. arizonicum** (Gray)Petrak, Ariz., N.M.—**C. breweri** (Gray)Jepson, Calif., Wash.—**C. californicum** Gray, Calif.—**C. canescens** Nutt., Colo.—**C. centaureae** (Rydb.) Schum., Colo.—**C. coloradense** (Rydb.)Cockerell, Colo.—**C. discolor** (Muhl.) Spreng., Iowa, N.J., Okla.—**C. drummondii** T.&G., Colo., Nev., Utah, Wyo.—**C. eatoni** (Gray)B.L.Rob., Utah.—**C. edule** Nutt., Calif., Ore., Wash.—**C. flodmanii** (Rydb.)Arth.(*C. canescens* Gray, not Nutt.), Mont., N. D.—**C. foliosum** (Hook.)DC., Ida.—**C. griseum** (Rydb.)Schum., Colo.—**C. hookeri** Nutt., Mont.—**C. inornatum** W.&S., N.M.—**C. lanceolatum** (L.)Hill, Calif., La., Mont., Wis.—**C. megacephalum** (Gray)Cockerell, Colo., Neb., Okla.—**C. muticum** Michx., Conn.—**C. nelsonii** (Pam.)Rydb., Wyo.—**C. neomexicanum** Gray, Colo.—**C. ochrocentrum** Gray, Colo., N.M., Wyo.—**C. occidentale** (Nutt.)Jepson, Calif.—**C. oreophilum** Rydb., Colo.—**C. palousense** Piper, Ida., Wash.—**C. pallidum** W.&S., N.M.—**C. parryi** (Gray)Petrak, Colo.—**C. perennans** (Greene)W.&S., N.M.—**C. perplexans** Rydb., Colo.—**C. plattense** (Rydb.)Cockerell, Colo., Neb.—**C. pulchellum** (Greene)W.&S., Utah.—**C. quercetorum** (Gray)Jepson, Calif.—**C. remotifolium** (Hook.)DC., Wash.—**C. scopulorum** (Greene)Cockerell, Colo., Mont., Wyo.—**C. spathulifolium** Rydb., Colo.—**C. tracyi** Rydb., Colo.—**C. undulatum** (Nutt.)Spreng., Colo., Ind., Kans., Mont., N.M., Ore., S.D., Utah, Wash., Wyo.; Alta.—**C. vernale** Osterh., Colo.—**C. virginianum** (L.)Michx., N.C.—**C. wrightii** Gray, Ariz.—**C.** sp., Tex. **Range:** Pennsylvania to Alberta, southward to North Carolina, Texas and southern California; also in Mexico, Europe, Asia, Japan and Formosa.

321. PUCCINIA BARDANAE. Fig. 446.

(N. A. F. 7: 512, 801, 846.)

Uredo apiculata arctii Str., Ann. Wett. Ges. **2**: 98. 1810.
Puccinia inquinans bardanae Wallr., Fl. Crypt. Germ. **2**: 219. 1833.
Puccinia bardanae (Wallr.) Cda., Ic. Fung. **4**: 17. 1840.
Puccinia lappae Cast., Cat. Pl. Mars. 201. 1845.
Bullaria bardanae Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia epiphyllous, in groups. Aecia epiphyllous, surrounding the pycnia, uredinoid, otherwise like the uredia. Uredia amphigenous, scattered, chestnut-brown; urediospores globoid or broadly ellipsoid, 23–26 by 24–30 μ; wall light chestnut-brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial. Telia chiefly hypophyllous, blackish-brown; teliospores broadly ellipsoid, 23–26 by 34–38 μ, rounded above and below, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pores of both cells usually much depressed, minutely verrucose; pedicel colorless, short, fragile.


446

On Carduaceae (tribe *Cynareae*): **Arctium minus** Schk. (*Lappa m.* DC.), Conn., Ill., Ind., Iowa, Ky., Mass., Mich., Mo., N.Y., N.D., Ohio, Pa., Va., Vt., W.Va., Wis.; N.S., Ont. **Range:** Nova Scotia to North Dakota, southward to Virginia and Missouri; also in Europe.

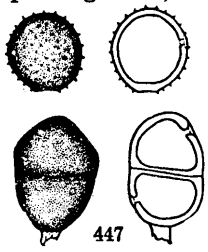
Cultures by Jacky (Centr. Bakt. II. **18:** 86. 1907), who used five species of *Lappa*, gave pycnia and uredinoid aecia, without disclosing specialization. Some American collections have been erroneously labelled as on *Arctium lappa*.

322. PUCCINIA CARTHAMI. Fig. 447.

(N. A. F. 7: 512.)

Puccinia carthami Cda., Ic. Fung. **4:** 15. 1840.
Bullaria carthami Arth. & Mains, N. Am. Flora **7:** 512. 1922.

Pycnia and aecia unknown. Uredia amphigenous, chestnut-brown; urediospores globoid, 17–23 by 22–26 μ; wall light chestnut-brown, 1.5–2 μ thick, echinulate, the pores 2 or 3, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 23–29 by 32–42 μ, rounded or somewhat obtuse at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2.5–3.5 μ thick, the pores of both cells more or less depressed, minutely verrucose; pedicel colorless, short, fragile.


447

On Carduaceae (tribe *Cynareae*): **Carthamus tinctorius** L., Mass. **Range:** Introduced into Massachusetts, only one collection reported, 1895; also in Europe, northern Africa, India and Japan.

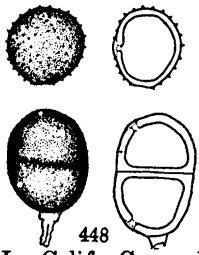
*. **Puccinia irrequisita** Jacks. (*Bullaria i.* Arth. & Mains), with pycnia and aecia unknown; uredia amphigenous, scattered, cinnamon-brown, urediospores globoid, 20–23 by 23–26 μ, wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 3, equatorial; telia amphigenous, chocolate-brown, teliospores ellipsoid, 24–29 by 34–40 μ, rounded or obtuse at both ends, slightly or not constricted at septum, wall chestnut-brown, uniformly 3–3.5 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, minutely verrucose, pedicel colorless, short, fragile; occurs on Carduaceae (tribe *Cynareae*): **Centaurea americana** Nutt., in southern Texas. (N. A. F. **7:** 512.)

323. PUCCINIA CYANI. Fig. 448.

(N. A. F. 7: 511, 845.)

(*Uredo cyani* Schleich. (Pl. Crypt. Helv. *95*, hyponym. 1805); DC., Fl. Fr. **6:** 74. 1815.)
Puccinia cyani [Schleich.] Pass., in Rab., Fungi Eur. *1767*. 1873.
Bullaria cyani Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia amphigenous, scattered. Aecia amphigenous, systemic, uredinoid, dark cinnamon-brown; aeciospores globoid, 20–24 by 22–26 μ; wall cinnamon-


448

brown, 1.5–2 μ thick, echinulate, the pores 2, equatorial. Uredia wanting or if present indistinguishable from the aecia. Telia amphigenous, apparently systemic, dark chestnut-brown; teliospores ellipsoid, 24–28 by 32–40 μ, rounded at both ends, not constricted at septum; wall chestnut-brown, uniformly 1.5–3 μ thick, the pores of both cells usually much depressed, minutely verrucose; pedicel colorless, short, fragile.

On Carduaceae (tribe *Cynareae*): **Centaurea cyanus** L., Calif., Conn., Del., Ind., Mass., Mich., N.J., N.Y., Ore., Pa., Tenn., Wash.; Ont. **Range:** Massachusetts to Michigan, southward to Tennessee and Indiana, and from Washington to central California; also in Europe and New Zealand.

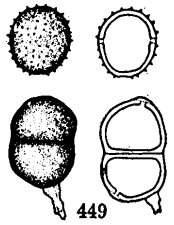
*. **Puccinia pinaropappi** Syd. (*Bullaria p.* Arth. & Mains), with pycnia and aecia unknown; uredia amphigenous, scattered, cinnamon-brown, urediospores globoid, 18–21 by 21–27 μ, wall cinnamon-brown, 3 μ thick, sometimes thicker below, echinulate, the pores 2, equatorial; telial amphigenous, blackish and shining, teliospores ellipsoid, 23–26 by 29–35 μ, rounded at both ends, not constricted at septum, wall chocolate-brown, uniformly 3 μ thick, the pores of both cells usually much depressed, minutely verrucose, pedicel colorless, usually short, fragile, often oblique; occurs on Cichoriaceae: **Pinaropappus roseus** Less., in southern Texas. (N. A. F. **7:** 515.)

324. PUCCINIA LAPSANAE. Fig. 449.

(N. A. F. 7: 435, 794, 843.)

(*Aecidium lapsanae* Schultz, Produr. Fl. Starg. 454. 1806.)
Trichobasis lapsanae Cooke, Micr. Fungi ed. 4. 224. 1865.
Puccinia lapsanae (Cooke) Fckl., Jahr. Nass. Ver. Nat. **23–24:** 53. 1870.
Dicaeoma lapsanae Ktze., Rev. Gen. **3**[3]**:** 469. 1898.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores globoid, 13–19 by 17–23 μ; wall colorless, 1–1.5 μ thick, minutely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid, 15–20 by 17–22 μ; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, rarely 3, equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 17–26 by 24–33 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, minutely verrucose; pedicel colorless, short, fragile, often oblique.


449

On Cichoriaceae: **Lapsana communis** L., N.Y., Ore., Wash.; Ont. **Range:** Introduced locally in the four regions named; also in Europe, Asia, Japan and New Zealand.

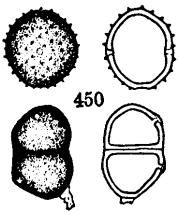
Cultures in 1885 by Plowright (Brit. Ured. Ustil. 150. 1889) proved that the life cycle included aeciospores, urediospores and teliospores.

325. PUCCINIA VARIABILIS. Fig. 450.

(N. A. F. 7: 437, 794.)

Puccinia variabilis Grev., Scot. Crypt. Fl. *pl. 75.* 1823.
Dicaeoma variabile Ktze., Rev. Gen. **3**[3]**:** 471. 1898.

Pycnia not seen. Aecia hypophyllous, in small groups or scattered, cupulate; aeciospores globoid, 13–20 by 16–23 μ; wall colorless, 1 μ thick, minutely


450

verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid, 16–24 by 20–28 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2 or 3, nearly equatorial. Telia amphigenous, dark chestnut-brown; teliospores ellipsoid, 18–24 by 21–30 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5–2 μ thick, rarely thicker above, the pores more or less depressed, minutely verrucose; pedicel colorless, short, fragile, often oblique.

On Cichoriaceae: **Taraxacum vulgare** (Lam.)Schr.(*T. officinale* Weber, *Leontodon taraxacum* L.), N.S. **Range:** Sparingly introduced in Nova Scotia; also in northern Europe.

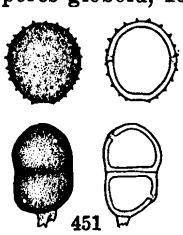
Cultures by using aeciospores were made by Soppitt, and again in 1888 by Plowright (Brit. Ured. Ustil. 151. 1889), which showed the life cycle to include aeciospores, urediospores and teliospores.

326. PUCCINIA INSPERATA. Fig. 451.

(N. A. F. 7: 438.)

Puccinia insperata Jacks., Brooklyn Bot. Gard. Mem. **1:** 253. 1918.
Dicaeoma insperatum Arth., N. Am. Flora **7:** 438. 1921.

Pycnia not seen. Aecia chiefly hypophyllous, in groups, cupulate; aeciospores globoid, 15–19 by 19–23 μ; wall colorless, 1–1.5 μ thick, finely verrucose. Uredia amphigenous, cinnamon-brown; urediospores globoid, 19–21 by 23–29 μ; wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2 or 3, nearly equatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid, 16–20 by 23–32 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 1.5 μ thick, the pores usually much depressed, minutely verrucose; pedicel colorless, short, fragile, often oblique.


451

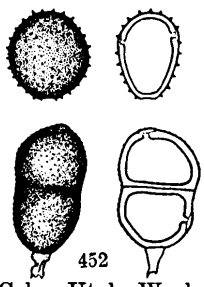
On Cichoriaceae: **Nabalus hastatus** (Less.)Heller, Alas., Ore. **Range:** Southeastern Alaska and northern Oregon.

327. PUCCINIA HIERACII. Fig. 452.

(N. A. F. 7: 513, 801, 846.)

Uredo hieracii Schum., Enum. Pl. Saell. **2:** 232. 1803.
Puccinia hieracii (Schum.) Mart., Fl. Mosq. ed. 2. 226. 1817.
Puccinia hypochaeridis Oud., Nederl. Kruidk. Arch. II. **1:** 175. 1872.
Puccinia endiviae Pass.; Thüm., Hedw. **12:** 113. 1873.
Puccinia troximontis Peck, Bot. Gaz. **6:** 227. 1881.
Puccinia taraxaci Plowr., Brit. Ured. 186. 1889.
Puccinia leontodontis Jacky, Zeits. Pflanzenkr. **9:** 339. 1899.
Puccinia crepidis-acuminatae Syd., Oesterr. Bot. Zeits. **51:** 27. 1901.
Puccinia krigiae Syd., Monog. Ured. **1:** 104. 1902.
Puccinia sejuncta Syd., Ann. Myc. **1:** 326. 1903.
Bullaria hieracii Arth., Rés. Sci. Congr. Bot. Vienne 346. 1906.

Pycnia amphigenous, in groups, infrequent. Aecia grouped about the pycnia, uredinoid, otherwise like the uredia. Uredia amphigenous, grouped or scattered, often appearing systemic, dark cinnamon-brown; urediospores globoid or obovoid, 17–28 by 21–32 μ; wall cinnamon-brown, 1–2.5 μ thick, echinulate, the pores 2 or 3, equatorial or superequatorial. Telia amphigenous, chocolate-brown; teliospores ellipsoid or oblong, 18–29 by 26–42 μ, rounded above and below, slightly or not constricted at septum; wall chestnut-brown, uniformly 1–



452

2.5 μ thick, finely verrucose, the pore in both cells much depressed; pedicel colorless, short, fragile.

On Cichoriaceae: **Agoseris arizonica** Greene(*A. leptocarpa* Osterh.), Colo.—**A. aurantiaca** (Hook.)Greene(*A. purpurea* Greene, *Troximon a.*), Colo., Wash., Wyo.—**A. barbellulata** Greene, Calif.—**A. cuspidata** (Pursh)Dietr. (*T. c., Nothocalais c.* Greene), Colo., Iowa, Neb., Wis.—**A. elata** (Nutt.)Greene, Wash.—**A. glauca** (Nutt.)Greene(*T. g.*), Ariz., Colo., Mont., Wyo.—**A. gracilens** (Gray)Ktze., Colo., Utah, Wash.—**A. gracilens greenei** (Gray)Blake, Colo., Mont.—**A. grandiflora** (Nutt.)Greene(*T. g.* Gray), Mont., Wash.—**A. heterophylla** (Nutt.) Greene, Wash.—**A. hirsuta** (Hook.)Greene(*T. humile* Benth.), Calif.—**A. laciniata** (Nutt.) Greene, Ore.—**A. montana** Osterh., Colo.—**A. plebia** Greene, Calif.—**A. taraxacifolia** (Nutt.)Dietr.(*A. agrestis* Osterh.), Utah.—**A. turbinata** Rydb., Mont.—**A. villosa** Rydb., Mont.—**Apargia autumnalis** (L.) Hoffm.(*Leontodon a.*), Me.; N.S.—**Cichorium endivia** L., Conn.—**C. intybus** L., Calif., N.Y., Ore., Vt., Wash., Wis.; N.S., Ont., Queb.—**Crepis acuminata** Nutt., Calif., Colo., Ida., Mont., Nev., Utah, Wash., Wyo.—**C. angustata** Rydb., B.C.—**C. glauca** (Nutt.)T.&G., Utah.—**C. gracilis** (Eaton)Rydb., Ida. —**C. intermedia** Gray, Calif., Colo., Utah, Wyo.—**C. occidentalis** Nutt., Colo., Nev., Utah.—**C. pleurocarpa** Gray, Calif.—**C. runcinata** (James)T.&G., Mont., N.D., S.D., Wash.—**C. scopulorum** Cov., Colo., Ida., Utah.—**C. subacaulis** (Kellogg)Cov., Calif.—**Cynthia virginica** (L.)D.Don(*Adopogon v.* Ktze., *Krigia amplexicaulis* Nutt.), N.C.—**Heteropleura fendleri** (Sch.-Bip.)Rydb. (*Hieracium f.*), Ariz., N.M.—**Hieracium albiflorum** Hook., Calif., Ida., Mont., Ore., Wash., Wyo.—**H. canadense** Michx., Conn., Ill., Ind., Iowa, Me., Mass., Mich., Mont., R.I., S.D., Wash., Wis., Wyo.; Alta., Ont., Queb.—**H. cinereum** Howell, Ore.—**H. columbianum** Rydb., Ida., Mont., Wash., Wyo.—**H. gracile** Hook., Ore., Wyo.—**H. g. detonsum** Gray, Calif.—**H. gronovii** L., N.Y.—**H. horridum** Fries, Calif.—**H. paniculatum** L., N.Y.—**H. scabriusculum** Schw. (*H. umbellatum* Am. auth., not L.), N.D., S.D.—**H. scabrum** Michx., Del., Ind., Me., N.Y., Pa., Va., W.Va., Wis.; N.S., Man.—**H. scouleri** Hook.(*H. griseum* Rydb.), Ore., Utah, Wash.—**H. venosum** L., N.Y.—**Hypochaeris glabra** L., Calif.—**H. radicata** L., Calif.—**Malacothrix saxatilis** (Nutt.)T.&G., Calif.—**Ptilocalais graciloba** Gray, Utah.—**P. macrolepis** Rydb., Utah.—**P. major** (Gray)Greene, Utah.—**P. nutans** (Geyer)Greene, Calif., Ida.—**P. tenuifolia** Osterh., Utah.—**Pyrrhopappus carolinianus** (Walt.) DC.(*Sitilias c.* Raf.), Ark., Fla., Ga., La., Miss., Mo., N.C., Okla., S.C., Tenn., Tex.—**P. grandiflorus** Nutt.(*P. scaposus* DC.), Ariz., Kans., Okla., Tex.—**P. multicaulis** DC., Tex.—**Taraxacum ceratophorum** (Ledeb.)DC.(*T. dumetorum* Greene, *Leontodon d.* Rydb.), Colo.—**T. erythrospermum** Andrz.(*L. e.* Eichw.), Calif., Ind., Me., Neb., N.D., Ohio, Utah.—**T. lyratum** (Ledeb.)DC.(*L. l.*), Alas.— **T. vulgare** (Lam.)Schr.(*T. officinale* Weber, *L. taraxacum* L.), Alas., Calif., Colo., Conn., Del., Fla., Ida., Ill., Ind., Iowa, Kans., Ky., Me., Md., Mass., Mich., Minn., Mo., Mont., Neb., N.H., N.J., N.M., N.Y., N.D., Ohio, Ore., Pa., R.I., S.D., Tenn., Utah, Va., Wash., W.Va., Wis., Wyo.; Alta., B.C., N.S., Ont., Queb., Sask.—**Uropappus lindleyi** (DC.)Nutt., Calif. **Range:**

Nova Scotia to southeastern Alaska, southward to Florida and central California; also in Mexico, Central and South America, Bermuda, Europe, Asia, Japan, Africa, Australia and New Zealand.

A cosmopolitan species, showing considerable morphologic variation, especially in the position of the pores in the urediospores. Cultures have been made in Europe, especially by Jacky (Centr. Bakt. II. **18**: 82. 1907) and Probst (same **22**: 676. 1909), which gave pycnia and uredinoid aecia by sowing of teliospores, and which brought out a high degree of specialization. It was found that the rusts on one host-genus will not infect a different host-genus, and sometimes not a different host-species in the same genus.

Puccinia harknessii.

(N. A. F. 7: 436, 437, 794, 815, 843.)

Puccinia harknessii Vize, Grev. **7**: 11. 1878.
Puccinia cladophila Peck, Bot. Gaz. **4**: 127. 1879.
Dicaeoma (?) *harknessii* Ktze., Rev. Gen. **3**[3]: 469. 1898.
Puccinia stephanomeriae Syd., Monog. Ured. **1**: 157. 1902.
Puccinia ptiloriae Bubák, Jour. Myc. **12**: 52. 1906.
Dicaeoma (?) *stephanomeriae* Arth., N. Am. Flora **7**: 437. 1921.

Pycnia caulicolous, in groups, on hypertrophied areas. Aecia caulicolous, surrounding the pycnia, uredinoid; aeciospores as in *Puccinia hieracii*. Uredia wanting; urediospores occasionally in the telia, similar to the aeciospores. Telia and teliospores as in *Puccinia hieracii*, except teliospores slightly longer, 32–45 μ, and with thicker wall, 2–3 μ.

On Cichoriaceae: **Lygodesmia spinosa** Nutt.(*Pleiacanthus s.* Rydb.), Calif., Nev., Ore.—**L. texana** (T.&G.)Greene(*L. aphylla* T.&G.), Tex.—**Malacothrix arachnoidea** McGreg., Calif.—**M. saxatilis** (Nutt.)T.&G., Calif.—**Ptiloria exigua** (Nutt.)Greene(*Stephanomeria e.*), Calif.—**P. lactucina** (Gray) Greene(*S. l.*), Calif.—**P. myrioclada** (Eaton)Greene(*S. m.*), Ida.—**P. neomexicana** Greene, N.M.—**P. paniculata** (Nutt.)Greene(*S. p.*), Ore., Wash.—**P. pauciflora** (Torr.)Raf.(*S. runcinata* Nutt.), Ariz., Mont., Wyo.—**P. ramosa** Rydb., Colo., Mont.—**P. tenuifolia** (Torr.)Raf.(*S. minor* Nutt.), Calif., Colo., Mont., Nev., Utah, Wash., Wyo. **Range:** Montana to Washington, southward to Texas and southern California.

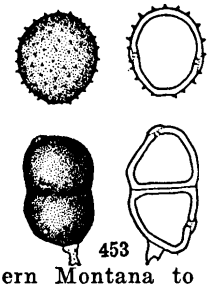
(1). **Puccinia harknessii major** n. nom.(*P. stephanomeriae* Syd.), with larger urediospores in the telia, 23–29 by 29–35 μ; thicker wall, 1.5–2.5 μ, with stronger echinulation; teliospores slightly larger, 21–29 by 35–45 μ; occurs on Cichoriaceae: **Ptiloria cichoriacea** (Gray)Greene(*Stephanomeria c.*), and **P. pleurocarpa** Greene(*S. virgata* Benth.), in southern California.

328. PUCCINIA CREPIDIS-MONTANAE. Fig. 453.

(N. A. F. 7: 439.)

(*Aecidium crepidis-montanae* Syd., Oesterr. Bot. Zeits. **51**: 29. 1901.)
Puccinia crepidis-montanae [Syd.] Magn.; Fisch., Beitr. Krypt. Schweiz **2**[2]: 212. 1904.
Dicaeoma crepidis-montanae Arth., N. Am. Flora **7**: 439. 1921.

Pycnia amphigenous, in groups. Aecia amphigenous, in groups, cupulate; aeciospores ellipsoid or oblong, 16–19 by 21–26 μ; wall nearly or quite colorless, 1 μ thick, finely verrucose. Uredia hypophyllous, cinnamon-brown; urediospores globoid or obovoid, 19–25 by 23–29 μ; wall light cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 3 or 4, nearly or quite equatorial. Telia hypophyllous, dark chocolate-brown; teliospores ellipsoid, 19–28 by 29–42 μ, rounded


453

above and below, slightly constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell apical or somewhat depressed, of the lower much depressed, minutely verrucose, often appearing smooth; pedicel colorless, short, fragile, often oblique.

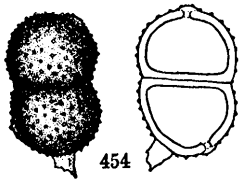
On Cichoriaceae: **Crepis barbigera** Leib., Wash.—**C. denticulata** Rydb., Colo.—**C. glauca** (Nutt.)T.&G., Utah.—**C. intermedia** Gray, Ida., Ore.—**C. occidentalis** Nutt., Mont.—**C. runcinata** (James)T.&G., Colo. **Range:** Western Montana to Washington, southward to Colorado and Utah; also in Europe.

329. PUCCINIA SUKSDORFII. Fig. 454.

(N. A. F. 7: 585, 806.)

Puccinia suksdorfii E. & E., Jour. Myc. **7:** 130. 1892.
Micropuccinia suksdorfii A. & J.; Arth., Bull. Torrey Club **48:** 41. 1921.

Pycnia amphigenous, systemic. Aecia and uredia wanting. Telia amphigenous, appearing systemic, chocolate-brown; teliospores ellipsoid, 27–39 by 35–55 μ, rounded at both ends, slightly or not constricted at septum; wall chestnut-brown, uniformly 2–3 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, coarsely verrucose; pedicel colorless, short, fragile.


454

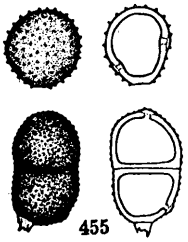
On Cichoriaceae: **Agoseris arizonica** Greene(*A. leptocarpa* Osterh.), Colo.—**A. aurantiaca** (Hook.) Greene(*A. purpurea* Greene, *Troximon a.*), Colo.—**A. cuspidata** (Pursh)Dietr. (*T. c., Nothocalais c.* Greene), Mont.—**A. elata** (Nutt.)Greene, Utah.—**A. glauca** (Nutt.)Greene(*T. g.*), Ariz., Ida., Mont., Wash., Wyo.—**A. grandiflora** (Nutt.)Greene(*T. g.* Gray), Mont. **Range:** Wyoming to Washington, southward to northern Arizona.

330. PUCCINIA ORBICULA. Fig. 455.

(N. A. F. 7: 437, 794, 843.)

Puccinia orbicula P. & C.; Peck, Ann. Rep. N. Y. State Mus. **30:** 53. 1879.
Dicaeoma orbicula Ktze., Rev. Gen. **3**[3]**:** 469. 1898.
Puccinia prenanthis-racemosae Syd., Monog. Ured. **1:** 137. 1902.

Pycnia amphigenous, in groups. Aecia hypophyllous, in groups, often associated with uredia or telia, or wanting, without evident peridia, opening by a pore; aeciospores globoid, 16–24 by 21–33 μ; wall nearly or quite colorless, 1–2 μ thick, minutely verrucose. Uredia chiefly hypophyllous, scattered, or associated with aecia or telia, or wanting, golden-brown; urediospores globoid or obovoid, 20–27 by 23–31 μ; wall light chestnut-brown, 1.5–3 μ thick, echinulate, the pores 2–5, usually scattered. Telia amphigenous, cinnamon-brown; teliospores ellipsoid, 20–30 by 30–43 μ, rounded at both ends, rarely constricted at septum; wall chestnut-brown, uniformly 1.5–2.5 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, finely verrucose; pedicel colorless, short, fragile.


455

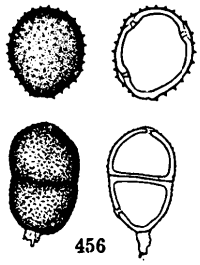
On Cichoriaceae: **Nabalus albus** (L.)Hook.(*Prenanthes a.*), Ind., Me., Mass., Mich., N.Y., Wis.—**N. altissimus** (L.)Hook.(*P. a.*), Mass., N.Y., Ohio, Pa., Vt., W.Va.; N.S.—**N. boottii** DC.(*P. b.* Gray), N.H.—**N. racemosus** (Michx.)DC.(*P. r.*), N.D.; Sask.—**N. trifoliolatus** Cass.(*P. t.* Fern.), Mass., N.Y., Pa.; Queb.—**N.** sp., Del.; Newf.; Ont. **Range:** Newfoundland to Saskatchewan, southward to West Virginia and Indiana.

331. PUCCINIA MINUSSENSIS. Fig. 456.

(N. A. F. 7: 438, 794, 843.)

(*Aecidium hemisphaericum* Peck, Bot. Gaz. **3:** 34. 1878.)
Puccinia minussensis Thüm., Bull. Soc. Nat. Mosc. **53:** 214. 1878.
Puccinia hemisphaerica E. & E., N. Am. Fungi *3144*. 1894.
Dicaeoma hemisphaericum Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia amphigenous, scattered. Aecia amphigenous, systemic, without peridia, opening by a pore; aeciospores globoid, 16–19 by 18–28 μ; wall colorless, 2–3 μ thick, finely verrucose. Uredia amphigenous, few, golden-brown; urediospores globoid or obovoid, 17–25 by 23–27 μ; wall cinnamon-brown, 1–2 μ thick, echinulate, the pores 3–6, scattered, often 4, with 2 above and 2 below the equator. Telia amphigenous, chestnut-brown; teliospores ellipsoid, 16–24 by 26–42 μ, rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly 1.5 μ thick, the pore of upper cell nearly or quite apical, of the lower much depressed, verrucose; pedicel colorless, short, fragile. Mesospores often present.


456

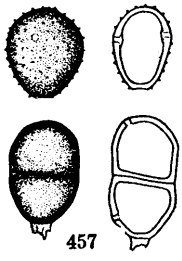
On Cichoriaceae: **Lactuca canadensis** L., N.Y.—**L. pulchella** (Pursh)DC., Calif., Colo., Ida., Kans., Mont., Neb., N.M., N.D., S.D., Utah, Wash., Wis., Wyo.; Alta., B.C., Man., Sask. **Range:** Manitoba to British Columbia, southward to northern New Mexico and northern California, and in central Wisconsin and Long Island, New York; also in northern Europe and Japan.

332. PUCCINIA CHONDRILLINA. Fig. 457.

(N. A. F. 7: 513.)

Uredo chondrillae Opiz, Seznam 151, hyponym. 1852.
Puccinia chondrillina Bubák & Syd., Oesterr. Bot. Zeits **51:** 17. 1901.
Bullaria chondrillina Arth. & Mains, N. Am. Flora **7:** 513. 1922.

Pycnia amphigenous, in groups, infrequent. Aecia amphigenous, uredinoid, grouped about the pycnia, otherwise like the uredia. Uredia amphigenous, scattered, dark cinnamon-brown; urediospores ellipsoid or obovoid, 16–23 by 23–29 μ; wall cinnamon-brown, 1–1.5 μ thick, echinulate, the pores 2, superequatorial. Telia amphigenous, chestnut-brown; teliospores ellipsoid or oblong, 19–23 by 30–39 μ, usually rounded at both ends, slightly or not constricted at septum; wall cinnamon-brown, uniformly about 1 μ thick, the pores of both cells depressed, minutely verrucose; pedicel colorless, short, fragile.


457

On Cichoriaceae: **Chondrilla juncea** L., D.C., Md., Va. **Range:** District of Columbia southward to northern Virginia; also in Europe.

17. GYMNOSPORANGIUM Hedw. f., 1805.

The genus reaches its most varied and abundant development in western North America. With only one exception the species are heteroecious. Uredia are wanting in all but one species. There are no microcyclic forms known. A characteristic feature of the genus is the more or less evident gelatinization of the pedicels of the teliospores.

The genus readily falls into two sections. In the first section the aecia closely resemble the aecidioid aecia of the genus *Puccinia,* while in the second section the aecia are more highly differentiated and belong to the form-genus *Roestelia.* In most and possibly all species there often occur both thick- and thin-walled teliospores, with intergrading forms. The thick-walled (resting) spores are darker in color, more compact, and occur more largely toward the outer surface of the gelatinous sorus, while the thin-walled (germinating) ones are paler, more slender, and occur imbedded in the sorus.

Pycnia subepidermal, more or less flask-shaped, with paraphyses. Aecia conspicuous, cylindric or cornute, dehiscent by apical or lateral rupture; aeciospores catenulate, the wall verrucose, usually deeply colored, with distinct, scattered pores. Uredia (in the one species known) without paraphyses; urediospores borne singly on pedicels, the wall verrucose, with distinct pores. Telia variously shaped, mostly flat, pulvinate, tongue-shaped, or conical, expanding greatly when moistened; teliospores chiefly 2-celled, in some species 1- 3- 4- 5- or 6-celled, not or only slightly constricted at septa, the wall smooth, with 1–several pores in each cell, the pedicel colorless, usually long, the outer portion swelling and becoming jelly-like when moistened.

Aecia aecidioid, dehiscent by apical rupture; uredia present or wanting; teliospores 2–5 celled. (§ *Gymnotelium* Syd.)
- Teliospores ellipsoid; uredia present. — 1. *G. nootkatense.*
- Teliospores linear-oblong; uredia wanting.
  - Telia foliicolous. — 2. *G. libocedri.*
  - Telia caulicolous. — 3. *G. speciosum.*
- Teliospores linear-fusiform; uredia wanting. — 4. *G. ellisii.*

Aecia roestelioid, cylindric or cornute, dehiscent by apical or lateral rupture; uredia wanting; teliospores 2-celled (2–4-celled in *G. biseptatum*). (§ *Eugymnosporangium.*)
- Teliospores 2–4-celled, or unknown; peridial cells smooth.
  - Peridial cells hypha-like. — 5. *G. biseptatum.*
  - Peridial cells lanceolate. — 6. *G. hyalinum.*
- Teliospores 2-celled; peridial cells verrucose.
  - Teliospore-pedicel carrotiform.
    - Telia arising between the scale-leaves. — 7. *G. inconspicuum.*
    - Telia arising on fusiform swellings. — 8. *G. clavipes.*
  - Teliospore-pedicel terete.
    - Teliospore-pores 5–7 in each cell. — 9. *G. multiporum.*
    - Teliospore-pores 1 or 2 in each cell.
      - Host branching abnormally, forming witches' brooms.
        - Teliospores 55–74 μ long. — 10. *G. kerneanum.*
        - Teliospores 38–55 μ long.
          - Telia on leafy-twigs only. — 11. *G. juvenescens.*
          - Telia on woody-twigs and branches. — 17. *G. nidus-avis.*
      - Host branching normally.
        - Telia small and inconspicuous, on leaves or leafy-twigs.
          - Telia pulvinate or hemispheric.

Teliospore-wall thickened at apex, 3–4 μ. — 12. *G. transformans.*
Teliospore-wall uniform.
Teliospore-pores covered by a papilla. — 13. *G. davisii.*
Teliospore-pores without papillae.
Teliospores 35–50 μ long. — 14. *G. haraeanum.*
Teliospores 31–42 μ long. — 18. *G. aurantiacum.*
Telia wedge- or tongue-shaped.
Telia truncate; teliospores 45–72 μ long. — 15. *G. harknessianum.*
Telia conic; teliospores 45–55 μ long. — *. *G. exiguum.*
Telia large and conspicuous, on leaves, twigs and branches.
Telia on fusiform swellings.
Telia pulvinate or applanate.
Galls abruptly fusiform. — 16. *G. juniperinum.*
Galls gradually fusiform.
Teliospores 38–55 μ long. — 17. *G. nidus-avis.*
Teliospores 31–42 μ long.
Teliospore-pores usually 2 in each cell. — 18. *G. aurantiacum.*
Teliospore-pores 1 in each cell. — 19. *G. exterum.*
Telia wedge-shaped, often irregular.
Teliospores oblong, rounded at ends. — 20. *G. effusum.*
Teliospores ellipsoid, narrowed at ends.
Teliospore-wall thick, 2–3 μ. — *. *G. cupressi.*
Teliospore-wall thin, 1–2 μ.
Teliospores 37–45 μ long. — 21. *G. trachysorum.*
Teliospores 57–66 μ long. — 22. *G. japonicum.*
Telia terete. — 23. *G. clavariaeforme.*
Telia on globoid gall-like excrescences.
Galls irregular, knot-like. — 24. *G. betheli.*
Galls globoid or reniform.
Telia laterally compressed.
Telia thick, wedge-shaped.
Telia regular. — 25. *G. globosum.*
Telia lacunose or ridged. — 21. *G. trachysorum.*
Telia thin, irregularly flattened.
Teliospores 39–58 μ long. — 26. *G. tubulatum.*
Teliospores 50–65 μ long. — 27. *G. nelsoni.*
Telia terete.
Teliospore-pores covered by papillae. — 28. *G. corniculans.*
Teliospore-pores without papillae.
Telia chestnut-brown. — 29. *G. floriforme.*
Telia golden-brown. — 30. *G. juniperi-virginianae.*
Telia pulvinate. — *. *G. bermudianum.*

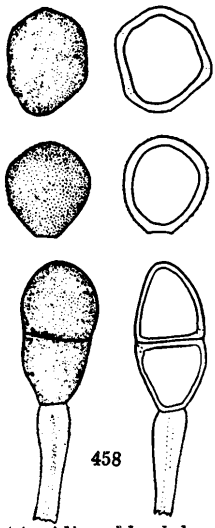
1. GYMNOSPORANGIUM NOOTKATENSE. Fig. 458.

(N. A. F. 7: 190, 735.)

Uredo nootkatensis Trel., Harriman Alaska Exp. Crypt. 36. 1904.
(*Aecidium sorbi* Arth., Bull. Torrey Club **33:** 521. 1906.)
Gymnosporangium sorbi Kern, Bull. N. Y. Bot. Gard. **7:** 438. 1911.
Gymnosporangium nootkatense (Trel.) Arth., Amer. Jour. Bot. **3:** 44. 1916.
Gymnotelium nootkatense Syd., Ann. Myc. **19:** 170. 1921.

Pycnia epiphyllous. Aecia hypophyllous, cupulate, 0.2–0.4 mm. high, the margin nearly erect, erose, the peridial cells rhomboidal, with the outer wall 10–13 μ thick, smooth, the inner 3–5 μ, verrucose; aeciospores ellipsoid, 23–27 by 27–39 μ; wall pale-yellow, 3–4 μ thick, the pores about 6, minutely verrucose.

On Malaceae (*Pomaceae*): **Malus rivularis** (Dougl.)Roem.(*Pyrus diversifclia* Bong.), Alas., Wash.; B.C.—**Pyrus betulaefolia** Bunge, Alas.—**Sorbus**



458

occidentalis (Wats.)Greene, Alas., Wash.; B.C.—**S. sitchensis** Roem., Alas., Ore., Wash.

Uredia foliicolous, bright-orange when fresh; urediospores globoid, 28–32 μ in diameter; wall pale-yellow when fresh, 3–4 μ thick, the pores 2, equatorial, finely verrucose. Telia not seen; teliospores in the uredia ellipsoid, 23–29 by 42–48 μ, rounded or narrowed above, narrowed below; wall pale lemon-yellow, uniformly 1–1.5 μ thick, with 1 pore in each cell near the septum; pedicel colorless, once to twice length of spore.

On Juniperaceae: **Chamaecyparis nootkatensis** (Lamb.)Spach, Alas., Ore., Wash.

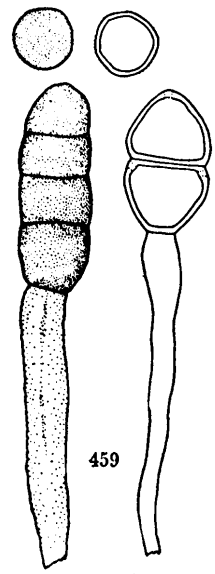
Range: Southeastern Alaska to northern Oregon.

2. **GYMNOSPORANGIUM LIBOCEDRI.** Fig. 459.

(N. A. F. 7: 190, 736.)

(*Aecidium blasdaleanum* D. & H., Erythea **3:** 77. 1895.)
Phragmidium libocedri P. Henn., Hedw. **37:** 271. 1898.
Gymnosporangium aurantiacum Syd., Ann. Myc. **2:** 28. 1904. Not. Chev. 1826.
Gymnosporangium libocedri (P. Henn.) Kern, Bull. Torrey Club **35:** 509. 1908.
Gymnosporangium blasdaleanum Kern, Bull. N. Y. Bot. Gard. **7:** 437. 1911.
Gymnotelium blasdaleanum Arth., Plant Rusts 113. 1929.

Pycnia chiefly hypophyllous. Aecia hypophyllous and fructicolous, cupulate, low, dehiscent at apex, the margin lacerate, spreading or somewhat recurved, the peridial cells rhomboidal, with the outer wall 3–4 μ thick, smooth, the inner 1.5–2 μ, verrucose; aeciospores globoid, 12–20 by 14–23 μ; wall pale-yellow, 1–1.5 μ thick, verrucose, the pores obscure.



459

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Calif., Ore.—**A. florida** Lindl.(*A. elliptica* Nels.), Ore.—**A. pallida** Greene, Calif.—**Choenomeles japonica** (Thunb.)Lindl.(*Pyrus j., Cydonia j.* Pers.), Ore.—**Crataegus douglasii** Lindl.(*C. brevispina* Dougl.), Calif., Ore.—**Cydonia vulgaris** (L.)Pers.(*P. v.*), Ore.—**Malus baccata** (L.)Desf.(*P. b.*), Ore.—**M. ioensis** (Wood)Britt.(*P. i.* Bailey), Ore.—**M. sylvestris** (L.)Mill.(*M. malus* Britt., *P. m.* L.), Ore.—**M. rivularis** (Dougl.)Roem.(*P. diversifolia* Bong.), Ore.—**Pyrus communis** L., Ore.—**Sorbus aucuparia** L., Ore.—**S. hybrida** L., Ore.

Uredia wanting. Telia foliicolous, usually causing no distortion but sometimes producing witches' brooms, pulvinate, cinnamon-brown in germinating form, deep reddish-brown in resting form; teliospores in germinating form 2–5-celled, linear-oblong, 19–30 by 35–87 μ, obtuse at both ends, in resting form 1- or 2-celled; wall in germinating form pale golden-brown, in resting form cinnamon-brown, uniformly 1–1.5 μ thick, the pores in germinating form 1 apical in upper cell, 2 near septa in other cells, in resting form 1 or 2 near the apex, or when 2-celled, 2 near the septum in the lower; pedicel about thrice length of spore, stout.

On Juniperaceae: **Libocedrus decurrens** Torr. (*Heyderia d.* Koch), Calif., Ore.

Range: Western Oregon to northern California.

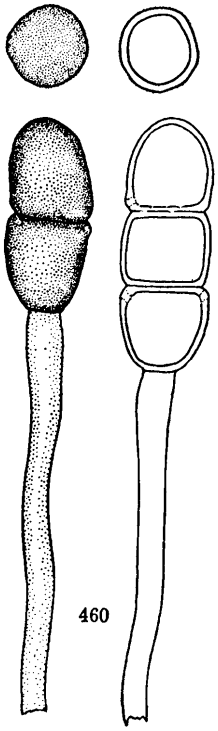
Teliospores from *Libocedrus decurrens* were sown in 1908 by Arthur (Mycol. **1:** 252. 1909) on *Crataegus pringlei,* producing pycnia and aecia, and again in 1911 (same **4:** 57. 1912) were sown on *Amelanchier vulgaris* with abundant infection, and on *Crataegus tomentosa* and *C. cerronis,* producing pycnia. In 1914 Jackson (Phytop. **4:** 266. 1914) used teliospores from *L. decurrens* and produced pycnia and aecia on *Pyrus communis,* and pycnia only on *Malus malus.* More extended cultures in the open resulted in pycnia and aecia on *Amelanchier alnifolia, Crataegus douglasii, Cydonia vulgaris, Malus rivularis* and *Pyrus communis.*

3. GYMNOSPORANGIUM SPECIOSUM. Fig. 460.

(N. A. F. 7: 200, 739, 815, 825.)

(*Aecidium gracilens* Peck, Bot. Gaz. **4:** 128. 1879.)
Gymnosporangium speciosum Peck, Bot. Gaz. **4:** 217. 1879.
(*Aecidium rusbyi* Ger., Bull. Torrey Club **8:** 34. 1881.)
Gymnosporangium gracilens Kern & Bethel; Kern, Bull. N. Y. Bot. Gard. **7:** 458. 1911.

Pycnia epiphyllous. Aecia hypophyllous, cylindric, 2–3 mm. high, dehiscent at apex, retaining tubular form, the margin lacerate, the peridial cells rhomboidal, with the outer wall 3–4 μ thick, the inner 10–15 μ, both densely verrucose with high slender warts; aeciospores globoid, 21–24 by 24–29 μ; wall pale-yellow, 2.5–3.5 μ thick, finely verrucose, the pores obscure, several.



460

On Hydrangeaceae: **Fendlera falcata** Thornb., N.M.—**F. rupicola** E.&G., Ariz., N.M.—**F. tomentella** Thornb., Colo.—**F. wrightii** Heller, Ariz.—**Philadelphus ellipticus** Rydb., N.M.—**P. microphyllus** Gray, Colo., N.M.—**P. occidentalis** Nels., Colo., Utah.

Uredia wanting. Telia caulicolous, on fusiform swellings, in more or less evident rows, cristiform, 3–4 mm. high, orange-yellow; teliospores 2- or 3-celled, ellipsoid or oblong, 20–26 by 50–80 μ, rounded at both ends; wall pale-yellow, uniformly 1 μ thick, the pores 2 in each cell near septa; pedicel very long.

On Juniperaceae: **Juniperus monosperma** (Engelm.)Sarg., Colo., N.M.—**J. pachyphlaea** Torr., Ariz., N.M.—**J. utahensis** (Engelm.)Lemm., Colo., Utah.

Range: Southwestern Colorado, southward to New Mexico and Arizona.

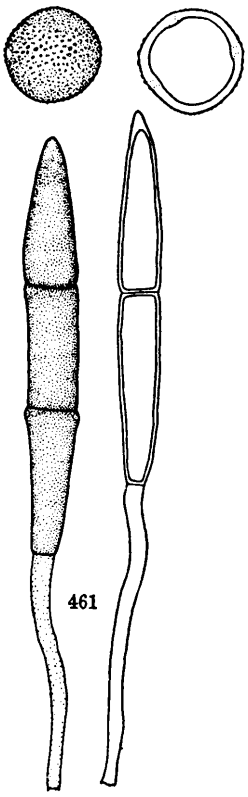
Cultures were made in 1911 by Arthur (Mycol. **4:** 63. 1912), teliospores from *Juniperus monosperma* being sown on *Philadelphus coronarius,* with production of pycnia and aecia.

4. GYMNOSPORANGIUM ELLISII. Fig. 461.

(N. A. F. 7: 203, 741.)

(*Caeoma* (*Aecidium*) *myricatum* Schw., Trans. Am. Phil. Soc. II. **4:** 294. 1832.)
(*Aecidium myricatum* Schw., Trans. Am. Phil. Soc. II. **4:** 309. 1832.)
Podisoma ellisii Berk., Grev. **3:** 56. 1874.

Hamaspora ellisii Körn., Hedw. **16:** 23. 1877.
Gymnosporangium ellisii (Berk.) Farl.; Ellis, N. Am. Fungi *271.* 1879.
Phragmidium ellisii De-T., in Sacc., Syll. Fung. **7:** 750. 1888.
Gymnosporangium myricatum Fromme, Mycol. **6:** 229. 1914.
Gymnotelium myricatum Arth., Plant Rusts 113. 1929.



461

Pycnia epiphyllous. Aecia hypophyllous, and on fruits and stems, cupulate, becoming lacerate to base, slightly recurved, the peridial cells oblong with the outer wall 7–10 μ thick, smooth, the inner 2–3 μ, prominently verrucose; aeciospores globoid, 24–30 by 27–34 μ; wall nearly or quite colorless, 2–3 μ thick, strongly verrucose, the pores 6–8.

On Myricaceae: **Comptonia peregrina** (L.)Coult. (*C. asplenifolia* Gaertn., *Myrica a.* L.), N.J.—**Myrica carolinensis** Mill., Conn., Mass., N.J., N.Y.—**M. cerifera** L., Del., N.J., N.Y.

Uredia wanting. Telia caulicolous, often causing dense fasciation, cylindric, 3–6 mm. high, orange-colored when fresh; teliospores linear-fusiform, 9–16 by 85–170 μ, 2–5-celled; wall pale-yellow, uniformly 1 μ thick, the pore of uppermost cell 1, apical, of the other cells 2 each near septum; pedicel very long.

On Juniperaceae: **Chamaecyparis thyoides** (L.) B.S.P.(*Cupressus t.*), Ala., Conn., Del., Fla., Mass., N.J.

Range: Massachusetts, southward to Florida and Alabama.

The connection of aecia and telia was established in 1914 by field observations by Fromme (Mycol. **6:** 226. 1914), and cultures by Arthur (same **7:** 86. 1915), using teliospores sown on *Myrica cerifera.* Dodge (Brooklyn Bot. Gard. Mem. **1:** 131. 1918) infected *C. thyoides* with aeciospores from *Myrica.*

5. GYMNOSPORANGIUM BISEPTATUM. Fig. 462.

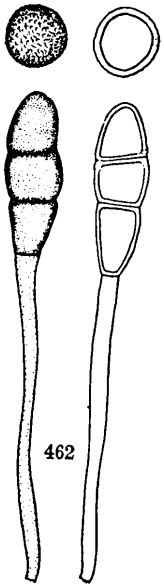
(N. A. F. 7: 195, 739, 825.)

(*Caeoma* (*Roestelia*) *botryapites* Schw., Trans. Am. Phil. Soc. II. **4:** 294. 1832.)
Gymnosporangium biseptatum Ellis, Bull. Torrey Club **5:** 46. 1874.
(*Roestelia ellisii* Peck, Bull. Torrey Club **6:** 13. 1875.)
Gymnosporangium botryapites Kern, Bull. Torrey Club **35:** 506. 1908.

Pycnia epiphyllous. Aecia hypophyllous, in small groups on gall-like swellings, cylindric, 2–4 mm. high, becoming finely cancellate at sides but not dehiscent at apex, the peridial cells very long and narrow, hypha-like, remaining straight when wet, all walls uniformly 1.5–2 μ thick, smooth; aeciospores globoid, 15–17 by 16–22 μ; wall dark cinnamon-brown, 2.5–3 μ thick, verrucose, the pores 5–8, obscure.

On Malaceae (*Pomaceae*): **Amelanchier canadensis** (L.)Medic.(*A. botryapium* DC.), Conn., Mass., N.J., N.Y., Pa.—**A. intermedia** Spach(*A. botryapium* Hook., not DC.), Mass., N.J.

Uredia wanting. Telia caulicolous, on fusiform swellings, hemispheric, 3–5 mm. high, or foliicolous, pulvinate, chestnut-brown when mature; telio-


462

spores 2–6-celled, oblong or cylindric, 13–19 by 35–77 μ, usually rounded above and slightly narrowed below; wall pale-yellow, 1–1.5 μ thick, the pores 2 in each cell near septa; pedicel very long.

On Juniperaceae: **Chamaecyparis thyoides** (L.)B.S.P. (*Cupressus t.*), Ala., Conn., Del., Mass., N.J., R.I.

Range: Along the Atlantic coast from Massachusetts to New Jersey, and in southern Alabama.

The first cultures were made in 1886 by Thaxter (Bot. Gaz. **11:** 236. 1886; Proc. Am. Acad. **22:** 263. 1887) by using teliospores sown on *Amelanchier canadensis*, giving pycnia and aecia. Cultures in 1908 by Arthur (Mycol. **1:** 240. 1909) using teliospores on *A. intermedia* gave abundant pycnia without maturing aecia. In 1916 Dodge (Bull. Torrey Club **45:** 297. 1916) infected *Amelanchier canadensis* with teliospores from single sori on leaves of *C. thyoides*. The foliicolous form of the species can not be distinguished from *G. transformans* with certainty, except by cultures.

6. GYMNOSPORANGIUM HYALINUM. Fig. 463.

(N. A. F. 7: 206, 826.)

(*Roestelia hyalina* Cooke, Bull. Soc. Bot. Fr. **24:** 315. 1877.)
Gymnosporangium hyalinum [Cooke] Kern, Bull. N. Y. Bot. Gard. **7:** 470. 1911.

Pycnia epiphyllous. Aecia hypophyllous, on small gall-like pyriform protuberances, consolidated at the bases, cylindric, 2–5 mm. high, tardily rupturing along the sides, somewhat distorted but not recurved, the peridial cells lanceolate in face view, remaining straight when wet, with the outer wall 12–16 μ thick, the inner and side walls 3–4 μ, smooth throughout; aeciospores globoid, 19–26 μ in diameter; wall light cinnamon-brown, 2–3 μ thick, finely verrucose, the pores 6–8.


463

On Malaceae (*Pomaceae*): **Crataegus clara** Beadle, Fla.—**C. dispar** Beadle, S.C.—**C. egens** Beadle, Fla.—**C. egregia** Beadle, Fla.—**C. michauxii** Pers., S.C.—**C. munda** Beadle, N.C.—**C. pexa** Beadle, N.C.—**C. quasita** Beadle, Fla.—**C. viridis** L., N.C., S.C.—**C. visenda** Beadle, Fla.

Uredia wanting. Telia unknown.

Range: Atlantic coast from North Carolina southward to northern Florida.

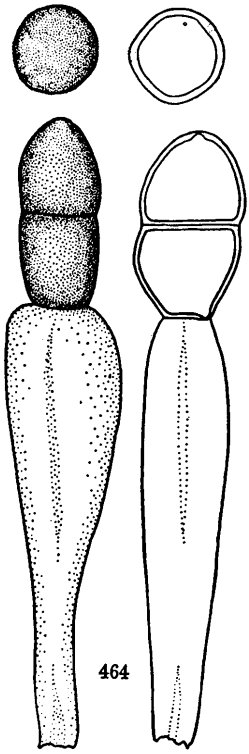
7. GYMNOSPORANGIUM INCONSPICUUM. Fig. 464.

(N. A. F. 7: 191, 737, 814, 824.)

Gymnosporangium inconspicuum Kern, Bull. Torrey Club **34:** 461. 1907.
(*Roestelia harknessianoides* Kern, Bull. Torrey Club **34:** 463. 1907.)

Pycnia chiefly on fruits. Aecia chiefly on fruits, scattered or crowded over entire surface, cylindric, rupturing at apex, remaining tubular, the peridial cells polygonal-oblong, remaining straight when wet, the outer wall 5–8 μ thick, smooth, the inner 27–35 μ, verrucose, with side walls similarly verrucose on inner third; aeciospores globoid, 23–27 by 25–31 μ; wall pale-yellow, 2–2.5 μ thick, finely verrucose, the pores indistinct.

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Colo., Utah.—**A. bakeri** Greene, Ariz., Colo., N.M.—**A. oreophila** Nels., Colo.—**A. prunifolia**



464

Greene, Utah.—**A. utahensis** Koehne, Utah.—**Peraphyllum ramosissimum** Nutt., Colo.

Uredia wanting. Telia caulicolous, arising between the scale-like leaves on green twigs, or less often from the woody twigs, pulvinate, 0.5–1 mm. high, reddish-brown; teliospores oblong-ellipsoid, 25–29 by 55–80 μ, usually rounded or obtuse at both ends; wall golden-yellow, uniformly 1 μ thick, the pores 1 in each cell, apical in upper cell, near pedicel in lower cell; pedicel carrotiform, swelling greatly near spore, very long.

On Juniperaceae: **Juniperus utahensis** (Engelm.)Lemm., Colo., Utah.

Range: Western Colorado to Utah, southward to New Mexico and Arizona.

Teliospores from *Juniperus utahensis* were sown in 1907 by Arthur (Jour. Myc. **14:** 24. 1908) on leaves of *Amelanchier canadensis* without infection, but on fruits of *A. erecta* with abundant infection, and again in 1911 (Mycol. **4:** 57. 1912) on leaves of *A. erecta* and *A. vulgaris* with only pycnia showing on the latter.

8. GYMNOSPORANGIUM CLAVIPES. Fig. 465.

(N. A. F. 7: 197, 739, 825.)

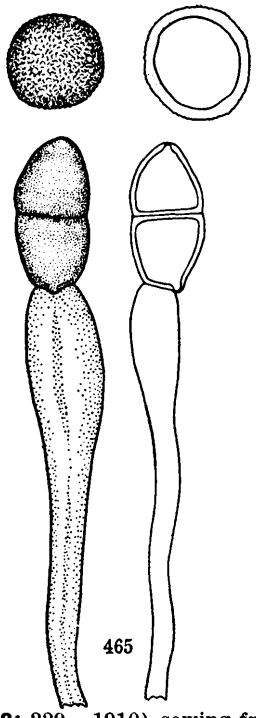
(*Caeoma* (*Peridermium*) *germinale* Schw., Trans. Am. Phil. Soc. II. **4:** 294. 1832.)
Podisoma gymnosporangium clavipes C. & P.; Cooke, Jour. Quek. Club **2:** 267. 1871.
Gymnosporangium clavipes C. & P.; Peck, Ann. Rep. N. Y. State Mus. **25:** 89. 1873.
(*Roestelia aurantiaca* Peck, Bull. Buffalo Soc. Nat. Sci. **1:** 68. 1873.)
Gymnosporangium germinale Kern, Bull. Torrey Club **35:** 506. 1908.

Pycnia chiefly on fruits. Aecia crowded on fruits and stems, cylindric, soon becoming lacerate to base, the white peridial cells polygonal-oblong in face view, rhomboidal in side view, remaining straight when wet, the outer wall 3–5 μ thick, smooth, the inner 13–23 μ, coarsely verrucose, the side walls similarly verrucose on inner half; aeciospores globoid, 21–32 by 24–39 μ; wall pale-yellow, 3–4.5 μ thick, coarsely verrucose, the pores 6–10, obscure.

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Mont., Wyo.; B.C., Man.—**A. canadensis** (L.)Medic.(*A. botryapium* DC.), Conn., Ind., Me., Mass., Mich., N.Y.; Newf.; N.S., Ont., Queb.—**A. erecta** Blanch., Mich.—**A. intermedia** Spach(*A. botryapium* Hook., not DC.), Me., Mass., Mich., N.J., N.Y.; N.B.—**A. oblongifolia** (T.&G.)Roem., Me., Mass., Mich., Wis.—**A. oligocarpa** (Michx.)Roem., Queb.—**A. sanguinea** (Pursh)DC.(*A. rotundifolia* Roem.), Me.; Ont.—**A. spicata** (Lam.)Koch, Mich.—**Aronia arbutifolia** (L.) Ell.(*Pyrus a.*), Me., Mass.; N.B.—**A. atropurpurea** Britt., Me.—**A. melanocarpa** (Michx.)Ell.(*A. nigra* Britt.), Me.; Ont.—**A. monstrosa** Zabel, Me.—**Choenomeles japonica** (Thunb.)Lindl.(*Pyrus j., Cydonia j.* Pers.), N.J.—**Crataegus chrysocarpa** Ashe(*C. sheridana* Nels.), Wyo.—**C. coccinea** L.(*C. modesta* Sarg.), Me., Mass., Miss., Pa.—**C. colonica** Beadle, S.C.—**C. crus-galli** L., Conn., Ga., Ky., Mass., Miss., N.C., Ohio, Pa., Tex., Va.—**C. dispar** Beadle, S.C.—**C. douglasii** Lindl.(*C. brevispina* Dougl.), Mont.—**C. flava** Ait., Ala.,

Fla., S.C.—**C. holmesiana** Ashe(*C. tenuifolia* Britt.), Me., Mass.—**C. jonesae** Sarg., Me.—**C. mollis** (T.&G.)Scheele, Ark., Ill., Ind., Mich.—**C. phaenopyrum** (L.f.)Medic.(*C. cordata* Ait.), Tenn.—**C. punctata** Jacq., Ind., Mich., Mo., N.Y., N.C., W.Va.; Ont.—**C. reverchoni** Sarg., Tex.—**C. rotundifolia** Moench, Me., N.Y.—**C. spathulata** Michx., Ala., Ga., N.C., S.C., Tenn., Va.—**C. unifolia** Moench(*C. parvifolia* Ait.), N.J.—**Cydonia vulgaris** (L.)Pers.(*Pyrus v.*), Ala., Conn., Del., Ind., Me., Md., Mass., Mich., Miss., N.Y., Vt.—**Malus sylvestris** Mill.(*M. malus* Britt., *Pyrus m.* L.), Conn., Mass., Neb., N.Y.—**Pyrus sinensis** Lindl.(*P. japonica* Auth., not Thunb.), Ark.

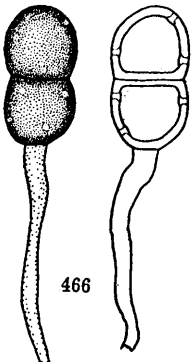
Uredia wanting. Telia caulicolous, on small fusiform swellings, hemispheric, 1–3 mm. high, orange-brown; teliospores ellipsoid, 18–26 by 35–51 μ, rounded or obtuse at both ends; wall yellowish, 1–2 μ thick, or slightly thicker at apex, the pores 1 in each cell, apical in upper cell, near pedicel in the lower; pedicel carrotiform, very long.



On Juniperaceae: **Juniperus communis** L., Me., Mass., Mich.; Man.—**J. sibirica** Burgsd.(*J. nana* Willd., *J. communis depressa* Pursh), Ill., Me., Mich., Mont., N.Y., Wis., Wyo.—**J. virginiana** L., Ala., Ark., Conn., Del., D.C., Fla., Ind., Iowa, Ky., La., Md., Mass., Miss., Mo., N.J., N.Y., N.C., Ohio, Pa., S.C., Tenn., Tex., Va., W.Va.; Ont.

Range: Newfoundland to British Columbia, southward east of the Rocky Mountains to northern Florida and Texas; also in Mexico.

The first cultures were made in 1883 by Farlow (Proc. Am. Acad. **20:** 313. 1885), using teliospores from *Juniperus virginiana* on leaves of *Amelanchier canadensis, Aronia arbutifolia* and *Malus malus*, producing pycnia but no mature aecia. Similar cultures were made in 1886 by Thaxter (Bot. Gaz. **11:** 236. 1886), producing pycnia on *M. malus*, and both pycnia and aecia on *A. canadensis*, especially on stems and midribs. In 1907 teliospores from *J. sibirica* were sown by Arthur (Jour. Myc. **14:** 18. 1908) on leaves of *A. intermedia* and fruit of *A. erecta*, producing pycnia only. Teliospores from *J. virginiana* were also sown in 1908 (Mycol. **1:** 239. 1909) on *Crataegus* sp., giving pycnia and aecia. Again in 1909 (same **2:** 229. 1910) sowing from *J. sibirica* on fruit of *A. erecta* gave pycnia and aecia, and on leaves of *C. punctata* gave pycnia only. Finally sowings from *J. sibirica* on *A. erecta* and *C. tomentosa* in 1910 (same **4:** 24. 1912) gave both pycnia and aecia. The aeciospores from *A. erecta* were then sown in June on *J. sibirica* and gave fully developed telia the following May.



9. GYMNOSPORANGIUM MULTIPORUM. Fig. 466.

(N. A. F. 7: 192, 814, 824.)

Gymnosporangium multiporum Kern, Mycol. **1:** 210. 1909.

Pycnia and aecia unknown. Uredia wanting. Telia caulicolous, arising between the scale-like leaves on the green branches, chestnut-brown; teliospores oblong or ellipsoid, 20–24 by 45–51 μ, rounded at both ends; wall light cinnamon-

brown, uniformly 1.5–2.5 μ thick, the pores 5–7 in each cell, evident, scattered; pedicel slender, very long.

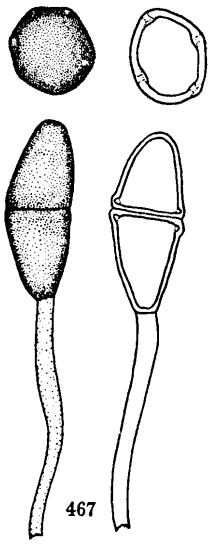
On Juniperaceae: **Juniperus occidentalis** Hook., Calif.—**J. monosperma** (Engelm.)Sarg., Colo., N.M.—**J. utahensis** (Engelm.) Lemm., Colo. **Range:** Southern Colorado, northern New Mexico and Central California.

10. GYMNOSPORANGIUM KERNIANUM. Fig. 467.

(N. A. F. 7: 194, 738, 825.)

Gymnosporangium kernianum Bethel, Mycol. **3:** 157. 1911.

Pycnia epiphyllous. Aecia hypophyllous, inconspicuous, cylindric, 2–2.5 mm. high, rupturing at apex, somewhat lacerate, the peridial cells oblong in side view, considerably overlapping and articulate, the outer wall 2–2.5 μ thick, smooth, the inner 9–12 μ, faintly rugose; aeciospores globoid, 21–26 by 26–32 μ; wall cinnamon-brown, 2.5–3.5 μ thick, minutely verrucose, with 8–10 prominent pores.



467

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Ore.—**A. oreophila** Nels., Ariz., Colo.—**Pyrus communis** L., Ariz.

Uredia wanting. Telia caulicolous, arising between the scale-like (not subulate) leaves, causing globose witches' brooms, hemispheric, dark reddish-brown; teliospores sometimes 3-celled, oblong, 21–26 by 55–74 μ, narrowed or rounded at both ends; wall yellowish, 1 μ thick, the pores usually 2 in each cell, near septum; pedicel very long.

On Juniperaceae: **Juniperus occidentalis** Hook., Calif., Ore.—**J. pachyphlaea** Torr., Ariz., N.M.—**J. utahensis** (Engelm.)Lemm., Colo., Ida., Nev.

Range: Idaho and Oregon, southward to New Mexico and Arizona.

Cultures were made in 1911 by Arthur (Mycol. **4:** 62. 1912) using teliospores from *J. utahensis* sown on *Amelanchier vulgaris*. Pycnia were produced, but no aecia matured.

11. GYMNOSPORANGIUM JUVENESCENS. Fig. 468.

(N. A. F. 7: 193, 738, 824.)

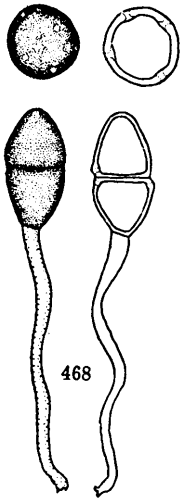
Gymnosporangium juvenescens Kern, Bull. N. Y. Bot. Gard. **7:** 448. 1911.

Pycnia epiphyllous. Aecia chiefly hypophyllous, cylindric, rupturing by lateral slits, tardily dehiscent at apex, the peridial cells lanceolate-oblong in face view, remaining straight when wet, the outer wall 1–1.5 μ thick, smooth, the inner 5–7 μ, finely verrucose-rugose, as also are the side walls; aeciospores globoid, 18–26 by 21–30 μ; wall chestnut-brown, 2–3 μ thick, finely verrucose, the pores 8–10.

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Colo., Ida., Mont., Neb., N.D., Ore., S.D., Utah, Wash., Wyo.; Alta., Sask.—**A. bakeri** Greene, Utah.—**A. canadensis** (L.)Medic.(*A. botryapium* DC.), Wis.—**A. flor-**

ida Lindl.(*A. elliptica* Nels.), Utah, Wyo.; B.C.—**A. humilis** Wieg., S.D.—**A. jonesiana** Schneid., Utah.—**A. mormonica** Schneid., Ariz., N.M.—**A. oreophila** Nels., Colo., Ida.—**A. polycarpa** Greene, Colo., Utah, Wyo.—**A. pumila** Nutt., Colo.; Alta.—**A. spicata** (Lam.)Koch, Wis.

Uredia wanting. Telia caulicolous, often forming witches' brooms, with leaves of affected shoots usually subulate, hemispheric, 1–1.5 mm. high, cinnamon-brown; teliospores ellipsoid, 18–26 by 39–52 μ, rounded at both ends; wall pale cinnamon-brown, uniformly 1–2 μ thick, the pores 2 in each cell near septum or only 1 in upper cell and apical, usually with a papilla over the pores; pedicel very long.



468

On Juniperaceae: **Juniperus horizontalis** Moench(*J. prostrata* Pers.), Mont., N.D., Wis., Wyo.; Sask.—**J. scopulorum** Sarg., Ariz., Colo., Ida., Mont., N.M., Ore., S.D., Utah, Wyo.—**J. virginiana** L., Neb., Wis.

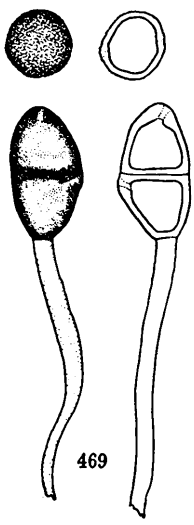
Range: Wisconsin to British Columbia, southward to New Mexico and Arizona.

Cultures were made in 1906, 1907, 1908 and 1910 by Arthur (Jour. Myc. **13:** 203. 1907; same **14:** 18. 1908; Mycol. **1:** 239. 1909; same **4:** 26. 1912), all erroneously reported as *G. nelsoni*, using teliospores from *J. scopulorum* sown on *Amelanchier canadensis* and related species and on *Sorbus americana*, giving in most instances abundant pycnia and aecia. Teliospores from *J. horizontalis* were also sown by Fraser (Mycol. **17:** 84. 1925) on *Amelanchier alnifolia*, producing pycnia and aecia.

12. GYMNOSPORANGIUM TRANSFORMANS. Fig. 469.

(N. A. F. **7:** 191, 202, 736, 740, 825.)

(*Roestelia transformans* Ellis; Peck, Bull. Torrey Club **5:** 3. 1874.)
Gymnosporangium fraternum Kern, Bull. N. Y. Bot. Gard. **7:** 439. 1911.
Gymnosporangium transformans [Ellis] Kern, Bull. N. Y. Bot. Gard. **7:** 463. 1911.



469

Pycnia epiphyllous and fructicolous. Aecia hypophyllous, and on stems and fruit, on gall-like, frustrum-shaped protuberances, at first cylindric, 2–2.5 mm. high, becoming finely fimbriate to base, partially dropping away, the remainder spreading and twisted, the peridial cells long and narrow, becoming curved or coiled when wet, the outer wall 2–3 μ thick, smooth, the inner 4–6 μ, coarsely verrucose, the side walls smooth on outer half, verrucose on inner half; aeciospores globoid, 18–22 μ in diameter; wall cinnamon-brown, 1.5–2.5 μ thick, finely verrucose, the pores 6–8, obscure.

On Malaceae (*Pomaceae*): **Aronia arbutifolia** (L.) Ell.(*Pyrus a.*), Del., Mass., N. J.

Uredia wanting. Telia foliicolous, pulvinate, chestnut-brown; teliospores ellipsoid, 16–24 by 39–48 μ, rounded or somewhat narrowed above, narrowed below; wall cinnamon-brown or darker, 1.5–2.5 μ thick at sides, 3.5 μ above, the pores in upper cell 1 apical or 1 apical and 1 at septum, in lower 1 or 2 at septum; pedicel long.

On Juniperaceae: **Chamaecyparis thyoides** (L.)B.S.P.(*Cupressus t.*), Mass., N.J.

Range: Small area on Atlantic coast from Massachusetts to New Jersey.

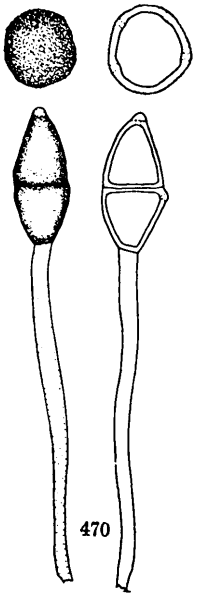
In 1914 and 1915 reciprocal cultures were made by Dodge (Torreya **15:** 133. 1915; Bull. Torrey Club **42:** 519. 1915), with mixed material, but in 1916 (Bull. Torrey Club **45:** 296. 1918) pure cultures were made by taking teliospores from single foliicolous sori on *C. thyoides*, and infection was obtained on *A. arbutifolia*. The reverse cultures were then tried with success.

13. GYMNOSPORANGIUM DAVISII. Fig. 470.

(N. A. F. 7: 193, 737, 824.)

Gymnosporangium davisii Kern, Bull. Torrey Club **35:** 507. 1908.

Pycnia epiphyllous. Aecia hypophyllous, on hypertrophied spots, cylindric, the apex acute and tardily dehiscent, finally lacerate at sides, the peridial cells lanceolate in face view, rhomboidal in side view, remaining straight when wet, the outer wall 1.5–2 μ thick, smooth, the inner 5–8 μ, rugose with closely set narrow ridges of varying length; aeciospores globoid, 19–25 by 23–27 μ; wall dark cinnamon-brown, 1.5–2 μ thick, finely verrucose, the pores 8–10.



470

On Malaceae (*Pomaceae*): **Aronia arbutifolia** (L.) Ell.(*Pyrus a.*), Me.—**A. atropurpurea** Britt., Me.—**A. melanocarpa** (Michx.)Ell.(*A. nigra* Britt.), Me., Mich., N.H., Wis.

Uredia wanting. Telia chiefly epiphyllous, occasionally on small stems at base of leaves, hemispheric or oblong, 0.5–1 mm. high, light chocolate-brown; teliospores ellipsoid, 18–28 by 40–55 μ, usually attenuate at both ends; wall cinnamon-brown, uniformly 1–1.5 μ thick, the pores 1 or 2 in each cell near septum, or apical in upper cell, covered with large papillae; pedicel moderately long.

On Juniperaceae: **Juniperus sibirica** Burgsd.(*J. nana* Wild., *J. communis depressa* Pursh), Me., Wis.

Range: Maine to Wisconsin.

Teliospores from *Juniperus sibirica* were sown in 1908 by Arthur (Mycol. **1:** 241. 1909) on *Aronia nigra* with abundant success, and later on same host showing only pycnia. Similar sowings were made in 1910 (same **4:** 25. 1912) on *A. nigra* and *A. arbutifolia* resulting only in production of pycnia.

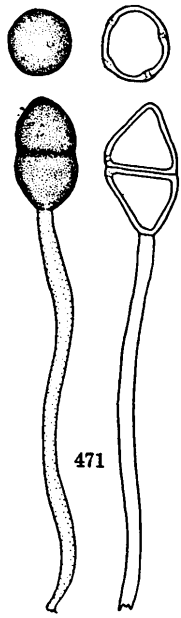
14. GYMNOSPORANGIUM HARAEANUM. Fig. 471.

(N. A. F. 7: 737.)

(*Roestelia koreaensis* P. Henn., in Warb., Monsunia **1:** 5. 1899.)
Gymnosporangium asiaticum Miyabe, Bot. Mag. Tokyo **17:** 34, hyponym. 1903.
Gymnosporangium haraeanum Syd., Ann. Myc. **10:** 405. 1912.
Gymnosporangium chinense Long, Jour. Agric. Res. **1:** 353. 1914.
Gymnosporangium koreaense Jacks., Jour. Agric. Res. **5:** 1006. 1916.

Pycnia epiphyllous. Aecia hypophyllous, cylindric, 2–3 mm. high, soon lacerate and cancellate, erect or somewhat spreading, the peridial cells broadly lanceolate, or rounded at ends, the outer wall 1.5–2 μ thick, the inner 5–7 μ,

the side walls coarsely rugose with ridges extending entirely across; aeciospores globoid, 18–23 μ in diameter; wall pale cinnamon-brown, 1.5–2 μ thick, verrucose, the pores 6–10.



471

On Malaceae (*Pomaceae*): **Pyrus sinensis** Lindl.(P. *japonica* Auth., not Thunb.), Calif., Ore.

Uredia wanting. Telia foliicolous, pulvinate, forming gelatinous masses, becoming dark-brown; teliospores ellipsoid, 16–23 by 35–50 μ, rounded or narrowed at both ends; wall cinnamon-brown, uniformly 1.5–2 μ thick, the pores 2 in each cell near septum, or one of the pores in upper cell near apex; pedicel moderately long.

On Juniperaceae: **Juniperus chinensis** L., Conn., Ore., Wash.

Range: Sporadic on Atlantic and Pacific coasts on plants cultivated for ornament; also in Japan and eastern Asia.

Cultures were made in 1897 and 1898 by Shirai (Zeits. Pflanzenkr. **10:** 3. 1900) with teliospores from *J. chinensis* sown on *Pyrus sinensis*, giving pycnia and aecia. Miyabe and Yamada (Bot. Mag. Tokyo **17:** 34. 1903) also made successful cultures both on *P. sinensis* and *Cydonia vulgaris*, as did Hara (Bot. Mag. Tokyo **27:** 348. 1913) on the former. In America in 1915 Jackson (Jour. Agric. Res. **5:** 1005. 1916) used teliospores from *J. chinensis* sown on *P. sinensis* and *C. vulgaris*, both giving abundant pycnia and aecia.

15. GYMNOSPORANGIUM HARKNESSIANUM.

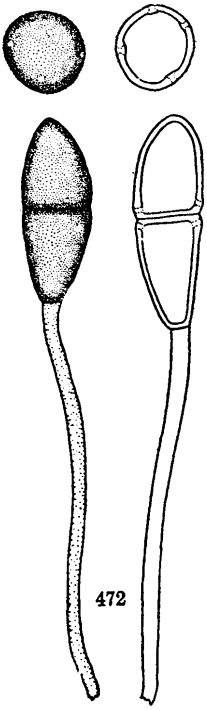
Fig. 472.

(N. A. F. 7: 192, 737, 814, 824.)

(*Aecidium harknessianum* Farl., Bibl. Index **1:** 53, hyponym. 1905.)

(*Roestelia harknessiana* E. & E.; Kern, Bull. Torrey Club **34:** 462. 1907.)

Gymnosporangium harknessianum [E. & E.] Kern, Bull. N. Y. Bot. Gard. **7:** 441. 1911.



472

Pycnia not seen. Aecia chiefly on fruits, usually over the entire surface, cylindric, 4–7 mm. high, dehiscent at apex, remaining tubular, the peridial cells polygonal-oblong, remaining straight when wet, the outer wall 4–6 μ thick, smooth, the inner 15–20 μ, verrucose, the sides similarly verrucose; aeciospores globoid, 22–26 by 26–30 μ; wall cinnamon-brown, 2–2.5 μ thick, finely verrucose, the pores 6–8.

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Calif., Ore.

Uredia wanting. Telia foliicolous, truncate, 1–1.5 mm. high, chestnut-brown; teliospores ellipsoid, 16–22 by 45–72 μ, rounded or obtuse at both ends; wall cinnamon-brown, uniformly 1.5 μ thick, the pores 2 in each cell near septum; pedicel moderately long.

ON JUNIPERACEAE: **Juniperus occidentalis** Hook., Calif., Ore.

Range: Central Oregon to northern California.

A culture was made in 1920 by Bethel but not published, teliospores from *J. occidentalis* being sown on *Amelanchier* sp. Data are in the Arthur herbarium.

*. **Gymnosporangium exiguum** Kern, with pycnia and aecia epiphyllous and fructicolous, the latter cylindric, 2–3 mm. high, rupturing at apex, remaining cylindric, the peridial cells lanceolate or oblong, remaining straight when wet, the outer wall 3 μ thick, closely spinulose, the inner 9–14 μ, more strongly spinulose, aeciospores globoid or ellipsoid, 22–25 by 26–31 μ, wall cinnamon-brown, 2–3 μ thick, finely verrucose, with 6–8 distinct pores; on MALACEAE (*Pomaceae*): **Crataegus tracyi** Ashe, in southern Texas; uredia wanting; telia foliicolous, tongue-shaped or conical, 1–1.5 mm. high, chestnut-brown, teliospores ellipsoid, 18–23 by 45–55 μ, wall cinnamon-brown, uniformly 1.5 μ thick, with 2 pores in each cell near septum, pedicel moderately long; occurs on JUNIPERACEAE: **Juniperus mexicana** Spreng., **J. pachyphlaea** Torr., and **J. virginiana** L., in southern Texas. (N. A. F. **7:** 192.)

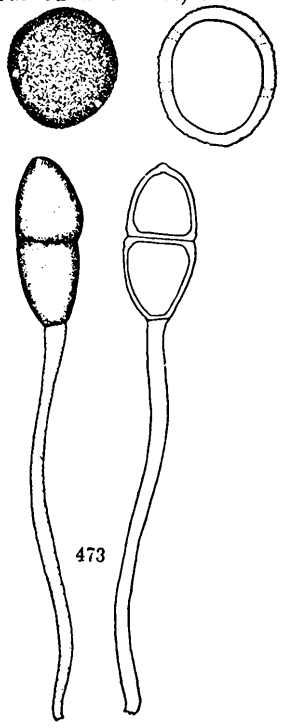
A culture was made in 1909 by Arthur (Mycol. **2:** 234. 1910) by sowing teliospores from *Juniperus virginiana* on *Crataegus pringlei*, producing pycnia and aecia.

16. GYMNOSPORANGIUM JUNIPERINUM. Fig. 473.

(N. A. F. 7: 199, 739, 825.)

Tremella juniperina L., Sp. Pl. 1157. 1753; Pers., Syn. Fung. 625. 1801.
(*Aecidium penicillatum* Pers., in J. F. Gmel., Syst. Nat. **2:** 1472. 1791.)
Gymnosporangium juniperinum (L.) Mart., Fl. Crypt. Erlang. 333. 1817.
(*Roestelia penicillata* Fries, Summa Veg. Scand. 510. 1849.)
Podisoma tremelloides A. Br., Bot. Zeit. **25:** 94. 1867.
Gymnosporangium tremelloides Hartig, Lehr. Baumkr. 133. 1882.

Pycnia epiphyllous. Aecia hypophyllous, cylindric, soon finely fimbriate to base, somewhat twisted, the peridial cells rhomboidal, becoming somewhat curved when wet, the outer wall 2–3 μ thick, smooth, the inner 7–10 μ, rugose, the side walls with ridges running almost across and roundish or elongate warts interspersed; aeciospores globoid, 28–35 by 30–45 μ; wall chestnut-brown, 3–5 μ thick, finely verrucose, the pores 10–14.



473

ON MALACEAE (*Pomaceae*): **Sorbus occidentalis** (Wats.)Greene, Ore., Wash.; Alta., B.C.—**S. scopulina** Greene (*S. sambucifolia* Gray, not C.&S.), Colo., Mont., Utah, Wash., Wyo.; B.C.—**S. sitchensis** Roem., Alas., Wash., Wyo.; B.C.

Uredia wanting. Telia caulicolous, causing enlargement of larger branches or globoid galls on smaller ones, becoming patelliform or covering the whole hypertrophied area, chocolate-brown; teliospores ellipsoid, 18–28 by 42–61 μ, obtuse at both ends; wall cinnamon-brown, uniformly 1–1.5 μ thick, the pores in lower cell 2 near septum, in the upper usually 3, 1 apical and 2 near septum; pedicel very long.

ON JUNIPERACEAE: **Juniperus sibirica** Burgsd. (*J. nana* Willd., *J. communis depressa* Pursh), Colo., Ore., Utah, Wash., Wyo.; Alta.

Range: Southeastern Alaska, southeastward to Colorado and Utah; also in Europe.

The first cultures were made about 1882 by Hartig(Lehr. Baumkr. 133. 1882), and were followed by Rostrup (1888), Nawaschin (1888), Ed. Fischer (1898, 1910), and Klebahn (1907). The only culture with American material was in 1911 by Arthur (Mycol. **4**: 57. 1912), sowing teliospores from *J. sibirica* on *Sorbus americana*, producing pycnia, without maturing aecia.

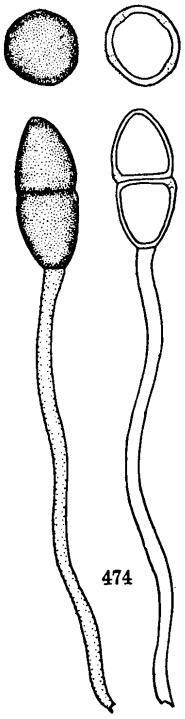
The name most commonly used by European writers is *G. tremelloides*, while *G. juniperinum* is applied by them to another species (see *G. aurantiacum*, page 370).

17. GYMNOSPORANGIUM NIDUS-AVIS. Fig. 474.

(N. A. F. 7: 196, 739, 825.)

Gymnosporangium conicum Farl., Gymnosp. U. S. 23. 1880. Not *G. conicum* Hedw. f., 1805.
Gymnosporangium nidus-avis Thaxt., Bull. Conn. Exp. Sta. **107**: 3. 1891.
(*Roestelia nidus-avis* Thaxt., Bull. Conn. Exp. Sta. **107**: 5. 1891.)

Pycnia epiphyllous and on fruits. Aecia amphigenous, more often on fruits and stems, cylindric, 2–4 mm. high, soon becoming irregularly lacerate, the peridial cells lanceolate in face view, linear in side view, remaining straight when wet, the outer wall 1–1.5 μ thick, smooth, the inner and side walls 5–7 μ, coarsely rugose with short ridges interspersed; aeciospores globoid, 18–23 by 23–28 μ; wall cinnamon-brown, 2.5–4 μ thick, very finely verrucose, with 8–10 pores.


474

On Malaceae (*Pomaceae*): **Amelanchier canadensis** (L.)Medic.(*A. botryapium* DC.), Conn., Iowa, Mass., N.J., N.Y., N.C., Pa., Vt., Wis.—**A. erecta** Blanch., Ohio.—**A. intermedia** Spach(*A. botryapium* Hook., not DC.), Conn., Mass., N.Y., N.C., Pa.; Ont.—**A. laevis** Wieg., Ill., N.C.—**A. oblongifolia** (T.&G.)Roem., Mass.—**A. vulgaris** Moench (cult.), Mass.—**Cydonia vulgaris** (L.)Pers.(*Pyrus v.*) Conn.

Uredia wanting. Telia caulicolous, often dwarfing the shoots and causing bird's-nest distortions, usually with subulate leaves, on larger branches producing gradual enlargements, pulvinate or hemispheric, sometimes 2–7 mm. long, dark reddish-brown; teliospores ellipsoid, 16–23 by 39–55 μ, or oblong, 13–18 by 37–58 μ, rounded or obtuse at both ends; wall pale cinnamon-brown, 1–1.5 μ thick, or slightly thicker above, the pores 2 in each cell near septum, occasionally with 1 apical or 1 near hilum; pedicel very long.

On Juniperaceae: **Juniperus virginiana** L., Ala., Conn., Del., D.C., Fla., Ga., Ill., Iowa, Me., Md., Mass., Miss., Mo., Neb., N.J., N.Y., N.C., S.C., Tenn., Vt., Va.

Range: Maine to Wisconsin and Nebraska, southward to Florida and Mississippi.

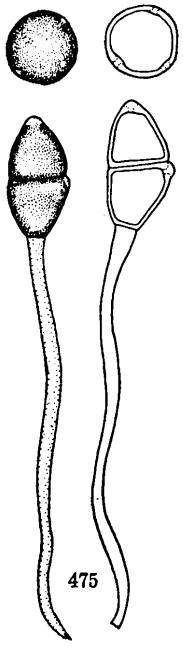
The first cultures were made in 1886, 1887 and 1888 by Thaxter (Bot. Gaz. **11**: 238. 1886; same **14**: 167. 1889), under the name of *G. conicum*, by sowing teliospores from *J. virginiana* on *Amelanchier canadensis*, resulting in pycnia and aecia. In 1907 cultures by Arthur (Jour. Myc. **14**: 19. 1908) gave pycnia and aecia on *Malus malus*, in 1909 (Mycol. **2**: 230. 1910) on *Malus ioensis* and pycnia only on *Crataegus pringlei*, in 1910 (same **4**: 25. 1912) on *Amelanchier vulgaris* and *Cydonia vulgaris* with pycnia only, in 1911 (same **4**: 56. 1912) on fruit of *Amelanchier erecta* and *Malus coronaria*, the latter with pycnia only, and in 1914 (same **7**: 83. 1915) on *A. vulgaris* with both pycnia and aecia. In 1919 Petri dish cultures by Clinton (Ann. Rep. Conn. Exper. Sta. **47**: 492. 1924; also Bull. 260) gave pycnia only on *Malus malus* and *Cydonia vulgaris*.

18. GYMNOSPORANGIUM AURANTIACUM. Fig. 475.

(N. A. F. 7: 198, 739, 825.)

(*Aecidium cornutum* Pers., in J. F. Gmel., Syst. Nat. **2:** 1472. 1791.)
Gymnosporangium juniperi Link, in Willd., Sp. Pl. **6²:** 127. 1825. Not *Puccinia juniperi* Pers. 1794, 1801.
Gymnosporangium aurantiacum Chev., Fl. Paris **1:** 424. 1826.
Gymnosporangium juniperinum Fries, Syst. Myc. **3:** 506. 1832. Not Mart. 1817.
Podisoma juniperinum Oerst., Overs. Danske Vid. Selsk. Forh. **1866:** 191. 1866.
Gymnosporangium cornutum Arth., Mycol. **1:** 240. 1909.

Pycnia epiphyllous. Aecia chiefly hypophyllous, cylindric or cornute, acute at apex, apically dehiscent and somewhat but not deeply lacerate, with peridial cells lanceolate in face view, rhomboidal in side view, remaining straight when wet, the outer wall 2 μ thick, smooth, the inner and side walls 8–12 μ, coarsely rugose with short ridge-like markings; aeciospores globoid, 18–25 by 21–29 μ; wall chestnut-brown, uniformly 2–2.5 μ thick, finely verrucose, the pores 8–10.



On Malaceae (*Pomaceae*): **Sorbus americana** Marsh., Me., Mass., Mich., N.H., N.Y.; N.B., Ont.; Newf.—**S. aucuparia** L., Mich.—**S. scopulina** Greene (*S. sambucifolia* Gray, not C.&S.), Colo., Me., Mich., Mont., Wis., Wyo.; Man., Ont., Queb.; Greenl.—**S. sitchensis** Roem., Alas., Wash.

Uredia wanting. Telia caulicolous, usually on slight fusiform swellings, sometimes on leaves, varying in size, pulvinate, chocolate-brown; teliospores ellipsoid, 16–22 by 31–42 μ, usually narrowed somewhat at both ends; wall cinnamon-brown, about 1 μ thick, with 1 or 2 pores in each cell near the septum, or in upper cell apical, each pore covered with a prominent hyaline papilla; pedicel moderately long.

On Juniperaceae: **Juniperus sibirica** Burgsd.(*J. nana* Wild., *J. communis depressa* Pursh), Colo., Mich.

Range: Greenland to Washington, southward to New York and Colorado; also in Europe and Japan.

The first cultures were made in 1866 by Oersted (Overs. Danske Vid. Selsk. Forh. **1866:** 185. 1866), followed by Plowright (1882) and others, mostly under the name of *G. juniperinum*, but in some instances vitiated by mixed material. American cultures under the name of *G. cornutum*, were made in 1908 by Arthur (Mycol. **1:** 240. 1909), by sowing teliospores from *J. sibirica* on *Sorbus americana*, resulting in abundant pycnia and aecia. Similar cultures in 1909 and 1910 (Mycol. **2:** 230. 1910; same **4:** 25. 1912) gave pycnia but aecia did not mature.

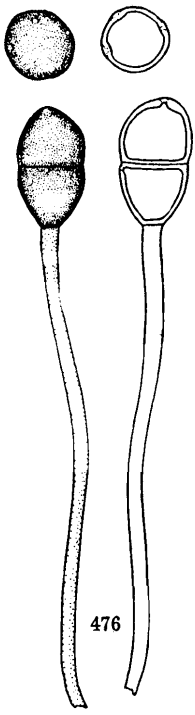
The confusion of this name with that of the true *G. juniperinum* dates back to the time of Oersted, who erroneously assumed his material to be the same as that described by Linnaeus under the name of *Tremella juniperina*. The error was first pointed out by Kern (Science II. **27:** 931. 1908).

19. GYMNOSPORANGIUM EXTERUM. Fig. 476.

(N. A. F. 7: 199, 739, 825.)

Gymnosporangium exterum A. & K.; Arth., Mycol. **1:** 254. 1909.

Pycnia epiphyllous. Aecia hypophyllous, in large loose groups, soon lacerate almost to base, spreading but not revolute, with lanceolate peridial cells remaining straight when wet, the outer wall 1.5 μ thick, smooth, the inner 3–5 μ, rugose, both views difficult to observe, side walls rugose with ridges extending



entirely across; aeciospores globoid, 17–21 by 21–26 μ; wall very pale cinnamon-brown, 2–2.5 μ thick, finely verrucose, the pores 8–10.

On Rosaceae: **Porteranthus stipulatus** (Muhl.)Britt. (*Gillenia s.* Nutt., *Spiraea s.*), Ind., Ky., Mo.—**P. trifoliatus** (L.)Britt.(*G. t.* Moench, *S. t.*), Va., W.Va.

Uredia wanting. Telia caulicolous, on fusiform swellings, 2–6 cm. long, applanate, chocolate-brown; teliospores ellipsoid, 18–23 by 32–42 μ, rounded or obtuse at both ends; wall cinnamon-brown, 1–1.5 μ thick, or slightly thicker at apex, with 1 pore in each cell, at septum in lower cell, apical in the upper; pedicel very long.

On Juniperaceae: **Juniperus virginiana** L., Ky.

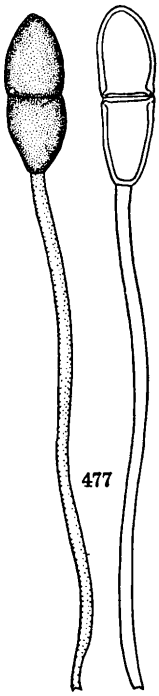
Range: Virginia to southeastern Missouri.

Cultures with teliospores from *J. virginiana* were made in 1908 and again in 1909 by Arthur (Mycol. **1:** 253. 1909; same **2:** 231. 1910) on *Porteranthus stipulatus,* with abundant production of pycnia and aecia.

20. GYMNOSPORANGIUM EFFUSUM. Fig. 477.

(N. A. F. 7: 201, 740, 825.)

Gymnosporangium effusum Kern, Bull. N. Y. Bot. Gard. **7:** 459. 1911.



Pycnia and aecia on **Aronia** sp., as indicated by cultures, showing pycnia only.

Uredia wanting. Telia caulicolous, on fusiform enlargements, often in long series, more or less wedge-shaped or stag-horn-like, 7–10 mm. high, chestnut-brown; teliospores oblong-ellipsoid, 16–22 by 45–55 μ, rounded or obtuse at both ends; wall cinnamon-brown, uniformly 1–2 μ thick, the pores 1 or 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus virginiana** L., D.C., N.J., N.Y., S.C., Va.

Range: Vicinity of Atlantic coast from southern New York to South Carolina.

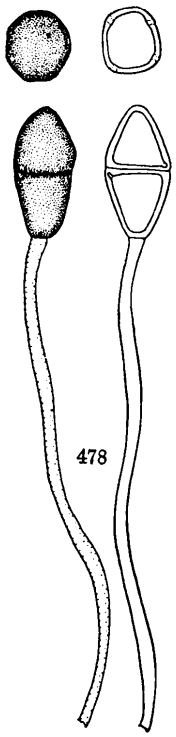
Only one set of cultures has been made, that in 1911 by Arthur (Mycol. **4:** 63. 1912) with teliospores from *J. virginiana* sown on four species of hosts, giving an abundance of pycnia on *Aronia arbutifolia,* but failing to mature aecia.

*. **Gymnosporangium cupressi** Long & Goodd., with pycnia and aecia unknown; uredia wanting; telia caulicolous, causing fusiform or globoid swellings, often in rows on larger branches, irregularly wedge-shaped, 4–6 mm. high, dark chestnut-brown, teliospores ellipsoid, 22–27 by 43–50 μ, rounded at both ends; wall cinnamon-brown, uniformly 2–3 μ thick, the pores 2 in each cell near septum, pedicel very long; occurs on Juniperaceae: **Cupressus arizonica** Greene, in Central Arizona. (N. A. F. **7:** 740.)

21. GYMNOSPORANGIUM TRACHYSORUM. Fig. 478.

(N. A. F. 7: 194, 738, 825.)

Gymnosporangium trachysorum Kern; Arth., Mycol. **2:** 237. 1910.



Pycnia epiphyllous. Aecia hypophyllous, on slightly thickened spots, cylindric, 2–4 mm. high, horn-like, finally rupturing by lateral slits, the peridial cells long and narrow, remaining straight when wet, the outer wall 1.5–2 μ thick, nearly or quite smooth, the inner 3–6 μ, subspinulose, with lower ridge-like papillae interspersed, with similar markings obliquely across the side walls; aeciospores globoid, 15–23 by 18–27 μ; wall chestnut-brown, 2.5–3 μ thick, very minutely verrucose, with about 6 indistinct pores.

On Malaceae (*Pomaceae*): **Crataegus flavo-carnis** Ashe, N.C.—**C. marshallii** Eggl.(*C. apiifolia* Michx.), Ala., La.—**C. monogyna** Jacq.(*C. oxyacantha* Auth., not L.), Pa.—**C. phaenopyrum** (L.f.)Medic.(*C. cordata* Ait.), N.C.

Uredia wanting. Telia caulicolous, on abruptly fusiform or globoid somewhat gall-like enlargements, more or less wedge-shaped, 6–10 mm. high, roughened with warts and ridges, dark chestnut-brown; teliospores ellipsoid, 18–21 by 37–45 μ, rounded at each end; wall cinnamon-brown, 1.5–2.5 μ thick, the pores 1 or 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus virginiana** L., La., Miss., S.C.

Range: Near the coast from eastern Pennsylvania to Louisiana.

Production of pycnia and aecia was obtained in 1909 by Arthur (Mycol. **2:** 237. 1910) by sowing teliospores from *Juniperus virginiana* on *Crataegus cerronis*, but similar sowings on *C. punctata* and *C. coccinea* gave only pycnia, doubtless due to early maturity of the leaves.

22. GYMNOSPORANGIUM JAPONICUM. Fig. 479.

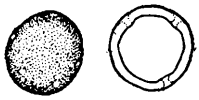
(N. A. F. 7: 201, 740, 825.)

(*Roestelia photiniae* P. Henn., Hedw. **33:** 231. 1894.)
Gymnosporangium janonicum Syd., Hedw. Beibl. **38:** 141. 1899.
(*Aecidium pourthiaeae* Syd., Mem. Herb. Boiss. **4:** 3. 1900.)
Gymnosporangium photiniae Kern, Bull. N. Y. Bot. Gard. **7:** 443. 1911.
Gymnosporangium spiniferum Syd., Ann. Myc. **10:** 78. 1912.

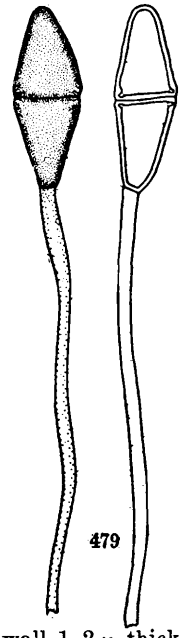
Pycnia epiphyllous. Aecia hypophyllous, cylindric, rupturing apically, mostly remaining tubular, the peridial cells lanceolate in face view, with the outer wall 2–3 μ thick, smooth, the inner 5–7 μ, densely and sharply subspinulose; aeciospores globoid or ellipsoid, 17–18 by 19–23 μ; wall dingy yellow, 2.5–3.5 μ thick, verrucose, the pores 6–10.

On Malaceae (*Pomaceae*): **Photinia arbutifolia** Lindl.(*Heteromeles angustifolia* Roem.), Calif.

Uredia wanting. Telia caulicolous, from a perennial mycelium, on fusiform enlargements, irregularly wedge-shaped, often incised at apex, lacunose



below, 3–5 mm. high, cinnamon-brown; teliospores ellipsoid, 18–22 by 57–66 μ, usually narrowed above and below; wall pale cinnamon-brown, uniformly 1–1.5 μ thick, the pores 2 in each cell near the septum; pedicel very long.



479

On Juniperaceae: **Juniperus chinensis** L., Conn., N.J., Wash.

Range: Sparingly sporadic on Atlantic and Pacific Coasts of the United States on plants cultivated for ornament; also in eastern China and Japan.

A successful culture was made in 1913 by Ito (Bot. Mag. Tokyo **27:** 221. 1913) by sowing teliospores from *Juniperus chinensis* on *Photinia villosa*.

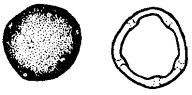
23. GYMNOSPORANGIUM CLAVARIAEFORME.

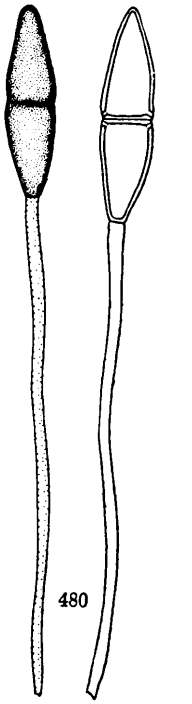
Fig. 480.

(N. A. F. 7: 202, 741, 825.)

Tremella clavariaeformis Jacq., Coll. **2:** 174. 1788.
Tremella clavariaeformis Pers., Syn. Fung. 629. 1801.
(*Aecidium lacertum* Sow., Engl. Fungi *pl. 318.* 1801.)
Gymnosporangium clavariaeforme (Jacq.) DC., Fl. Fr. **2:** 217. 1805.
Tremella juniperina Wahl., Fl. Suec. 994. 1826. Not. L. 1753.
(*Roestelia lacerata* Fries, Summa Veg. Scand. 510. 1849.)

Pycnia chiefly epiphyllous and on fruits. Aecia hypophyllous, and on fruits and stems, cylindric, soon becoming lacerate, the peridial cells long and narrow, somewhat curved when wet, with the outer wall 1–2 μ thick, smooth, the inner 5–7 μ, coarsely verrucose with somewhat irregular warts of varying sizes; aeciospores globoid, 20–27 by 25–30 μ; wall cinnamon-brown, 2.5–3.5 μ thick, verrucose, the pores 8–10.





480

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Colo., Mont., Neb., S.D., Utah, Wyo.; Man.—**A. canadensis** (L.)Medic.(*A. botryapium* DC.), Conn., Del., Ind., Mass., Mich., N.H., Vt.; N.S.—**A. florida** Lindl.(*A. elliptica* Nels.), Utah.—**A. intermedia** Spach(*A. botryapium* Hook., not DC.), Mass., N.H., Wis.—**A. oblongifolia** (T.& G.)Roem., Me., Mich.—**A. oreophila** Nels., Colo.—**A. polycarpa** Greene, Colo., Wyo.—**A. pumila** Nutt., Utah, Wyo.—**Aronia arbutifolia** (L.)Ell.(*Pyrus a.*), Mass.—**Cydonia vulgaris** (L.)Pers.(*Pyrus v.*), Conn., Me.—**Pyrus communis** L., S.C.

Uredia wanting. Telia caulicolous, on long fusiform swellings, cylindric, 5–10 mm. high, acute or sometimes forked at apex, brownish-yellow; teliospores lanceolate, 13–20 by 50–80 μ, or longer, narrowed at both ends or rounded above; wall golden-yellow, uniformly 1 μ thick, the pores 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus communis** L., Conn., Ill., Iowa, Me., Mass., Mich., Minn., Mont., N.H., N.Y.,

Pa.—**J. sibirica** Burgsd.(*J. nana* Willd., *J. communis depressa* Pursh), Colo., Ill., Me., Mich., Mont.

Range: Nova Scotia to Manitoba and Montana, southward to South Carolina and Utah; also in Europe, northern Africa and Japan.

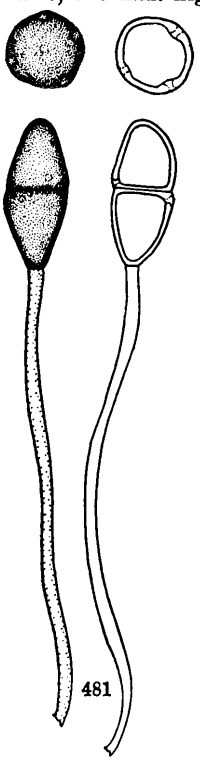
A resumé of the many cultures made in Europe is given by Klebahn (Wirstw. Rostpilze 339–345. 1904). The first American cultures were in 1886 by Thaxter (Proc. Amer. Acad. **14:** 263. 1887) with teliospores from *J. communis* sown on *Crataegus tomentosa*, giving pycnia and aecia, and repeated in 1887 (Bot. Gaz. **14:** 166. 1889) with teliospores from *J. communis* sown on *Amelanchier canadensis*, giving abundant pycnia and aecia. Cultures were made with teliospores from *J. sibirica* in 1907 by Arthur (Jour. Myc. **14:** 19. 1908), giving pycnia only on *Malus malus*, in 1908 and 1911 (Mycol. **1:** 239. 1909; same **4:** 56. 1912), giving abundant pycnia and aecia on *Amelanchier erecta*, and in 1913 (same **7:** 79. 1915), giving pycnia and aecia on *Crataegus cerronis*.

24. GYMNOSPORANGIUM BETHELI. Fig. 481.

(N. A. F. 7: 204, 741, 826.)

Gymnosporangium betheli Kern, Bull. Torrey Club **34:** 459. 1907.
(*Roestelia betheli* Kern, Bull. Torrey Club **34:** 461. 1907.)

Pycnia epiphyllous and on fruits. Aecia hypophyllous and on fruits, cylindric, 3–8 mm. high, becoming finely lacerate, spreading, the peridial cells long and narrow in side view, somewhat curved when wet, broadly lanceolate in face view, the outer wall 1–1.5 μ thick, smooth, the inner 4–6 μ, moderately rugose, with closely set linear ridges and a few separate elongate warts interspersed; aeciospores globoid, 18–24 by 23–30 μ; wall chestnut-brown, 2.5–3 μ thick, finely verrucose, the pores 8–10.


481

On Malaceae (*Pomaceae*): **Crataegus coloradensis** Nels., Colo., S.D.—**C. chrysocarpa** Ashe(*C. sheridana* Nels.), Colo., Mont., Wyo.—**C. douglasii** Lindl.(*C. brevispina* Dougl.), Ida., Mont., Ore., Utah, Wash.; B.C.—**C. erythropoda** Ashe(*C. cerronis* Nels.), Colo., N.M.—**C. occidentalis** Britt., Colo.—**C. rivularis** Nutt., Colo., Utah.—**C. saligna** Greene, Colo.

Uredia wanting. Telia caulicolous, in gall-like knots, usually forming irregular lines, wedge-shaped, 3–4 mm. high, chestnut-brown; teliospores ellipsoid, 17–25 by 40–55 μ, usually rounded at both ends; wall cinnamon-brown, 1–2 μ thick, the pores 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus occidentalis** Hook., Ore. —**J. scopulorum** Sarg., Colo., Ida., N.M., N.D., Utah, Wash.

Range: North Dakota to British Columbia, southward to New Mexico and Utah; also in Mexico.

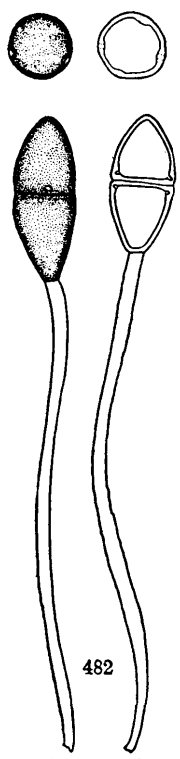
Cultures with teliospores from *J. scopulorum* in 1907 by Arthur (Jour. Myc. **14:** 23. 1908) sown on *Crataegus coccinea, C. cordata* and *Sorbus americana* gave abundant pycnia and aecia on each, other sowings gave pycnia only. Similar results were obtained in 1908, 1909, 1910 and 1912 (Mycol. **1:** 240. 1909; same **2:** 230. 1910; same **4:** 25. 1912; same **7:** 78. 1915) using in addition *Crataegus cerronis* and *C. pringlei*.

25. GYMNOSPORANGIUM GLOBOSUM. Fig. 482.

(N. A. F. 7: 204, 741, 826.)

Gymnosporangium fuscum globosum Farl., Gymnosp. U. S. 18. 1880.
Gymnosporangium globosum Farl., Gymnosp. U. S. 34. 1880.

Pycnia epiphyllous. Aecia chiefly hypophyllous, cylindric, 1.5–3 mm. high, soon splitting in upper part, the margin finely lacerate or fimbriate, erect, the peridial cells linear-rhomboidal in side view, remaining straight when wet, broadly lanceolate in face view, with the outer wall about 1.5 μ thick, smooth, the inner 3–5 μ, densely rugose with ridges of varying length; aeciospores globoid, 15–19 by 18–25 μ; wall light chestnut-brown, 1.5–2 μ thick, finely verrucose, the pores 6–8, distinct.



On Malaceae (*Pomaceae*): **Crataegus**, 90 species recorded in N. Am. Flora (**7**: 205, 206, 741), including **C. coccinea** L.(*C. modesta* Sarg.), Conn., Ill., Ind., Mass., N.Y., Pa., S.D., Vt.; Ont.—**C. crus-galli** L., Ky., Mass., Mo., N.C., Ohio, Tenn., Va.—**C. mohrii** Beadle, Ga.—**C. mollis** (T.&G.)Scheele, Ark., Ill., Ind., Iowa, Kans., Ky., Mass., Mo., Neb., Ohio.—**C. punctata** Jacq., Ind., Ill., Iowa, Mass., Mich., Mo., Neb., N.Y., N.C., Ohio, Pa., Vt., W.Va., Wis.; Ont.—**C. tomentosa** L., Ill., Ky., Me., Mo., N.Y., Ohio, Wis.; Ont., Queb.—**Malus angustifolia** (Ait.)Michx. (*Pyrus a.*), S.C.—**M. glaucescens** Rehder, Ind.—**M. sylvestris** (L.)Mill.(*M. malus* Britt., *P. m.* L.), Conn., Me., Mass., Mo., N.J., N.Y., Vt.—**Pyrus communis** L., Conn., N.Y., Pa.—**Sorbus americana** Marsh., Me., Mass., N.Y., Vt.

Uredia wanting. Telia caulicolous, on globoid galls, tongue-shaped, 6–12 mm. high, chestnut-brown; teliospores ellipsoid, 16–21 by 37–48 μ, somewhat narrowed at both ends; wall cinnamon-brown, uniformly 1–2 μ thick, the pores 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus barbadensis** L., Ala.—**J. horizontalis** Moench(*J. prostrata* Pers.), N.D.—**J. virginiana** L., Ala., Conn., Ill., Ind., Iowa, Kans., Ky., La., Me., Mass., Mich., Miss., Mo., N.Y., N.C., Okla., S.C., Tex., Vt., W.Va., Wis.; Ont.

Range: Maine to Ontario and North Dakota, southward to Georgia and Texas.

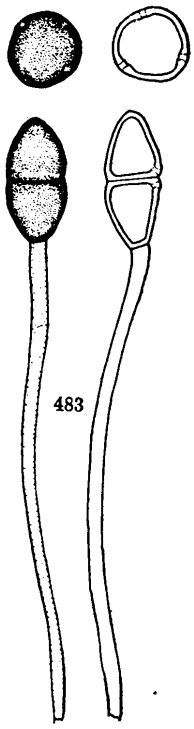
The earliest cultures were in 1876 and 1877 by Farlow (Gymnosp. U. S. 34–35. 1880), using teliospores from *J. virginiana* sown on *Crataegus tomentosa*, giving pycnia only. In 1887 and 1888 Thaxter (Bot. Gaz. **14:** 167. 1889) grew both pycnia and aecia on *C. coccinea* and *Malus malus*, and in 1887 pycnia only on *Sorbus americana* and *Cydonia vulgaris*. In 1906 cultures were made by Arthur (Jour. Myc. **13:** 200. 1907) on *Crataegus pringlei* and *Sorbus americana* resulting in pycnia and aecia, and on *Malus coronaria* giving pycnia only. Also in 1908 (Mycol. **1:** 239. 1909) pycnia and aecia were grown on *C. pringlei*, and in 1909 (same **2:** 229. 1910) on *C. coccinea*.

26. GYMNOSPORANGIUM TUBULATUM. Fig. 483.

(N. A. F. 7: 195, 738, 825.)

(*Roestelia tubulata* Kern; Jones, Bull. Univ. Mont. 61 : 64. 1910.)
Gymnosporangium tubulatum Kern, Bull. N. Y. Bot. Gard. **7:** 451. 1911.

Pycnia epiphyllous. Aecia chiefly hypophyllous, cylindric, acutish above, 2–3.5 mm. high, tardily dehiscent by slits in lower part, the peridial cells oblong in side view, remaining straight when wet, fusiform-oblong in face view, with the outer wall 1–1.5 μ thick, smooth, the inner 5–6 μ, densely rugose with ridges of varying length; aeciospores globoid, 18–22 by 21–28 μ; wall chestnut-brown, 1.5–2.5 μ thick, finely verrucose, the pores 6–8, evident.



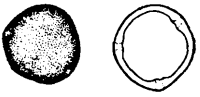
On Malaceae (*Pomaceae*): **Crataegus chrysocarpa** Ashe(*C. sheridana* Nels.), Wyo.—**C. douglasii** Lindl.(*C. brevispina* Dougl.), Ida., Mont., Ore., Wash., Wyo.—**C. williamsii** Eggl., Mont.

Uredia wanting. Telia caulicolous, on irregular globoid galls 2–10 mm. or more in diameter, mostly wedge-shaped, 3–4 mm. high, chestnut-brown; teliospores ellipsoid, 21–26 by 39–58 μ, usually narrowed at both ends; wall cinnamon-brown, uniformly 1.5–2.5 μ thick, the pores 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus horizontalis** Moench(*J. prostrata* Pers.), Wyo.—**J. scopulorum** Sarg., Ida., Mont., Wash., Wyo.

Range: Western South Dakota to easternmost Washington and Oregon.

Cultures were made in 1915 and again in 1916 by Weir and Hubert (Phytop. **5:** 218. 1915; same **7:** 109. 1917) by using teliospores from *J. scopulorum* sown on *Crataegus douglasii,* giving abundant pycnia and aecia.

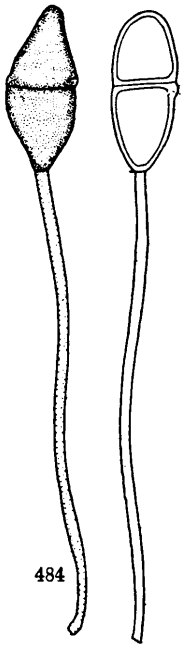


27. **GYMNOSPORANGIUM NELSONI.** Fig. 484.

(N. A. F. 7: 207, 742, 826.)

Gymnosporangium nelsoni Arth., Bull. Torrey Club **28:** 665. 1901.
(*Roestelia nelsoni* Arth., Bull. Torrey Club **28:** 665. 1901.)
Gymnosporangium durum Kern, Bull. Torrey Club **34:** 460. 1907.

Pycnia epiphyllous. Aecia hypophyllous and on fruits, cylindric, 2–4 mm. high, dehiscent at apex and more or less along sides, the peridial cells linear-rhomboidal in side view, remaining straight when wet, broadly lanceolate in face view, with the outer wall 1.5–2 μ thick, smooth, the inner 7–12 μ, densely verrucose; aeciospores globoid, 19–26 by 21–29 μ; wall chestnut-brown, 2–3 μ thick, finely verrucose, the pores 6–8.



On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Colo., Mont., Neb., N.M., Utah, Wyo.; Alta., B.C., Man.—**A. bakeri** Greene, Ariz., Colo.—**A. florida** Lindl.(*A. elliptica* Nels.), Colo., Nev.—**A. mormonica** Schneid., Colo., Utah.—**A. oreophila** Nels., Colo., N.M., Wyo.—**A. polycarpa** Greene, Wyo.—**A. pumila** Nutt., Mont.—**A. utahensis** Koehne, Colo.—**Crataegus chrysocarpa** Ashe(*C. sheridana* Nels.), Wyo.—**Cydonia vulgaris** (L.)Pers.(*Pyrus v.*),

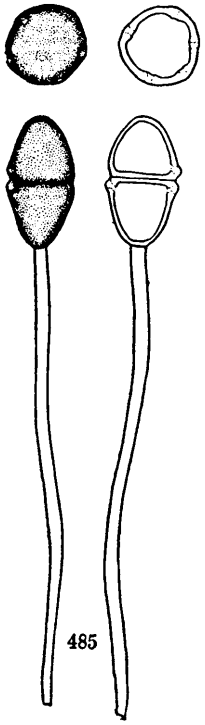
Ariz., Colo.—**Malus rivularis** (Dougl.)Roem.(*Pyrus diversifolia* Bong.), Alas., Wash.—**Peraphyllum ramosissimum** Nutt., Colo., Utah.—**Pyrus communis** L., Ariz., Colo.—**Sorbus occidentalis** (Wats.)Greene, Mont., Wash.—**S. scopulina** Greene(*S. sambucifolia* Gray, not C.&S.), Mont., Wyo.—**S. sitchensis** Roem., Mont.

Uredia wanting. Telia caulicolous, on woody globose galls of varying size, 0.5–5 cm. in diameter, irregularly flattened, 3–5 mm. high, chestnut-brown; teliospores narrowly ellipsoid, 18–22 by 50–65 μ, narrowed at both ends; wall pale cinnamon-brown, uniformly 1–1.5 μ thick, the pores 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus horizontalis** Moench(*J. prostrata* Pers.), Mont., S.D.—**J. monosperma** (Engelm.)Sarg., Ariz., Colo., Wyo.—**J. occidentalis** Hook., Ore.—**J. scopulorum** Sarg., Colo., Ida., Mont., N.M., N.D., Ore., Utah, Wyo.; Alta.—**J. utahensis** (Engelm.)Lemm., Ariz., Colo., Utah.

Range: Manitoba to southeastern Alaska, southward to New Mexico and Arizona.

Much confusion existed in the early studies of this species. The reports of cultures made in 1906, 1907, 1908 and 1910 by Arthur (Jour. Myc. **13:** 203. 1907; same **14:** 18. 1908; Mycol. **1:** 239. 1908; same **4:** 26. 1912) should have been credited to *G. juvenescens,* as subsequent studies revealed. The first cultures made with authentic material were in 1911 by Arthur (Mycol. **4:** 61. 1912) by sowing teliospores from *Juniperus utahensis* on *Amelanchier vulgaris,* giving pycnia only, and supplemented in 1912 (same **7:** 78. 1915) with teliospores from *J. scopulorum* sown on *A. canadensis,* giving both pycnia and aecia. In 1916 a culture by Weir and Hubert (Phytop. **7:** 109. 1917) on *Amelanchier alnifolia* produced pycnia and aecia.



28. **GYMNOSPORANGIUM CORNICULANS.** Fig. 485.

(N. A. F. **7:** 208, 742, 826.)

Gymnosporangium corniculans Kern; Arth., Mycol. **2:** 236. 1910.

Pycnia epiphyllous. Aecia hypophyllous, cylindric or horn-shaped, acutish above, 2–3.5 mm. high, tardily dehiscent by side slits, the peridial cells rhomboidal in side view, broadly lanceolate in face view, remaining straight when wet, with the outer wall 1.5–2 μ thick, smooth, the inner 5–7 μ, moderately verrucose with oval or roundish warts and a few elongate warts interspersed becoming shorter and more oval toward the outer wall; aeciospores globoid, 20–26 by 23–32 μ; wall dark cinnamon-brown, 3–4 μ thick, minutely verrucose, the pores 8–10.

On Malaceae (*Pomaceae*): **Amelanchier alnifolia** Nutt., Man., Sask.—**A. canadensis** (L.)Medic.(*A. botryapium* DC.), Ill., Iowa, Me., Mass., Pa., Vt., Va., W.Va.—**A. erecta** Blanch., Mich.—**A. intermedia** Spach(*A. botryapium* Hook., not DC.), Ill., N.Y.—**A. oblongifolia** (T.&G.) Roem., Mich.—**A. sanguinea** (Pursh)DC.(*A. rotundifolia* Roem.), Ont.

Uredia wanting. Telia caulicolous, on irregularly lobed gall-like excrescences, cylindric-acuminate, 3–5 mm. high, chestnut-brown; teliospores ellipsoid, 18–21 by

35–50 μ, rounded at both ends; wall cinnamon-brown, uniformly 1–1.5 μ thick, the pores 1 or 2 in each cell near septum, often covered with hyaline papillae; pedicel moderately long.

On Juniperaceae: **Juniperus horizontalis** Moench (*J. prostrata* Pers.), Mich.; Man., Sask.—**J. virginiana** L., N.Y.

Range: Maine to Saskatchewan, southward to Virginia and Michigan.

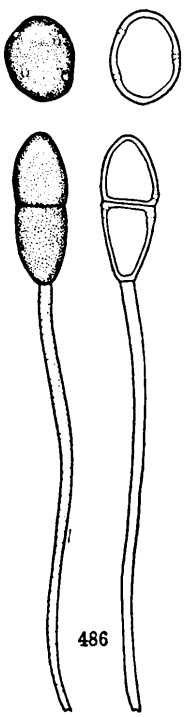
Teliospores from *Juniperus horizontalis* were sown on *Amelanchier erecta* and *A. canadensis* in 1909 by Arthur (Mycol. **2:** 235. 1910) with production of pycnia, but early maturity of the leaves prevented formation of aecia. In 1924 Fraser (Mycol. **17:** 84. 1925) infected *Amelanchier alnifolia* with teliospores from *J. horizontalis*.

29. GYMNOSPORANGIUM FLORIFORME. Fig. 486.

(N. A. F. 7: 208, 742, 826.)

(*Roestelia flaviformis* Atk.; Underw. & Earle, Bull. Ala. Exp. Sta. 80: 218, hyponym. 1897.)
Gymnosporangium flaviforme Earle, Contr. U. S. Nat. Herb. **6:** 186, hyponym. 1901.
Gymnosporangium floriforme Thaxt.; Kern, Bull. Torrey Club **35:** 503. 1908.

Pycnia epiphyllous. Aecia hypophyllous, cylindric, 1–1.5 mm. high, early fimbriately dehiscent, strongly revolute, the peridial cells long and narrow, becoming curved when wet, with the outer wall 1.5–2 μ thick, smooth, the inner 4–5 μ, rugose, the side walls closely rugose with ridges running from the inner side transversely and slightly downward nearly across and becoming slightly broader with a few ridge-like warts in the intervening spaces; aeciospores ellipsoid, 18–23 by 23–29 μ; wall chestnut-brown, 1.5–2.5 μ thick, finely verrucose, the pores 6–8, evident.



On Malaceae (*Pomaceae*): **Crataegus spathulata** Michx., Ala., Ark., Miss.

Uredia wanting. Telia on leaves and stems, on small gall-like excrescences 3–10 mm. across, or occasionally on larger globoid or subreniform ones, cylindric-acuminate, 3–10 mm. high, chestnut-brown; teliospores narrowly ellipsoid, 15–19 by 39–50 μ, rounded at both ends; wall pale cinnamon-brown, uniformly 1–1.5 μ thick, the pores 2 in each cell near septum; pedicel very long.

On Juniperaceae: **Juniperus virginiana** L., Ala., Ark., Fla., Okla., Miss., S.C., Tex.

Range: South Carolina to Oklahoma, southward to Florida and Texas.

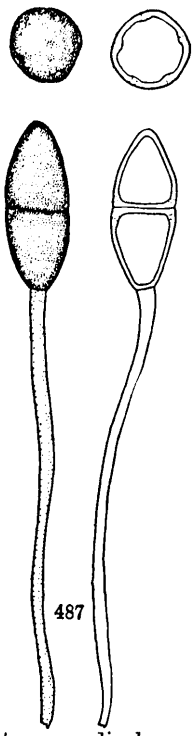
Cultures were made in 1908 by Arthur (Mycol. **1:** 238. 1909) with teliospores from *J. virginiana* sown on *Crataegus punctata*, and in 1909 (same **2:** 231. 1910) on *C. coccinea*, both giving pycnia and aecia.

30. GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE. Fig. 487.

(N. A. F. 7: 209, 742, 826.)

Gymnosporangium juniperi-virginianae Schw., Schr. Nat. Ges. Leipzig **1:** 74 1822.
Gymnosporangium macropus Link., in Willd., Sp. Pl. **6**[2]: 128. 1825.
(*Roestelia pyrata* Thaxt., Proc. Am. Acad. **22:** 269. 1887.)

Pycnia epiphyllous. Aecia chiefly hypophyllous, at first cylindric, 1–2 mm. high, soon becoming finely fimbriate, strongly revolute, the peridial cells long and narrow, much curved when wet, with the outer wall 2.5–3 μ thick, smooth, the inner 4–6 μ, coarsely rugose, the side walls coarsely rugose with ridges running from the inner side obliquely downward extending about half way or more across and becoming gradually broader with shorter ridge-like warts in the intervening spaces; aeciospores globoid, 16–24 by 21–31 μ; wall chestnut-brown, 2–3 μ thick, finely verrucose, the pores 8–10, distinct.



On Malaceae (*Pomaceae*): **Malus angustifolia** (Ait.) Michx.(*Pyrus a.*), Ala., Fla., Neb., N.C., S.C., Va.—**M. baccata** (L.)Desf.(*P. b.*), Conn., Md., Mo., Neb., Va.—**M. coronaria** (L.)Mill.(*P. c.*), Del., D.C., Ill., Ind., Iowa, Kans., Md., Mass., Mo., N.C., Ohio, Pa., S.C., Va., W.Va., Wis.; Ont.—**M. fragrans** Rehder, N.C.—**M. glaucescens** Rehder, Ind.—**M. ioensis** (Wood)Britt.(*P. i.* Bailey), Ala., Conn., Ill., Ind., Iowa, Kans., Miss., Mo., Neb., N.Y., N.D., Wis.—**M. sylvestris** (L.)Mill.(*M. malus* Britt., *P. m.* L.), Ala., Ark., Conn., Del., D.C., Ga., Ill., Ind., Iowa, Ky., La., Me., Md., Mass., Mich., Miss., Mo., Neb., N.J., N.C., Ohio, Pa., S.C., S.D., Tenn., Vt., Va., W.Va., Wis.; Ont.

Uredia wanting. Telia foliicolous, on globoid or reniform gall-like excrescences 5–30 mm. or more in diameter, cylindric-acuminate, 1–2 cm. high when fully expanded, golden-brown; teliospores rhombic-oval or narrowly ellipsoid, 15–21 by 42–65 μ, obtuse or acute at both ends; wall cinnamon-brown, uniformly 1 μ thick, the pores 2 near septum; pedicel very long.

On Juniperaceae: **Juniperus barbadensis** L., Ala.—**J. scopulorum** Sarg., Colo., Neb.—**J. virginiana** L., Ala., Ark., Conn., Del., Fla., Ga., Ill., Ind., Iowa, Kans., Ky., La., Me., Md., Mass., Miss., Mo., Neb., N.J., N.Y., N.C., R.I., Pa., S.C., S.D., Tenn., Tex., Va., W.Va., Wis.

Range: Maine to North Dakota, southward to Florida and Texas.

The earliest cultures in 1876 and later by Farlow (Gymnosp. U. S. 34. 1880; Proc. Amer. Acad. **12:** 213) appear to have given uncertain results. In 1886 Thaxter (Proc. Amer. Acad. **22:** 259. 1887) grew from teliospores on *J. virginiana* both pycnia and aecia on *Malus malus*, and repeated the same in 1887 (Bot. Gaz. **14:** 166. 1889). In 1886 Halsted (Bot. Gaz. **11:** 190, 240. 1886) grew pycnia and aecia on *Malus coronaria*. Since that time cultures by a large number of mycologists have been numerous, only in part recorded. The species is the most conspicuous and common in the eastern half of the United States, and because of its injury to orchards has attracted much attention.

*. **Gymnosporangium bermudianum** (Farl.) Earle, with pycnia not seen, possibly not formed; aecia caulicolous, on globoid or subreniform galls, 6–12 mm. in diameter, cylindric, 0.8–1.5 mm. high, fragile, soon lacerate, spreading but not recurved, the peridial cells remaining straight when wet, linear-rhomboidal in side view, narrowly obovate in face view, with the outer wall 1.5 μ thick, smooth, the inner 3–5 μ, rugose with closely set linear ridge-like warts of varying length, aeciospores globoid, 16–19 by 19–29 μ, wall dark chestnut-brown, 2–2.5 μ thick, minutely verrucose, the pores 6–8; uredia wanting; telia following aecia on same galls, few, pulvinate, cinnamon-brown, teliospores ellipsoid, 18–25 by 34–50 μ, rounded or obtuse at both ends, wall cinnamon-brown, uniformly 1 μ thick, the pores 2 in each cell near septum, pedicel three to four times length of spore; occurs on Juniperaceae: **Juniperus barbadensis** L., in southern Alabama and Mississippi, and **J. virginiana** L., in southern Florida, Louisiana and Mississippi; also in Bermuda and Bahamas. (N. A. F. **7:** 210.)

FORM-GENERA

The term "form-genera," as employed in the Uredinales, is applied to aecial or uredial stages whose full life cycle is unknown. The names of the genera, with one exception, that of *Uraecium,* are those that were established by early mycologists before the polymorphic nature of the rusts, resulting in autoecism and heteroecism, had been recognized.

Aecia with catenulate spores and peridia.	
On angiospermous hosts.	1. *Aecidium.*
On gymnospermous hosts.	2. *Peridermium.*
Aecia with catenulate spores and no peridia.	3. *Caeoma.*
Aecia with pedicellate spores.	4. *Uraecium.*
Uredia with or without peridia.	5. *Uredo.*

1. AECIDIUM Pers., 1791.

Under this form-genus are grouped various aecia occurring on angiospermous hosts, whose telial connections are not known. Being generally more conspicuous than most microfungi, they are often gathered by collectors. They are doubtless heteroecious, but their life cycle is not easily ascertained, which accounts for the large number of unconnected forms. Most of the forms are accompanied by pycnia, which are usually paraphysate. All of the forms doubtless belong to the Pucciniaceae. Pycnia and aecia subepidermal.

Aecia with peridium, one cell in thickness, dehiscent at apex, cupulate, urceolate or cylindric, firm or evanescent; aeciospores catenulate, 1-celled, usually globoid, or not much longer than broad; wall usually colorless, verrucose.

Borne on a systemic mycelium.	
Host belonging to family Urticaceae.	1. *A. libertum.*
Host belonging to family Polygalaceae.	2. *A. renatum.*
Host belonging to family Euphorbiaceae.	3. *A. tithymali.*
Host belonging to family Solanaceae.	4. *A. physalidis.*
Host belonging to family Valerianaceae.	5. *A. valerianellae.*
Host belonging to family Cichoriaceae.	6. *A. columbiense.*
Borne on a limited mycelium.	
Host belonging to family Dracaenaceae.	7. *A. yuccae.*
Host belonging to family Smilaceae.	8. *A. smilacis.*
Host belonging to family Iridaceae.	9. *A. residuum.*
Host belonging to family Orchidaceae.	10. *A. graebnerianum.*
Host belonging to family Urticaceae.	11. *A. boehmeriae.*
Host belonging to family Polygonaceae.	12. *A. minutulum.*
Host belonging to family Allioniaceae.	*. *A. mirabilis.*
Host belonging to family Papaveraceae.	13. *A. plenum.*
Host belonging to family Saxifragaceae.	14. *A. mitellae.*
Host belonging to family Caesalpiniaceae.	15. *A. chamaecristae.*
Host belonging to family Linaceae.	16. *A. lini.*
Host belonging to family Cyrillaceae.	*. *A. cyrillae.*
Host belonging to family Hippocastanaceae.	17. *A. aesculi.*
Host belonging to family Vitaceae.	18. *A. mexicanum.*
Host belonging to family Fouquieriaceae.	*. *A. cannonii.*
Host belonging to family Onagraceae.	
Aeciospore-wall thick, 2–3 μ.	19. *A. anograe.*
Aeciospore-wall thin, 1 μ.	*. *A. betheli.*
Host belonging to family Ammiaceae (*Umbelliferae*).	
Peridium white, fragile.	20. *A. ligustici.*
Peridium yellowish, firm.	21. *A. mutum.*

Host belonging to family Apocynaceae.	22.	*A. apocyni.*
Host belonging to family Boraginaceae.	23.	*A. hesleri.*
Host belonging to family Lamiaceae (*Labiatae*).	*.	*A. subsimulans.*
Host belonging to family Solanaceae.	*.	*A. lycii.*
Host belonging to family Scrophulariaceae.	24.	*A. insulsum.*
Host belonging to family Acanthaceae.	*.	*A. tracyanum.*
Host belonging to family Caprifoliaceae.	25.	*A. triostei.*
Host belonging to family Campanulaceae.	26.	*A. campanulastri.*
Host belonging to family Ambrosiaceae.	27.	*A. ivae.*
Host belonging to family Carduaceae.		
Aeciospore-wall thick, 2.5–3.5 μ.	*.	*A. borrichiae.*
Aeciospore-wall thin, 1–1.5 μ.		
Aeciospores large, 18–23 by 22–27 μ.		
Peridial cells abutted.	28.	*A. batesii.*
Peridial cells overlapping.	29.	*A. arcularium.*
Aeciospores small, 12–16 by 15–19 μ.	30.	*A. mesadeniae.*

1. AECIDIUM LIBERTUM.

(N. A. F. 7: 623.)

Aecidium libertum Arth., Bull. Torrey Club **37:** 580. 1910.

Pycnia hypophyllous, usually in the points of the teeth. Aecia hypophyllous, systemic, short cylindric, the peridial cells cuboidal, abutted; aeciospores globoid, 17–19 by 18–23 μ; wall pale-yellow, 1 μ thick, finely verrucose.

On Urticaceae: **Urtica chamaedryoides** Pursh, Okla. **Range:** In vicinity of Sapulpa, eastern Oklahoma.

2. AECIDIUM RENATUM.

(N. A. F. 7: 627.)

Aecidium renatum Arth., Bull. Torrey Club **47:** 477. 1920.

Pycnia epiphyllous, inconspicuous. Aecia hypophyllous, systemic, short-cylindric, the peridial cells imbricated; aeciospores globoid, 19–23 by 21–24 μ; wall colorless, 1 μ thick, finely verrucose.

On Polygalaceae: **Polygala longa** Blake, N.M. **Range:** Organ Mountains, New Mexico.

3. AECIDIUM TITHYMALI.

(N. A F. 7: 628.)

Aecidium tithymali Arth., Bull. Torrey Club **45:** 151. 1918.

Pycnia hypophyllous. Aecia hypophyllous, systemic, at first bullate, opening by a pore, with fragile peridium, the peridial cells rhomboidal, somewhat imbricated; aeciospores globoid or ellipsoid, 18–22 by 19–24 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose.

On Euphorbiaceae: **Tithymalus commutatus** (Engelm.)K.&G.(*Euphorbia c.*), Ind., Iowa, Md., Wis.—**T. leiococcus** (Engelm.)Small(*E. texana* Boiss.), Tex.—**T. missouriensis** (Norton)Small(*E. m.*), Neb. **Range:** Local from Maryland to eastern Nebraska and southern Texas.

4. AECIDIUM PHYSALIDIS.

(N. A. F. 7: 636.)

Aecidium physalidis Burr., Bot. Gaz. **9:** 190. 1884.

Pycnia amphigenous. Aecia hypophyllous, systemic, cupulate, the peridial cells rhomboidal, somewhat imbricated; aeciospores globoid or ellipsoid, 14–19 by 16–24 μ; wall colorless, 1–2 μ thick, inconspicuously verrucose.

On Solanaceae: **Physalis comata** Rydb., N.M., Tex.—**P. heterophylla** Nees (*P. viscosa* Pursh, not L.), Colo., Ill., Ind., Neb.—**P. lanceolata** Michx., Colo., Kans., Neb.—**P. longifolia** Nutt., Colo., Kans., Neb.—**P. virginiana** Mill., Colo., Mo., Okla., Wis. **Range:** Southwestern Wisconsin to foothills of Colorado, southward to northern Texas and northeastern New Mexico.

5. AECIDIUM VALERIANELLAE.

(N. A. F. 7: 813.)

Aecidium valerianellae Biv., Stirp. Rar. Sic. **4:** 28. 1816.
Aecidium fediae Berg., Giorn. Fis. Chim. Pavia **7:** 281. 1824.
Aecidium velenovskyi Bubák, Sitz.-ber. Böhm. Ges. Wiss. **1900**[7]**:** 4. 1900.

Pycnia hypophyllous, noticeable. Aecia hypophyllous, systemic, cylindric or somewhat cupulate, the peridial cells rhomboidal; aeciospores globoid or ellipsoid, 13–18 by 15–23 μ; wall nearly or quite colorless, 1–1.5 μ thick, minutely verrucose.

On Valerianaceae: **Valerianella congesta** Lindl., Calif., Wash.—**Range:** Southern Washington to central California; also in Europe.

This form is thought by Tranzschel to be the alternate stage of *Puccinia glumarum* (see page 187), but no cultures have been made.

6. AECIDIUM COLUMBIENSE.

(N. A. F. 7: 644.)

Aecidium columbiense E. & E., Erythea **1:** 206. 1893.

Pycnia amphigenous, conspicuous. Aecia hypophyllous, systemic, cupulate, the peridial cells rhomboidal; aeciospores globoid, 16–20 by 18–21 μ; wall colorless, 1–1.5 μ thick, minutely verrucose.

On Cichoriaceae: **Hieracium albertinum** Farr (*H. scouleri* Gray, not Hook.) Wash.—**H. albiflorum** Hook., Ore., Wash.; B.C.—**H. venosum** L., N.Y.—**H.** sp., Calif. **Range:** British Columbia to northern California and one locality on Long Island, New York.

7. AECIDIUM YUCCAE.

(N. A. F. 7: 621.)

Aecidium yuccae Arth., Bull. Torrey Club **49:** 194. 1922.

Pycnia amphigenous, in crowded groups. Aecia amphigenous, in loose groups, cylindric; aeciospores globoid or ellipsoid, 16–20 by 19–24 μ; wall colorless, 1 μ or less thick, finely verrucose.

On Dracaenaceae: **Yucca glauca** Nutt., Neb. **Range:** Sandhills of western Nebraska.

8. AECIDIUM SMILACIS.

(N. A. F. 7: 377.)

Aecidium smilacis Schw., Schr. Nat. Ges. Leipzig **1:** 69. 1822.
Caeoma (Aecidium) smilacinatum Schw., Trans. Am. Phil. Soc. II. **4:** 292. 1832.

Pycnia epiphyllous, in groups. Aecia hypophyllous, cupulate, on prominent wart-like protuberances 2–10 mm. in diameter; aeciospores globoid or broadly ellipsoid, 19–25 by 23–29 μ; wall colorless, 1–2 μ thick, finely verrucose.

On Smilaceae: **Smilax pseudo-china** L., S.C.—**S. rotundifolia** L., N.C.

Range: Only three localities reported, Clemson College, S. C., on *S. pseudo-china*, with uredia and telia of *Puccinia smilacis* on same leaves, and Salem and Raleigh, N. C., on *S. rotundifolia*.

It has been assumed heretofore that this form was the aecial stage of *Puccinia smilacis*, but field observations indicate that it is heteroecious, and may be connected with *Puccinia arundinariae*.

9. AECIDIUM RESIDUUM.

(N. A. F. 7: 622.)

Aecidium residuum Arth., N. Am. Flora **7:** 622. 1924.

Pycnia amphigenous, inconspicuous. Aecia amphigenous, pustulate, the epidermis overarching, opening by a pore, the peridium fragile, evanescent; aeciospores globoid or ellipsoid, 19–24 by 22–27 μ; wall colorless, 1.5–2.5 μ thick, finely verrucose.

On Iridaceae: **Sisyrinchium graminoides** Bickn.(*S. gramineum* Curtis, not Lam.), Okla. **Range:** Vicinity of Enid in north-central Oklahoma.

10. AECIDIUM GRAEBNERIANUM.

(N. A. F. 7: 622.)

Aecidium graebnerianum P. Henn., Hedw. **37:** 273. 1898.
Aecidium alaskanum Trel., Harriman Alaska Exp. Crypt. 37. 1904.

Pycnia not seen. Aecia usually hypophyllous, in crowded groups, cupulate; aeciospores irregularly globoid or ellipsoid, 15–18 by 16–22 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Orchidaceae: **Habenaria borealis** Cham.(*Limnorchis b.* Rydb.), Mont. —**H. bracteata** (Willd.)R.Br.(*Coeloglossum b.* Parl.), Alas.—**H. dilatata** (Pursh)Hook.(*L. d.* Rydb.), Alas., Ore., Wash.—**H. gracilis** Wats.(*L. stricta* Rydb.), Alas.; B.C.—**H. hyperborea** (L.)R.Br.(*L. viridiflora* Rydb.), Alas.—**H. leucostachys** (Lindl.)Wats.(*L. l.* Rydb.), Alas., Calif.—**Orchis aristata** Fisch., Alas. **Range:** Southern Alaska to southeastern California.

11. AECIDIUM BOEHMERIAE.

(N. A. F. 7: 622.)

Aecidium boehmeriae Arth., Bull. Torrey Club **34:** 590. 1907.

Pycnia epiphyllous, inconspicuous. Aecia hypophyllous, in groups, short-cupulate; aeciospores globoid, 10–13 by 13–16 μ; wall pale-yellow, 0.5–1 μ thick, minutely verrucose, appearing smooth when wet.

On Urticaceae: **Boehmeria cylindrica** (L.)Sw., D.C., Ind., Md., N.Y. **Range:** Local in and near District of Columbia, eastern Long Island, N. Y., and Central Indiana.

12. AECIDIUM MINUTULUM.

(N. A. F. 7: 812.)

Aecidium minutulum Jacks.; Barth., N. Am. Ured. *3401*. 1926.

Pycnia chiefly epiphyllous. Aecia hypophyllous, in large concentric groups, cupulate; aeciospores globoid, 14–16 μ in diameter; wall colorless, 1 μ thick, very minutely verrucose, appearing smooth.

On Polygonaceae: **Rumex** sp., Tex. **Range:** Vicinity of Wichita Falls, in northern Texas.

*. **Aecidium mirabilis** D. & H., with epiphyllous pycnia; aecia hypophyllous, in groups, cylindric, aeciospores ellipsoid or oblong, 16–19 by 21–28 μ, wall colorless, 1–1.5 μ thick, finely verrucose; occurs on Allioniaceae: **Mirabilis multiflora** Gray, in southern Arizona; also in Mexico. (N. A. F. **7:** 624.)

13. AECIDIUM PLENUM.

(N. A. F. 7: 624.)

Aecidium plenum Arth., Bull. Torrey Club **45:** 149. 1918.

Pycnia amphigenous, inconspicuous. Aecia hypophyllous, in groups about pycnia, cupulate or short-cylindric; aeciospores globoid, 16–21 by 18–24 μ; wall colorless, 1 μ thick, finely verrucose.

On Papaveraceae: **Argemone intermedia** Sweet, Tex. **Range:** Vicinity of Burkburnett, in northern border of Texas.

14. AECIDIUM MITELLAE.

(N. A. F. 7: 625.)

Aecidium mitellae E. & E.; Arth., Bull. Torrey Club **47:** 475. 1920.

Pycnia not seen. Aecia hypophyllous, in crowded groups, cupulate, small; aeciospores globoid or ellipsoid, 15–18 by 18–26 μ; wall colorless, 1 μ thick, minutely verrucose.

On Saxifragaceae: **Mitella nuda** L., Newf. **Range:** Only known from Shoal Point, Bay of Islands, Newfoundland.

15. AECIDIUM CHAMAECRISTAE.

(N. A. F. 7: 625.)

Aecidium cassiae E. & K., Trans. Kans. Acad. **10:** 91, hyponym. 1887.
Aecidium chamaecristae Arth., Bull. Torrey Club **46:** 123. 1919.

Pycnia amphigenous, in small groups. Aecia amphigenous, cupulate; aeciospores globoid or ellipsoid, 15–19 by 18–25 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Caesalpiniaceae: **Chamaecrista fasciculata** (Michx.)Greene (*Cassia chamaecrista* Am.auth.), Kans., Neb. **Range:** Eastern Kansas and Nebraska.

16. AECIDIUM LINI.

(N. A. F. 7: 626.)

Aecidium lini Dearn. & House, Bull. N. Y. State Mus. **179:** 26. 1915.

Pycnia amphigenous, in groups. Aecia hypophyllous, grouped on discolored spots, cupulate; aeciospores ellipsoid or oblong, 13–16 by 18–23 μ; wall colorless, 1.5 μ thick, minutely and inconspicuously verrucose.

On Linaceae: **Linum virginianum** L., N.Y. **Range:** Known only from eastern part of Long Island, N. Y.

*. **Aecidium cyrillae** Arth., with pycnia epiphyllous; aecia hypophyllous, in small groups, short-cylindric, aeciospores globoid or ellipsoid, 19–23 by 23–26 μ, wall colorless, 1–1.5 μ thick, greatly thickened above 7–9 μ, finely verrucose; occurs on Cyrillaceae: **Cyrilla racemiflora** L., in southern Louisiana and Mississippi, near the coast of the Mississippi Sound. (N. A. F. **7:** 629.)

17. AECIDIUM AESCULI.

(N. A. F. 7: 629.)

Aecidium aesculi E. & K., Bull. Torrey Club **11:** 114. 1884.

Pycnia epiphyllous, in groups. Aecia hypophyllous, in loose groups, cylindric or cupulate; aeciospores globoid or ellipsoid, 17–22 by 21–26 μ; wall colorless, 1 μ thick, very finely verrucose.

On Hippocastanaceae: **Aesculus arguta** Buckl., Kans.—**A. glabra** Willd., Kans., Neb. **Range:** North-central Kansas and adjoining Nebraska.

18. AECIDIUM MEXICANUM.

(N. A. F. 7: 630.)

Aecidium mexicanum D. & H.; Holw., Bot. Gaz. **24:** 36. 1897.
Aecidium clemensae Arth., Bull. Torrey Club **46:** 122. 1919.

Pycnia amphigenous, conspicuous. Aecia hypophyllous, in groups, short-cylindric; aeciospores globoid, 19–24 by 21–27 μ; wall colorless, 1.5–2 μ thick, finely verrucose.

On Vitaceae: **Cissus incisa** (Nutt.)DesMoul., Okla. **Range:** Southern Oklahoma; also in Mexico.

*. **Aecidium cannonii** Griff., with pycnia chiefly epiphyllous; aecia hypophyllous, in crowded groups, cupulate, aeciospores globoid or ellipsoid, 24–27 by 29–31 μ, wall colorless, 2.5–3.5 μ thick, very finely verrucose; occurs on Fouquieriaceae: **Fouquieria splendens** Engelm., in southern Arizona. (N. A. F. **7:** 630.)

19. AECIDIUM ANOGRAE.

(N. A. F. 7: 631.)

Aecidium anograe Arth., Bull. Torrey Club **28:** 664. 1901.

Pycnia amphigenous, inconspicuous. Aecia chiefly hypophyllous, in groups, cylindric; aeciospores globoid or ellipsoid, 18–23 by 22–26 μ; wall nearly colorless, 2–3 μ thick, verrucose.

On Onagraceae: **Anogra nuttallii** (Sweet)Nels., Neb. **Range:** Arid northwestern part of Nebraska.

*. **Aecidium bethelii** Arth., with pycnia unknown; aecia hypophyllous, in small groups on hypertrophied substratum, cupulate, aeciospores globoid, 13–18 by 16–18 μ, wall colorless, 1 μ or less thick, very finely verrucose; occurs on Onagraceae: **Jussiaea californica** (Wats.)Jepson, in southern California. (N. A. F. **7:** 632.)

20. AECIDIUM LIGUSTICI.

(N. A. F. 7: 632.)

Aecidium ligustici E. & E., Bull. Torrey Club **11:** 73. 1884.

Pycnia epiphyllous, scattered over swollen areas. Aecia chiefly hypophyllous, loosely grouped, cupulate; aeciospores globoid or ellipsoid, 13–19 by 18–23 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Ammiaceae (*Umbelliferae*): **Ligusticum scoticum** L., Me.; Queb. **Range:** Anticosti Island in Gulf of St. Lawrence, southward to southern Maine.

21. AECIDIUM MUTUM.

(N. A. F. 7: 632.)

Aecidium mutum Arth., N. Am. Flora **7:** 632. 1924.

Pycnia amphigenous, conspicuous. Aecia amphigenous, surrounding the pycnia, cylindric; aeciospores globoid or ellipsoid, 16–18 by 18–24 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Ammiaceae (*Umbelliferae*): **Musineon divaricatum** (Pursh) C. & R., S.D. **Range:** Western South Dakota.

22. AECIDIUM APOCYNI.

(N. A. F. 7: 632.)

Aecidium apocyni Schw., Schr. Nat. Ges. Leipzig **1:** 68. 1822.
Caeoma apocynatum Link, in Willd., Sp. Pl. **6**[2]**:** 49. 1825.

Pycnia amphigenous, in groups. Aecia hypophyllous, grouped about the pycnia on sightly swollen areas, short-cylindric; aeciospores globoid, 15–19 by 18–22 μ; wall colorless, 1–1.5 μ thick, minutely verrucose.

On Apocynaceae: **Apocynum cannabinum** L., Del., D.C., N.J., N.C., Va., W.Va.—**A. androsaemifolium** L., Md., Mass., N.Y. **Range:** Eastern Massachusetts, southward to central North Carolina.

Observations made by Roy Latham at Mattituck, Long Island, N. Y., on the occurrence of this form in proximity to *Smilax rotundifolia*, followed by uredia and telia, indicate a possible genetic connection with *Puccinia smilacis*. See page 226.

23. AECIDIUM HESLERI.

Aecidium hesleri Arth., Bull. Torrey Club **60:** 476. 1933.

Pycnia epiphyllous, few. Aecia hypophyllous, loosely grouped on small yellowish spots, cupulate; aeciospores globoid, 11–13 by 13–16 μ; wall colorless, 0.5–1 μ thick, finely verrucose.

On Boraginaceae: **Lithospermum tuberosum** Rugel, Tenn. **Range:** Known only from one collection near Jasper in southeastern Tennessee.

*. **Aecidium subsimulans** Arth. & Mains, with pycnia amphigenous; aecia hypophyllous, crowded with the pycnia, cylindric, aeciospores globoid or ellipsoid, 19–23 by 23–29 μ, wall colorless, 1.5–2.5 μ thick, very finely verrucose; occurs on Lamiaceae (*Labiatae*) : **Salvia lemmoni** Gray, in southern Arizona; also in Mexico. (N. A. F. **7:** 635.)

*. **Aecidium lycii** Arth., with pycnia amphigenous, inconspicuous; aecia hypophyllous, surrounding groups of pycnia, cupulate, aeciospores globoid or ellipsoid, 20–24 by 23–28 μ, wall colorless, 2–3 μ thick, finely verrucose; occurs on SOLANACEAE: **Lycium pallidum** Miers, in southern Arizona. (N. A. F. **7:** 636.)

24. AECIDIUM INSULSUM.

(N. A. F. 7: 637.)

Aecidium insulsum Arth., N. Am. Flora **7:** 637. 1924.

Pycnia amphigenous, in small groups. Aecia chiefly hypophyllous, densely crowded in groups, cupulate, small; aeciospores globoid or oblong, 16–20 by 18–23 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

ON SCROPHULARIACEAE: **Collinsia parviflora** Dougl., Utah. **Range:** Known only from Hot Springs, in northwestern Utah.

*. **Aecidium tracyanum** Syd., with pycnia amphigenous, conspicuous; aecia hypophyllous, loosely grouped on yellowish spots, cupulate, aeciospores globoid or ellipsoid, 18–23 by 21–26 μ, wall colorless, 0.5–1 μ thick, very finely verrucose; occurs on ACANTHACEAE: **Calophanes oblongifolia** (Michx.)D.Don(*Dyschoriste o.* Ktze.), in southern Florida; also in Mexico. (N. A. F. **7:** 637.)

25. AECIDIUM TRIOSTEI.

(N. A. F. 7: 639.)

Aecidium triostei Arth., Bull. Torrey Club **33:** 32. 1906.

Pycnia amphigenous. Aecia hypophyllous, in groups about the pycnia, cupulate; aeciospores globoid or ellipsoid, 19–23 by 23–26 μ; wall colorless, 1 μ thick, minutely verrucose.

ON CAPRIFOLIACEAE: **Triosteum angustifolium** L., Mo. **Range:** Known only from Perryville, in eastern Missouri.

26. AECIDIUM CAMPANULASTRI.

(N. A. F. 7: 640.)

Aecidium campanulastri G. W. Wilson, Proc. Iowa Acad. **17:** 74. 1911.

Pycnia amphigenous, inconspicuous. Aecia hypophyllous, loosely grouped on yellowish spots, cupulate; aeciospores globoid, 12–15 by 13–18 μ; wall colorless, 1–1.5 μ thick, minutely verrucose.

ON CAMPANULACEAE: **Campanulastrum americanum** (L.)Small(*Campanula a.*), Iowa, Minn. **Range:** Southern Minnesota and northern Iowa.

27. AECIDIUM IVAE.

(N. A. F. 7: 640.)

Aecidium ivae Jacks., Proc. Ind. Acad. Sci. **1917:** 373. 1918.

Pycnia amphigenous, in groups. Aecia chiefly hypophyllous, crowded on spots with the pycnia, cupulate; aeciospores globoid or ellipsoid, 21–29 by 26–33 μ; wall nearly or quite colorless, 2–3 μ thick, finely verrucose.

ON AMBROSIACEAE: **Iva frutescens** L., Del., Fla., La., Md., Va. **Range:** Coast of the Atlantic Ocean and Gulf of Mexico from Delaware to Louisiana.

*. **Aecidium borrichiae** Syd., with pycnia amphigenous, in small groups; aecia hypophyllous, loosely grouped about the pycnia, cupulate, aeciospores globoid or ellip-

soid, 24–28 by 26–32 μ, wall colorless, 2.5–3.5 μ thick, minutely verrucose; occurs on CARDUACEAE (tribe *Heliantheae*) : **Borrichia frutescens** (L.)DC., in vicinity of Fort Morgan, in southern Alabama. (N. A. F. **7:** 642.)

28. AECIDIUM BATESII.

(N. A. F. 7: 642.)

Aecidium batesii Arth., Bull. Torrey Club **47:** 479. 1920.

Pycnia chiefly epiphyllous, in groups. Aecia amphigenous, loosely grouped on brownish spots, cupulate, but margin remaining incurved for a time, the peridial cells abutted; aeciospores globoid or ellipsoid, 19–23 by 24–27 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

ON CARDUACEAE (tribe *Heliantheae*): **Rudbeckia hirta** L., Neb. **Range:** Known only from vicinity of Callaway, in central Nebraska.

29. AECIDIUM ARCULARIUM.

(N. A. F. 7: 640.)

Aecidium arcularium Arth., Bull. Torrey Club **47:** 478. 1920.

Pycnia epiphyllous, few, inconspicuous. Aecia hypophyllous, densely crowded in groups, cylindric; aeciospores globoid or ellipsoid, 18–23 by 22–29 μ; wall nearly or quite colorless, 1–1.5 μ thick, finely verrucose.

ON CARDUACEAE (tribe *Eupatorieae*): **Brickellia grandiflora** (Hook.) Nutt.(*Coleosanthus g.* Ktze.), Ariz., Colo., N.M. **Range:** Northern to southern Arizona and New Mexico.

30. AECIDIUM MESADENIAE.

(N. A. F. 7: 643.)

Aecidium mesadeniae Arth., Bull. Torrey Club **47:** 479. 1920.

Pycnia epiphyllous, few, inconspicuous. Aecia chiefly hypophyllous, crowded in groups, cupulate; aeciospores globoid or ellipsoid, 12–16 by 15–19 μ; wall colorless, 1 μ or less thick, finely verrucose.

ON CARDUACEAE (tribe *Senecioneae*): **Cacalia atriplicifolia** L.(*Mesadenia a.* Raf.), Kans., Mo.—**C. reniformis** Muhl.(*M. r.* Raf.), Wis. **Range:** Northeastern Wisconsin to northeastern Kansas.

2. PERIDERMIUM Link, 1816.

Under this form-genus are grouped various aecia having peridia, occurring on gymnospermous hosts, whose telial connections are not known. They are usually even more conspicuous than the forms placed under *Aecidium*. All of the forms are doubtless heteroecious, and belong to the Melampsoraceae.

Aecia with peridium, one cell or more in thickness, dehiscent at apex or by circumscissile rupture, cylindric, tongue-shape, or irregularly bullate, firm or less often fragile; aeciospores catenulate, 1-celled, globoid or ellipsoid or rarely lanceolate; wall colorless, verrucose or tuberculate, the

tubercles often deciduous. Pycnia subcuticular, subepidermal or subcortical, with short or no paraphyses.

Borne on a limited mycelium.	
Host belonging to family Pinaceae.	
Of the genus *Pinus*.	
Aeciospores oblong, the wall thin, 2–2.5 μ.	1. *P. weirii*.
Aeciospores ellipsoid, the wall thick, 3–3.5 μ.	*. *P. guatemalense*.
Of the genus *Abies*.	2. *P. rugosum*.
Of the genus *Picea*.	3. *P. parksianum*.
Borne on a systemic mycelium.	
Host belonging to family Ephedraceae.	4. *P. ephedrae*.

1. PERIDERMIUM WEIRII.

(N. A. F. 7: 645.)

Peridermium weirii Arth., N. Am. Flora **7:** 645. 1924.

Pycnia amphigenous, subepidermal, conspicuous. Aecia amphigenous, tongue-shape, with fragile peridium; aeciospores ellipsoid or oblong, 16–20 by 29–35 μ; wall colorless, 2–2.5 μ thick, evenly verrucose with short rods about 1 μ long.

On Pinaceae: **Pinus contorta** Dougl.(*P. murrayana* Balf.), Ida. **Range:** Only known from Kooskia, in northern Idaho.

*. **Peridermium guatemalense** A. & K., with pycnia amphigenous, subepidermal; aecia amphigenous, flattened laterally, rupturing irregularly; aeciospores ellipsoid, 18–24 by 22–39 μ, wall colorless, 3–3.5 μ thick, verrucose with large deciduous tubercles; occurs on Pinaceae: **Pinus palustris** Mill.(*P. australis* Michx.), in southern Florida; also in Mexico and Central America. (N. A. F. **7:** 645.)

2. PERIDERMIUM RUGOSUM.

(N. A. F. 7: 646.)

Peridermium rugosum Jacks., N. Am. Flora **7:** 646. 1924.

Pycnia hypophyllous, subepidermal, inconspicuous. Aecia hypophyllous, white, on leaves of preceding season, on yellow spots, cylindric; aeciospores ellipsoid, 16–24 by 24–32 μ; wall colorless, 1.5–2 μ thick, prominently verrucose.

On Pinaceae: **Abies grandis** Lindl., Calif., Ore., Wash. **Range:** Mountains of Washington to northern California.

This form closely resembles the aecia of *Milesia polypodophila*. The pycnia "correspond closely in their position in the leaf, and in their size, shape and structure" (Hunter, Bot. Gaz. **83:** 22. 1927). Doubtless the form belongs to some species of *Milesia* on ferns.

3. PERIDERMIUM PARKSIANUM.

Peridermium parksianum Faull, Jour. Arnold Arb. **15:** 87. 1934.

Pycnia hypophyllous, subepidermal. Aecia hypophyllous, cylindric or laterally compressed; aeciospores oblong or lanceolate, 13–24 by 25–111 μ, usually narrowed toward the ends; wall colorless, 1–1.5 μ thick, closely verrucose.

On Pinaceae: **Picea sitchensis** (Bong.)Carr., Calif., Ore. **Range:** Southern Oregon to northern California.

Unsuccessful but inconclusive cultures were made by Faull (*l.c.*), sowing aeciospores on *Rhododendron californicum*. Despite the uncertain results obtained by Faull it seems probable from the remarkable similarity of the aeciospores of this species and the urediospores of *Chrysomyxa piperiana* (see p. 35) that *P. parksianum* is the aecial stage of *C. piperiana* of which the teliospores are not known. This conclusion is further strengthened by field observation made by Mr. H. E. Parks at Trinidad, California.

4. PERIDERMIUM EPHEDRAE.

(N. A. F. 7: 647.)

Peridermium pini minor B. & C., Grev. **3:** 59. 1874.
Peridermium ephedrae Cooke, Indian Forester **3:** 95. 1877.
Aecidium ephedrae Diet., in E. & P., Nat. Pfl. **1**1**: 79. 1897.

Pycnia caulicolous, subcuticular, conspicuous. Aecia caulicolous, systemic, on slightly hypertrophied shoots, cylindric; aeciospores globoid or ellipsoid, 16–20 by 19–26 μ; wall colorless, 1–1.5 μ thick, finely verrucose.

On Ephedraceae: **Ephedra antisyphilitica** C.Mey., N.M., Tex.—**E. californica** Wats., Calif.—**E. nevadensis** Wats., Ariz., Utah.—**E. trifurca** Torr., N.M.—**E. viridis** Cov., Ariz. **Range:** Southwestern Texas to southern Utah and southern California; also in Mexico.

3. CAEOMA Link, 1809.

Under this form-genus are placed aecia, having no peridia, occurring on gymnospermous hosts, the telial connection not being known. The absence of peridia makes them inconspicuous. The forms doubtless are heteroecious, and belong to the Melampsoraceae.

Aecia without peridium; aeciospores catenulate, 1-celled, globoid; wall colorless, often thicker above, verrucose. Pycnia subepidermal, without paraphyses.

1. CAEOMA DUBIUM.

(N. A. F. 7: 648.)

Caeoma dubium C. A. Ludwig, Phytop. **5:** 281. 1915.

Pycnia hypophyllous, noticeable, subepidermal. Aecia hypophyllous, subepidermal, early naked, pulverulent, light-yellow when dry; aeciospores globoid, 15–21 by 15–22 μ; wall colorless, 1.5–2.5 μ thick, often thicker above, verrucose.

On Pinaceae: **Tsuga heterophylla** (Raf.)Sarg., Ida., Ore., Wash. **Range:** Northern Idaho to northwestern Washington.

4. URAECIUM Arth., 1933.

This form-genus includes stylosporic aecia, occurring on both gymnospermous and angiospermous hosts, the telial connections not being known. The species have heretofore been placed under the form-genus *Uredo*, although accompanied by pycnia.

Aecia uredinoid, with or without paraphyses; aeciospores borne singly on pedicels, 1-celled, globoid or ellipsoid; wall echinulate. Pycnia subepidermal or subcuticular, with or without paraphyses.

Besides the one species given below another, *U. lucumae* (A. & J.) Arth. (*Uredo lucumae* A. & J.), occurs in Cuba on the angiosperm, *Lucuma nervosa* A. DC., a host that also is found in southern Florida.

1. URAECIUM HOLWAYI.

(N. A. F. 7: 606.)

Uredo holwayi Arth., Bull. Torrey Club **33:** 518. 1906.
Uraecium holwayi Arth., Bull. Torrey Club **60:** 476. 1933.

Pycnia hypophyllous, numerous, inconspicuous. Aecia hypophyllous, uredinoid, from a limited mycelium, subepidermal, dehiscent by a central pore, the paraphyses imbricated to form a pseudoperidium; aeciospores ellipsoid or obovoid, 15–19 by 21–26 μ; wall nearly colorless, 2–3 μ thick, conspicuously echinulate below, finely echinulate or smooth above, the pores about 4, scattered, obscure.

On Pinaceae: **Tsuga heterophylla** (Raf.)Sarg., Alas., Ida., Mont.; B.C.—**T. mertensiana** (Bong.)Carr., B.C. **Range:** Southeastern Alaska, southward to western Montana and southern British Columbia.

5. UREDO Pers., 1794.

Under this form-genus are grouped various uredia, whose aecial and telial connections are not known. Such isolated forms occur much more abundantly in the tropical and semitropical regions, in most parts of which exploration is less readily effected, than in the north. The forms with a peridium or pseudoperidium doubtless belong to genera of the Melampsoraceae, the others to genera of the Pucciniaceae.

Uredia subepidermal, with or without peridium or paraphyses; urediospores 1-celled, borne singly on pedicels; wall colored or colorless, echinulate or sometimes verrucose, the pores 2 or more, usually obscure.

Peridium membranous.	1. *U. phorodendri.*
Pseudoperidium of imbricated paraphyses.	
Host belonging to family Polygonaceae.	*. *U. coccolobae.*
Host belonging to family Annonaceae.	*. *U. cherimoliae.*
Peridium and paraphyses wanting.	
Host belonging to family Orchidaceae.	*. *U. nigropuncta.*
Host belonging to family Chenopodiaceae.	*. *U. spirostachydis.*
Host belonging to family Corrigiolaceae.	2. *U. paronychiae.*
Host belonging to family Fabaceae.	*. *U. posita.*
Host belonging to family Loasaceae.	*. *U. floridana.*
Host belonging to family Hydrophyllaceae.	3. *U. contraria.*
Host belonging to family Lamiaceae (*Labiatae*).	4. *U. sphacelicola.*
Host belonging to family Solanaceae.	*. *U. nicotianae.*
Host belonging to family Rubiaceae.	*. *U. cephalanthi.*

Besides the above two tropical species have been found within our range in greenhouses: *U. behnickiana* on orchids in New Jersey, and *U. fuchsiae* on fuchsias in Ohio.

1. UREDO PHORADENDRI.

(N. A. F. 7: 609.)

Uredo phoradendri Jacks., Brookl. Bot. Gard. Mem. **1**: 285. 1918.

Uredia amphigenous, in groups, but not crowded, the irregularly ruptured epidermis remaining firm and persistent, the peridium membranous, with nearly isodiametric cells, remaining closely adherent to the epidermis; urediospores ellipsoid or obovoid, 17–33 by 26–32 μ; wall colorless, 1.5–2.5 μ thick, very closely and minutely echinulate, the pores 10–12, scattered, indistinct.

On Loranthaceae: **Phoradendron longispicum** Trel., Calif.—**P. villosum** Nutt., Ore. **Range:** Western Oregon and northern California.

*. **Uredo coccolobae** P. Henn., with uredia chiefly hypophyllous, scattered, minute, opening by a central pore, the clavate paraphyses imbricated into a pseudoperidium, urediospores ellipsoid, 21–24 by 29–37 μ, wall nearly or quite colorless, 1–1.5

μ thick, often somewhat thickened at hilem, finely and closely echinulate, the pores about 4, obscure; occurs on POLYGONACEAE: **Coccolobis uvifera** (L.)Jacq., in southern Florida; also in West Indies and South America. (N. A. F. **7:** 609. 848.)

*. **Uredo cherimoliae** Lagerh., with uredia hypophyllous, scattered, early naked, pulverulent, the clavate paraphyses somewhat imbricated into a pseudoperidium, urediospores obovoid, 16–19 by 26–31 μ, wall pale-yellow, about 1 μ thick, finely echinulate, the pores obscure; occurs on ANNONACEAE: **Annona cherimolia** Mill., and **A. squamosa** L., in southern Florida; also in Cuba, Yucatan and South America. (N. A. F. **7:** 610.)

*. **Uredo nigropuncta** P. Henn., with uredia hypophyllous, forming irregular orange or blackish masses, 1–2 mm. across, pulverulent, cinamon-brown, urediospores ellipsoid or obovoid, 20–25 by 24–32 μ, wall brownish-yellow, 2–3 μ thick, sparsely and coarsely verrucose-echinulate, the pores 3, equatorial; occurs on ORCHIDACEAE: **Bletia purpurea** (Lam.)DC., in southern Florida; also in Bahamas, West Indies and South America. (N. A. F. **7:** 608.)

*. **Uredo spirostachydis** Arth., with uredia caulicolous, rather tardily naked, pulverulent, cinnamon-brown, urediospores ellipsoid, 18–21 by 23–29 μ, wall cinnamon-brown, 2–2.5 μ thick, finely echinulate, the pores 6–8, scattered, somewhat obscure; occurs on CHENOPODIACEAE: **Allenrolfea occidentalis** (Wats.)Ktze. (*Spirostachys o.*), in southern Arizona. (N. A. F. **7:** 609.)

2. UREDO PARONYCHIAE.

(N. A. F. 7: 610.)

Uredo paronychiae Jacks., N. Am. Flora **7:** 610. 1924.

Uredia hypophyllous, one to few on discolored spots, tardily naked, pulverulent, yellowish-brown; urediospores globoid or ellipsoid, 20–23 by 23–26 μ; wall light golden-brown, 2–2.5 μ thick, closely verrucose-echinulate, the pores 4–6, scattered, indistinct.

ON CORRIGIOLACEAE: **Paronychia chilensis** DC., Calif. **Range:** Only known from vicinity of San Francisco, California.

*. **Uredo posita** J. J. Davis, with uredia caulicolous, scattered, pale cinnamon-brown, early naked, urediospores globoid or obovoid, flattened laterally, 17–21 by 19–23 μ, wall cinnamon-brown, 1.5–2 μ thick, echinulate, the pores 2, near apex, in the flattened sides; occurs on FABACEAE: **Aeschynomene virginica** (L.)B.S.P., Crowley, in southern Louisiana, coll. A. L. Smith, August 9, 1932.

*. **Uredo floridana** Syd., with uredia hypophyllous, in indefinite groups, soon naked, pulverulent, orange-yellow, urediospores ellipsoid or obovoid, 14–20 by 20–30 μ; wall pale-yellow, 1.5–2 μ thick, sparsely echinulate, the pores equatorial, obscure; occurs on LOASACEAE: **Mentzelia floridana** Nutt., in southern Florida; also in Mexico and South America. (N. A. F. **7:** 614.)

3. UREDO CONTRARIA.

(N. A. F. 7: 616, 811.)

Uredo contraria Arth., Bull. Torrey Club **47:** 472. 1920.

Uredia hypophyllous, scattered, minute, early naked, yellow, very pulverulent; urediospores oblong or obovate-oblong, 20–24 by 27–35 μ; wall colorless, 1.5–2 μ thick, finely and sparsely echinulate, the pores obscure.

ON HYDROPHYLLACEAE: **Phacelia californica** Cham., Calif.—**P. tanacetifolia** Benth., Calif. **Range:** Known only from vicinity of Carmel, in west-central California.

4. UREDO SPHACELICOLA.

(N. A. F. 7: 616.)

Uredo sphacelicola D. & H.; Diet., Erythea **1:** 248. 1893.

Uredia amphigenous, early naked, puverulent, cinnamon-brown; urediospores ellipsoid or flattened from above, 26–31 by 23–34 μ; wall dark cinnamon-brown, 1–1.5 μ thick, sometimes 2.5 μ above, echinulate, often more strongly above, the pores 2, near hilum.

On Lamiaceae (*Labiatae*): **Sphacele calycina** Benth., Calif. **Range:** Known only from Mt. Tamalpais, west-central California.

*. **Uredo nicotianae** A.S.S. (*U. n.* Arth.), with uredia chiefly hypophyllous, early naked, pulverulent, pale cinnamon-brown or whitish, urediospores globoid, 23–26 by 24–32 μ, wall colorless, 1.5–3 μ thick, closely and coarsely verrucose, the pores obscure; occurs on Solanaceae: **Nicotiana bigelovii** Wats., in southern California; also in Italy. (N. A. F. **7:** 616, 811.)

*. **Uredo cephalanthi** Arth., with uredia hypophyllous, scattered, small, early naked, pulverulent, pale-yellowish, urediospores ellipsoid or obovoid, 15–20 by 19–26 μ, wall very light cinnamon-brown, 1–1.5 μ thick, closely echinulate, the pores probably 4, equatorial, obscure; occurs on Rubiaceae: **Cephalanthus occidentalis** L., in southern Florida; also in Cuba. (N. A. F. **7:** 617.)

SUPPLEMENT.

Page 210, after *Puccinia caricis quadriporula,* insert:

Uromyces minutus.
(N. A. F. 7: 234, 752, 828.)

Uromyces minutus Diet.; Atk., Bull. Cornell Univ. **3:** 21. 1897.
Nigredo minuta Arth., Rés. Sci. Congr. Bot. Vienne 344. 1906.

Pycnia and aecia unknown. Urediospores 10–16 by 15–20 μ, with 2 or 3 equatorial pores. Teliospores one-celled, obovoid, 10–18 by 18–25 μ, otherwise as in *Puccinia caricis grossulariata.*

On Cyperaceae: **Carex gracillima** Schw., Wis.—**C. intumescens** Rudge, Wis.—**C. lanuginosa** Michx., Ind.—**C. muskingumensis** Schw., Mich.—**C. pubescens** Muhl., Iowa.—**C. triceps** Michx., Fla., Miss., Tex.—**C. virescens** Muhl., Ind., N.Y.—**C.** sp. Ala. **Range:** New York to Wisconsin, southward to Florida and Texas.

A macrocylic species remarkable for its small spores, correlated with (3) *Puccinia caricis grossulariata.*

INDEX OF HOST NAMES

Abies amabilis (Loud.)Forbes 5, 15, 19, 21
arizonica Merr. 15
balsamea (L.)Mill. 3, 4, 5, 7, 8, 9, 10, 15, 19, 21, 55
canadensis Michx., see Tsuga c. 17, 18, 53
canadensis Mill., see Picea c. 13, 21, 32, 33
concolor Lindl.&Gord. 15, 19, 21, 55
douglasii Lindl., see Pseudotsuga mucronata, 52
fraseri (Pursh)Lindl. 3
grandis Lindl. 4, 5, 15, 21, 55, 389
lasiocarpa (Hook.)Nutt. 4, 15, 19, 21, 55
magnifica Murr. 19, 21
nobilis Lindl. 4, 5, 15
subalpina Engelm. see Abies lasiocarpa, 4, 15, 19, 21, 55
Abronia 158
Abutilon 144
Acacia angustissima (Mill.)Ktze. 66
cavenia H.&A., see Vachellia farnesiana 65, 66
constricta Benth. 66
farnesiana Willd., see Vachellia f. 65, 66
filicioides (Cav.)Trel. 66
greggii Gray 66
roemeriana Scheele 66
suffrutescens Rose 67
tortuosa (L.)Willd. 65
Acaena californica Bitter 90
ACANTHACEAE 336, 337, 387
Acerates 171
Achillea 206
Achyrodes, see Lamarckia 153, 175
Acomastylis, see Sieversia 296
Aconitum columbianum Nutt. 238
delphinifolium DC. 178
Aconogonum, see Polygonum 279
Acorus calamus L. 215
Acrolasia, see Mentzelia 159
Actaea 178, 180
Acuan, see Desmanthus 67
Adelia, see Forestiera 38, 165
Adenocaulon bicolor Hook. 45
Adenostegia, see Cordylanthus 29, 258
Adopogon, see Cynthia 203, 352
Adoxa moschatellina L. 307, 308
ADOXACEAE 307, 308
Aegilops cylindrica Host 186
ovata L. 181
Aeschynomene virginica (L.)B.S.P. 392
Aesculus 385
Afzelia, see Seymeria 121, 123
Agalinis, see Gerardia 123
Agastache, see Lophanthus 257
Ageratum conyzoides L. 339
Agoseris *agrestis* Osterh., see A. taraxacifolia 352
arizonica Greene 141, 352, 354
aurantiaca (Hook.)Greene 352, 354
barbellulata Greene 352
cuspidata (Pursh)Dietr. 352, 354
elata (Nutt.)Greene 352, 354
glauca (Nutt.)Greene 203, 352, 354
gracilens (Gray)Ktze. 352
gracilens greenei (Gray)Blake 352
grandiflora (Nutt.)Greene 352, 354
heterophylla (Nutt.)Greene 352
hirsuta (Hook.)Greene 352
laciniata (Nutt.)Greene 141, 352
leptocarpa Osterh., see A. arizonica 141, 352, 354
montana Osterh. 352
plebia Greene 352
purpurea Greene, see A. aurantiaca 352, 354
taraxacifolia (Nutt.)Dietr. 352
turbinata Rydb. 352
villosa Rydb. 352
spp. 199
Agrimonia 14, 15, also:
mollis Britt., see A. pubescens 15, 295
pubescens Ait. 15, 295
Agropyron albicans Scribn.&Sm. 151, 180
caninum (L.)Beauv. 151, 175, 179
cristatum Beauv. 186
dasystachyum (Hook.)Scribn. 151, 175, 179, 186
desertorum Schult. 186
elongatum Host 186
flexuosum Piper 179
griffithsii Scribn.&Sm. 186
lanceolatum Scribn.&Sm. 179
molle (Scribn.&Sm.)Rydb. 179
obtusifolium Lange 186
occidentale Scribn., see A. smithii 151, 153, 175, 179, 180, 182, 186
palmeri (Scribn.&Sm.)Rydb. 151
pseudorepens (Scribn.&Sm.) 151, 175, 179
repens (L.)Beauv. 151, 153, 175, 180, 186
richardsonii (Trin.)Schrad. 175, 180, 186
smithii Rydb. 151, 153, 175, 179, 180, 182, 186
spicatum (Pursh)Scribn.&Sm. 179, 186, 272
tenerum Vasey 152, 153, 175, 179, 180, 182, 186
violaceum (Hornem.)Lange 179, 182
Agrostis alba L. 153, 174, 183
diegoensis Vasey 153, 174
exarata Trin. 146, 153, 174
hallii Vasey 185
hyemalis (Walt.)B.S.P. 146, 174, 183
longiligula Hitchc. 153
pallens Trin. 185
palustris Huds. 153, 174, 185
perennans (Walt.)Tuckerm. 174, 183
scabra Willd., see A. hyemalis 146, 174, 183
thurberiana Hitchc. 153
Aira *aquatica* L., see Catabrosa a. 150
caespitosa L., see Deschampsia c. 151, 153, 174, 185
danthonioides Munro, see Deschampsia d. 174, 185
elongata Hook., see Deschampsia e. 174, 185
holciformis Steud., see Deschampsia h. 174
Alchemilla filicaulis Buser 98
Aletris 227
Allenrolfea occidentalis Wats. 392
ALLIACEAE 137, 222–226, 272, 274–276
Allionia comata Small 158
ALLIONIACEAE 158, 384
Allium acuminatum Hook. 222, 224
attenuifolium Kellogg 222

bisceptrum Wats. 276
brandegei Wats. 222
brevistylum Wats. 224
campanulatum Wats. 224
canadense L. 137, 223
cepa L. 222, 226
cepa bulbifera Bailey 226
cernuum Roth 222, 223
geyeri Wats. 224
hickmani Eastw. 222
mutabile Michx. 137
nevii Wats. 223
precox Brand. 222
recurvatum Rydb. 223
reticulatum Fraser, see A. textile 137, 222, 224, 276
scaposum Benth. 222
schoenoprasum L. 222
serratum Wats. 222
stellatum Ker 137, 223
striatum Jacq., see Nothoscordium bivalve 177, 276
textile Nels.&Macb. 137, 222, 224, 276
unifolium Kellogg 222, 223
validum Wats. 223, 224, 225
sp. 135
Alnus 23
Alopecurus alpinus L. 150
aristulatus Michx. 150, 153, 174, 183
californicus Vasey 174
occidentalis Scribn., see A. alpinus 150
pratensis L. 174, 180
Alsine, see Stellaria 21, 158, 236
Althaea ficifolia (L.)Cav. 246
rosea (L.)Cav. 133, 143, 144, 246, 247
AMARANTHACEAE 158, 235
Amaranthus 158
Amarella, see Gentiana 323
AMARYLLIDACEAE 227, 279
Ambrosia *artemisiaefolia* Gray, see A. elatior 190
coronopifolia T.&G. 190, 216
elatior L. 190
media Rydb. 190
psilostachya Gray, see A. coronopifolia 190, 216
trifida L. 189, 190
AMBROSIACEAE 189, 190, 216, 263, 338, 387
Amelanchier alnifolia Nutt. 358, 361, 362, 364, 367, 373, 376, 377
bakeri Greene 361, 364, 376
botryapium DC., see A. canadensis 360, 362, 364, 369, 373, 377
botryapium Hook., see A. intermedia 360, 362, 369, 373, 377
canadensis (L.)Medic. 360, 362, 364, 369, 373, 377
elliptica Nels., see A. florida 358, 364, 373, 376
erecta Blanch. 362, 369, 377
florida Lindl. 358, 364, 373, 376
humilis Wieg. 365
intermedia Spach 360, 362, 369, 373, 377
jonesiana Scheid. 365
laevis Wieg. 369
mormonica Schneid. 365, 376
oblongifolia (T.&G.)Roem. 362, 369, 373, 377
oligocarpa (Michx.)Roem. 362
oreophila Nels. 361, 364, 365, 373, 376
pallida Greene 358
polycarpa Greene 365, 373, 376
prunifolia Greene 361
pumila Nutt. 365, 373, 376
rotundifolia Roem., see A. sanguinea 362, 377
sanguinea (Pursh)DC. 362, 377
spicata (Lam.)Koch 362, 365
utahensis Koehne 362, 376
vulgaris Moench 369
Amianthium muscaetoxicum (Walt.)Gray 220
AMMIACEAE 100, 192, 280, 281, 314–321, 386
Ammophila arenaria (L.)Link 153
Amorpha 77
Amphicarpa 122
Amsinckia 159
Amsonia *amsonia* Britt., see A. tabernaemontana 39
angustifolia Walt., see A. ciliata 39
ciliata Walt. 39
salicifolia Pursh 166
tabernaemontana Walt. 39
AMYGDALACEAE 72
Amygdalus persica L. 72
ANACARDIACEAE 70, 71
Anaphalis 265
Anchistia virginica (L.)Presl 4
Anchusa, see Lycopsis 181
Andropogon *furcatus* Muhl., see A. provincialis 119, 120, 124
glomeratus (Walt.)B.S.P. 119, 120
halepensis Brot., see Sorghum h. 125
hallii Hack. 120, 124
nutans L. see Sorgastrum n. 118
provincialis Lam. 119, 120, 124
scoparius Michx. 119, 120
semiberbis (Nees)Kunth 119
sorghum Brot., see Sorghum vulgare 125
stolonifer (Nash)Hitchc. 125
ternarius Michx. 120
virginicus L. 119, 120
Androsace chamaejasme Host 252
Anemone canadensis L. 156, 157, 180
caroliniana Walt. 72
coronaria L. 72
cylindrica Gray 157, 180, 238
decapetala Ard. 73
drummondii Wats. 184
globosa Nutt. 180, 238
hudsoniana Richards. 180
lithophila Rydb. 73
multifida Gray, see A. hudsoniana 180
nemorosa L. 180
oregana Gray 73
parviflora Michx. 73, 184
patens nuttalliana Gray, see Pulsatilla ludoviciana 74, 184
pennsylvanica L., see A. canadensis 156, 157, 180
piperi Britt. 73, 178
quinquefolia L. 72, 73, 180
riparia Fern. 157, 180
sphenophylla Britt., see A. tuberosa 73
tetonensis Porter 73
thalictroides L., see Syndesmon t. 180
tuberosa Rydb. 73
virginiana L. 157, 180
zephyra Nels. 288
Angelica ampla Nels. 281
atropurpurea L. 319
breweri Gray 319
dilatata Nels. 280
genuflexa Nutt. 319
grayi C.&R. 281
lyalli Wats. 319
tomentosa Wats. 319
villosa (Wats.)B.S.P. 319

Anisacanthus thurberi Gray 337
Anisocarpus madioides Nutt. 45
Annona 392
ANNONACEAE 392
Anogra nuttallii (Sweet) Nels. 385
Anthoxanthum aristatum Boiss. 174
odoratum L. 151, 174
Anticlea, see Zygadenus 220, 221
Antiphylla oppositifolia (L.) Fourr. 56
Antirrhinum 258
Apargia autumnalis (L.) Hoffm. 352
Apios tuberosa Moench 122
Aplopappus *lanceolatus* T.&G., see Pyrrocoma l. 44
nuttallii T.&G., see Sideranthus grindelioides 140, 142
squarrosus H.&A., see Hazardia s. 142
APOCYNACEAE 39, 166, 324, 386
Apocynum androsaemifolium L. 386
cannabium L. 166, 386
hypericifolium Ait., see A. sibiricum 166
sibiricum Jacq. 166
Aquilegia 178
Arabis ambigua DC. 149
arcuata Gray 149
bolanderi Wats. 147
brachycarpa (T.&G.) Britt. 147
breweri Wats. 149
canescens Nutt. 147, 149
connexa Greene 147
crandallii B.L.Rob. 148, 149
cusickii Wats. 148
divaricarpa Nels. 149
drummondii Gray 148, 149
exilis Nels. 148, 149
fendleri (Wats.) Greene 148
furcata Wats. 149
holboellii Am.auth., see A. retrofracta 148, 149
holboellii Hornem. 149
lignifera Nels. 148
lignipes Nels. 149
lyallii Wats. 148, 149
lyallii occidentalis Wats. 149
lyrata L. 148
menziesii Hook., see Phoenocaulis cheiranthoides 148
microphylla Nutt. 149
nuttallii B.L.Rob. 148
oreophylla Rydb. 149
ovata (Pursh) Poir. 148
pedicellata Nels., see Phoenocaulis p. 148
pendulocarpa Nels. 149
perennans Wats. 149
platysperma Gray 148
retrofracta Grah. 148, 149
selbyi Rydb. 148
whitedii Piper 148
Araccacea, see Velaea 317
ARACEAE 215
Arachis hypogaea L. 244
Aragallus, see Oxytropis 302, 303
Aralia 100
ARALIACEAE 100, 314
Arbutus menziesii Pursh 18
Arctagrostis arundinacea (Trin.) Beal 138
Arctium minus Schl. 349
Arctostaphylos *alpina* L., see Mairania a. 18
hookeri G.Don 18
nevadensis Gray 18
patula Greene 18
uva-ursi (L.) Spreng. 36
Arenaria burkei Howell 285
congesta Nutt. 236, 285
douglasii Fenzl 236
fendleri Gray 285
glabrescens (Wats.) Howell 236
lateriflora L., see Moehringia l. 168, 236
laxiflora Rydb. 285
peploides, see Honkenya p. 236
physodes Fisch., see Merckia p. 236
stricta Michx. 236
uintahensis Nels. 236
Argemone intermedia Sweet 384
Arisaema 215
Aristida 160, also:
adscensionis L. 159
arizonica Vasey 138
bromoides H.B.K., see A. adscensionis 159
ARISTOLOCHIACEAE 229
Armeniaca vulgaris Lam. 72
Armeria vulgaris Willd. 252
ARMERIACEAE, see PLUMBAGINACEAE
Arnica cana Greene 217
celsa Nels. 217
chamissonis Less. 217
cordifolia Hook. 217, 345
diversifolia Greene 345
foliosa Nutt. 345
fulgens Pursh 345
latifolia Bong. 345
latifolia viscidula Gray, see A. diversifolia 345
mollis Hook. 217
pedunculata Rydb., see A. fulgens 345
rhizomata Nels., see A. foliosa 345
stricta Nels. 217
subplumosa Greene 345
Aronia arbutifolia (L.) Ell. 362, 365, 366, 373
atropurpurea Britt. 362, 366
melanocarpa (Michx.) Ell. 362, 366
monstrosa Zabel 362
nigra Britt., see A. melanocarpa 362, 366
sp. 371
Arrhenatherum 174
Artemisia albula Wooton 206
arbuscula Nutt. 343
argophylla Rydb. 205
aromatica Nels. 205, 343
biennis Willd. 205
bigelovii Gray 343
brittonii Rydb. 205, 343
californica Less. 206, 343
camporum Rydb. 205, 343
cana Pursh 205, 343
carruthii Wood 205, 343
caudata Michx. 205
coloradensis Osterh. 343
cuneata Rydb. 343
diversifolia Rydb. 343
douglasiana Bess. 343
dracunculoides Pursh 205, 343
elatior (T.&G.) Rydb. 343
filifolia Torr. 205
forwoodii Rydb., see A. camporum 205, 343
forwoodii Wats. 205
franserioides Greene 205
frigida Willd. 205, 206, 343
glauca Pall. 205
gnaphalodes Nutt. 205, 206, 343
heterophylla Nutt. 205, 206, 343
hookeriana Bess. 206
kansana Britt., see A. carruthii 205, 343
longifolia Nutt. 205, 343
ludoviciana Nutt. 206, 343
mexicana Willd. 206, 343

nova Nels. 343
pabularis (Nels.) Rydb. 343
pacifica Nutt. 306
parishii Gray 343
purshiana Bess. 206, 343
pycnocephala DC. 343
redolens Gray 343
rigida (Nutt.) Gray 343
scouleriana Rydb., see A. pacifica 206
serrata Nutt. 343
silvicola Osterh., see A. mexicana 206, 343
spinescens Eaton 343
suksdorfii Piper 206, 343
tridentata Nutt. 343, 344
trifida Nutt., see A. tripartita 206, 343
tripartita Rydb. 206, 343
viscidula Osterh. 343
vulgaris L. 343
wrightii Gray 343
ARTOCARPACEAE 61
Arundinaria 188
Arundo donax L. 153
Asarum 229
ASCLEPIADACEAE 166, 171, 172, 324
Asclepias amplexicaulis J.E.Sm. 324
arenaria Torr. 171, 324
brachystephana Engelm. 171
cornuti Dec., see A. syriaca 166, 171, 325
curassavica L. 324
decumbens L. 324
exaltata (L.) Muhl. 324
galioides H.B.K. 171
incarnata L. 325
jamesii Torr., see A. latifolia 171, 325
latifolia (Torr.) Raf. 171, 325
obtusifolia Michx., see A. amplexicaulis 324
ovalifolia Dec. 171
phytolaccoides Pursh, see A. exaltata 324
pulchra Ehrh. 166, 325
pumila (Gray) Vail 171
purpurascens L. 325
quadrifolia Jacq. 325
rolfsii Britt. 325
speciosa Torr. 166, 171, 325
syriaca L. 166, 171, 325
tuberosa L. 171, 325
verticillata L. 171
Asclepiodora decumbens (Nutt.) Gray 171, 325
viridis (Walt.) Gray 171, 325
Ascyrum hypericoides L. 247
Asparagus officinalis L. 226
Aspidium *filix-mas* Sw., see Dryopteris f. 4
marginale Sw., see Dryopteris m. 9
munitum Kaulf., see Polystichum m. 7, 9
thelypteris Sw., see Drypoteris t. 4
Asplenium, see Athyrium 4
Aster amethystinus Nutt. 140
arenarioides Gray, see Erigeron a. 142
exiguus (Fern.) Rydb. 140
frondosus T.&G., see Brachyactis f. 44
glaucus T.&G., see Eucephalus g. 142, 202
lindleyanus T.&G. 217
macrophyllus L. 217, 218
multiflorus Ait. 140
paniculatus Lam. 202
porteri Gray 140
spinosus Benth., see Leucosyris s. 266
umbellatus Mill., see Doellingeria u. 44
spp. 44, 197, 202
Astragalus 301, 302, also:
alpinus L. 303
flexuosus Dougl. 302, 303
frigidus Gray, see Phaca f. 303
macounii Rydb. 303
Atelophragma, see Astragalus 303
Atenia, see Carum 281
Athyrium cyclosorum Rupr. 4
Atriplex californica Moq. 235
canescens (Pursh) Nutt. 235
confertifolia (Torr.) Wats. 235
hastata L. 158
leucophylla Dietr. 235
patula L. 160
polycarpa Wats. 235
rosea L. 158
wolfii Wats. 158
Audibertia, see Audibertiella 257
Audibertiella 257
Aulospermum 317
Aureolaria 121
Avena barbata Brot. 152, 174, 178
fatua L. 153, 174, 178
fatua glabrata Peterm. 174
sativa L. 153, 174, 178
smithii Porter, see Melica s. 272
Azalea 18

Baccharis 266
BALSAMINACEAE 30, 182, 308
Balsmorhiza 342
Bambos aureo-striata Regel 188
Baptisia 122
Beckmannia erucaeformis (L.) Host 153, 170, 174
Bellis perennis L. 219
Beloperone californica Benth. 337
Benthamantha 78
BERBERIDACEAE 75, 138, 149, 151, 173, 245, 289
Berberis *aquifolium* Pursh, see Mahonia a. 75, 149
atrocarpa Schneid. 75
canadensis Mill. 173
dictyota Jepson, see Mahonia d. 75
fendleri Gray 149, 151
fremontii Torr., see Mahonia f. 75
haematocarpa Wooton, see Mahonia h. 75
nervosa Pursh, see Mahonia n. 75
pinnata Lag., see Mahonia p. 75
pumila Greene, see Mahonia p. 75
repens Lindl., see Mahonia r. 75, 150, 245
trifoliata Hartw., see Mahonia trifoliolata 76
trifoliolata Moric., see Mahonia t. 76
vulgaris L. 173
sp. 138
Berchemia scandens (Hill.) Trel. 152
Besseya 334
Beta cicla L. 234
vulgaris L. 158, 234
Betula 22
BETULACEAE 22, 23
Bicuculla, see Dicentra 62
Bidens connata Muhl. 188
expansa Greene 342
frondosa L. 188
glaucescens Greene 188
leucantha L. 342
pilosa L. 342
trichosperma (Michx.) Britt. 188
Bigelovia, see Chrysothamnus 140, 142
Bilderdykia, see Polygonum 232, 233
Bistorta bistortoides (Pursh) Small 280
vivipara (L.) S.F.Gray 231, 280
Bivonea, see Cnidoscolus 310

Blephilia 328
Bletia purpurea (Lam.)DC. 392
Blitum capitatum L. 158
Boehmeria cylindrica (L.)Sw. 383
Boisduvalia densiflora (Lindl.)Wats. 248
glabella (Nutt.)Walp. 250, 313
parviflora Heller 248
salicina (Nutt.)Rydb. 248
sparsiflora Heller 248
stricta (Gray)Greene 248, 313
torreyi Wats., see B. stricta 248, 313
Boltonia 197
BORAGINACEAE 147, 159, 181, 182, 256, 327, 386
Borreria terminalis Small 261
Borrichia arborescens (L.)DC. 342
frutescens (L.)DC. 342, 388
Bouteloua barbata Lag. 171
curtipendula (Michx.)Torr. 171, 172, 173
gracilis (H.B.K.)Lag. 171
hirsuta Lag. 171
oligostachya Torr., see B. gracilis 171
racemosa Lag., see B. curtipendula 171, 172, 173
Bouvardia 337
Brachyactis frondosa (Nutt.)Gray 44
Brachychaeta 198
Brachyelytrum erectum (Schreb.)Beauv. 130
Brassica juncea (L.)Cosson 158
BRASSICACEAE 147–149, 158, 239, 290, 291, 292
Brayulinea densa (Willd.)Small 235
Brickellia californica T.&G. 42
coulteri Gray 339
grandiflora (Hook.)Nutt. 340, 388
Briza 174
Brodiaea capitata Benth. 272, 275
congesta Smith, see B. pulchella 274, 275
douglasii Wats. 225, 272, 274
ixioides Wats. 225
lactea (Lindl.)Wats. 225
laxa (Benth.)Wats. 225
multiflora Benth. 274
pauciflora (Torr.)Standl. 275
pulchella (Salisb.)Greene 274, 275
Bromus carinatus hookerianus (Thurb.) Shear 178, 186
ciliatus L. 153, 180, 186
ciliatus laeviglumis Scribn. 180
commutatus Schrad. 178
eximius (Shear)Piper 178
grandis (Shear)Hitchc. 179
hookerianus Thurb., see B. carinatus h. 178, 186
hordeaceus L. 174, 179
japonicus Thunb. 174, 180
latiglumis (Shear)Hitchc. 180
madritensis L. 179
marginatus Nees 179, 186
maximus Desf., see B. villosus 179
mollis L., see B. hordeaceus 174, 179
pacificus Shear 186
polyanthus Scribn. 153, 174, 179
porteri (Coult.)Nash 153, 179
porteri lanatipes Shear 179
pumpellianus Scribn. 153, 174, 179
purgans L. 174, 180
racemosus L. 179
richardsonii Link 153, 179
rigidus Roth 179
rubens L. 179
scoparius L. 179
secalinus L. 174, 180
sitchensis Bong. 179, 186
sterilis L. 179
subvelutinus Shear 179
tectorum L. 174, 179
tectorum nudum Mert.&Koch 174
unioloides (Willd.)H.B.K. 186
villosus Forsk. 179
villosus gussonei Aschers.&Graebn. 179
Buchloë dactyloides (Nutt.)Engelm. 273
Buckleya distichophylla (Nutt.)Torr. 28
Bulbilis, see Buchloë 273
Bursa, see Capsella 158

Cacalia 388
CAESALPINIACEAE 67, 68, 384
Cajan, see Cajanus 244
Cajanus 244
Calamagrostis aleutica Bong. 138, 153
canadensis (Michx.)Beauv. 138, 153, 174
elongata (Kearney)Rydb. 153
hyperborea Lange 153, 174
koelerioides Vasey 153
montanensis Scribn. 153
neglecta (Ehrh.)Gaertn. 153
purpurascens R.Br. 153
rubescens Buckl. 153
scopulorum Jones 153
Calamovilfa 145
Calendula officinalis L. 271
Calliandra 67
Callirhoë alceoides (Michx.)Gray 131, 143
digitata Nutt. 131, 143
involucrata (T.&G.)Gray 133, 143
Callistephus hortensis Cass. 44
Calochortus 276, 277
Calonyction aculeatum (L.)House 39
Calophanes oblongifolia (Michx.)D.Don 387
Calopogon, see Limnodorum 229
Caltha biflora DC. 237, 238, 287
howellii Greene 237, 238
leptosepala DC. 237, 238, 287
palustris L. 237, 287
rotundifolia (Huth)Greene 237, 287
Calycadenia, see Hemizonia 269
Calyptridium 284
Camelina microcarpa Andrz. 158
Campanula *americana* L., see Campanulastrum a. 40, 387
amplexicaulis Michx., see Specularia perfoliata 40
aparinoides Pursh 40
divaricata Michx. 40
intercedens Witasek 262
perfoliata L., see Specularia p. 40
persicifolia L. 40
petiolata A.DC. 262
rapunculoides L. 40
rotundifolia Am.auth., see Campanula intercedens 262
rotundifolia Am.auth., see Campanula petiolata 262
scouleri Hook. 262
uniflora L. 262
CAMPANULACEAE 40, 262, 387
Campanulastrum americanum (L.)Small 40, 387
Capnoides, see Corydalis 158, 290
CAPPARIDACEAE 159
CAPRIFOLIACEAE 40, 155, 162, 163, 204, 337, 387
Capriola, see Cynodon 170
Capsella bursa-pastoris (L.)Medic. 158
Cardamine bellidifolia L. 292
cordifolia Gray 292
douglasii (Torr.)Britt. 290
Cardiospermum 246

CARDUACEAE 41–49, 62, 140, 141, 145, 146, 164, 188, 190, 193–202, 205, 206, 216, 218, 219, 264–271, 338–350, 388
Carex aestivalis Curt. 209
aquatilis Wahl. 211
arcta Boott 212
arctata Boott 209
aristata R.Br., see C. atherodes 211
atherodes Spreng. 211
bebbii Olney 204
brevior (Dewey) Mack. 198
brunnescens (Pers.) Poir. 212
bullata Schk. 204
canescens L. 214
canescens alpicola Wahl., see C. brunnescens 212
comosa Boott 204, 205
complanata Torr. 209
conoidea Schk. 209
costellata Britt., see C. virescens 209
crinita Lam. 204
crus-corvi Shuttl. 204
debilis rudgei Bailey, see C. flexuosa 209, 210
diandra Schk. 206, 214
douglasii Boott 206
eburnea Boott 211
eleocharis Bailey 206
exsiccata Bailey 214
festivella Mack. 197
filifolia Nutt. 206
filiformis Gooden., see C. lasiocarpa 203
flexuosa Muhl. 209, 210
foenea Willd. 197
frankii Kunth 204, 214
geyeri Boott 206
gracillima Schw. 209, 210, 394
heliophila Mack. 206
hirtifolia Mack. 209
hoodii Boott 206
inops Bailey 206
intumescens Rudge 200, 204, 394
jamesii Schw. 198
lanuginosa Michx. 199, 200, 211, 394
lasiocarpa Ehrh. 203
liddonii Boott, see C. petasata 206
limosa L. 212
longirostris Torr., see C. sprengelii 200, 214
lupulina Muhl. 204, 210
lupuliformis Sartw. 204
lurida Wahl. 204, 214
magellanica Am.auth., see C. paupercula 214
marcida Boott, see C. praegracilis 206
multicaulis Bailey 206
muskingumensis Schw. 394
nigricans C.A.Mey. 206
oblita Steud. 209
obtusata Lilj. 206
oligocarpa Schk. 206
pallescens L. 209
paupercula Michx. 214
paupercula irrigua Fern., see C. paupercula 214
pennsylvanica Lam. 200
petasata Dewey 206
plantaginea Lam. 209
praegracilis W.Boott 206
pubescens Muhl. 209, 394
rossii Boott 206
scabrata Schw. 214
scoparia Schk. 198, 200
setifolia Britt., see C. eburnea 211
sparganioides Muhl. 197, 200
sprengelii Dewey 200, 214
stenolepis Torr., see C. frankii 204, 214
stenophylla Am.auth., see C. eleocharis 206
stipata Muhl. 198, 199
stratiformis Britt. 212
stricta L. 208
strictior Dewey 214
substriata (Kükenth.) Mack. 203
tenuis Rudge, see C. flexuosa 209, 210
teretiuscula Gooden., see C. diandra 206, 214
torta Boott 208
tribuloides Wahl. 204
triceps Michx. 394
trichocarpa Muhl. 199, 204
trisperma Dewey 197
tuckermani Dewey 214
utriculata Boott 210
verrucosa Muhl. 213
vestita Willd. 205
virescens Muhl. 209, 394
viridula Michx. 211
vulpinoidea Michx. 198
spp. 197–200, 207, 212, 213
Carpinus, see Ostrya 23
Carthamus tinctorius L. 349
Carum 281
CARYOPHYLLACEAE 21, 158, 168, 236, 285, 286
Caryopitys, see Pinus 28, 37
Cassandra, see Chamaedaphne 34
Cassia 68, also:
chamaecrista Am.auth., see Chamaecrista fasciculata 68, 384
Castilleja christo-galli Rydb. 29
coccinea (L.) Spreng. 121
confusa Greene 29
crispula Piper 29
douglasii Benth. 29
exilis Nels. 259
exilis minor Gray, see C. exilis 259
foliolosa H.&A. 29, 121, 259
integra Gray 29, 121
latifolia H.&A. 29
linariaefolia Benth. 30
miniata Dougl. 30
pallida (L.) Kunth 30
sessiliflora Pursh 121
stenantha Gray 259
sulphurea Rydb. 30, 121
spp. 124
Catabrosa aquatica (L.) Beauv. 150
Ceanothus 124
Cenchrus 127
Centaurea americana Nutt. 349
cyanus L. 350
Centaurium calycosum (Buckl.) Fern. 159
Centromadia pungens (H.&A.) Greene 45
Cephalanthus occidentalis L. 166, 393
Cerastium 21, also;
alpinum L. 21, 236
strictum L. 236
Ceropteris, see Pityrogramma 11
Chaerophyllum 315
Chaetochloa, see Setaria 126, 127, 129
Chamaecrista aspera (Muhl.) Greene 68
fasciculata (Michx.) Greene 68, 384
multipinnata (Pollard) Greene 68
Chamaecyparis nootkatensis (Lamb.) Spach 358
thyoides (L.) B.S.P. 360, 361, 366
Chamaedaphne calyculata (L.) Moench 34
Chamaenerion exaltatum Rydb. 15
latifolium (L.) Sweet 15, 273
spicatum (Lam.) S.F.Gray 15, 199, 203
Chamaepericlimenum, see Cornus 251

Chamaesaracha nana Gray 332
coronopus (Dunal) Gray 159
Chamaesyce 309, 310
Cheilanthes pringlei Dav. 11
Cheiranthus, see Erysimum 149
Cheirinia 158
Chelone glabra L. 121
lyoni Pursh 121
nemorosa Dougl. 333
CHENOPODIACEAE 134, 157, 158, 160, 234, 235, 282, 283, 392
Chenopodium 158, 160
Chimaphila 16
Chiogenes 33
Chloris elegans H.B.K. 170
verticillata Nutt. 171
Chlorogalum pomeridianum Kunth 225
Choenomeles japonica (Thunb.) Lindl. 358, 362
Chondrilla juncea L. 355
Chorizanthe 230
Chrosperma, see Amianthium 220
Chrysanthemum 270
Chrysobotrya, see Ribes 27, 28, 37, 38, 56, 139, 209
Chrysogonum 198
Chrysoma laricifolia (Gray) Greene 141
pauciflosculosa (Michx.) Greene 44
Chrysopogon, see Sorgastrum 118
Chrysopsis bakeri Greene 141
berlandieri Greene 141
caudata Rydb. 44
falcata (Pursh) Ell. 190
fastigiata Greene 142
hirsutissima Greene 44
horrida Rydb. 44
imbricata Nels. 142
resinolens Nels. 142
scabrella T.&G. 44
villosa (Pursh) Nutt. 44, 140, 142
Chrysothamnus 142, also:
graveolens (Nutt.) Greene 140, 142
pulcherrimus Nels. 140, 142
pumilus Nutt. 140, 142
serrulatus (Torr.) Rydb. 140
viscidiflorus (Hook.) Nutt. 140, 142
spp. 198
Chylismia cardiophylla (Torr.) Small 248
hirta Nels. 248
scapoidea Nutt. 159, 313
CICHORIACEAE 49, 141, 142, 199, 203, 216, 220, 271, 350–355, 382
Cichorium endivia L. 352
intybus L. 352
spp. 216
Cicuta bolanderi Gray 316
bulbifera L. 192
californica Gray 316
curtisii C.&R. 316
maculata L. 192, 316
occidentalis Greene 316
vagans Greene 316
Cimicifuga racemosa (L.) Nutt. 180
Cinna arundinacea L. 153, 174, 183
latifolia (Trev.) Griseb. 153, 174, 183
Circaea 250, 251
Cirsium 348, also:
arvense (L.) Scop. 347
canescens Gray, see C. flodmanii 217, 348
flodmanii (Rydb.) Arth. 217, 348
foliosum (Hook.) DC. 217, 348
hookerianum Nutt. 217
lanceolatum (L.) Hill 347, 348
megacephalum (Gray) Cockerell 217, 348
undulatum (Nutt.) Spreng. 217, 348
Cissus incisa (Nutt.) DesMoul. 385
Cladium 192
Clarkia 248, also:
elegans Dougl. 15, 248
superba Nels.&Macbr. 15, 248
Claytonia 283, 284
Clematis *douglasii* Hook., see Viorna hirsutissima 178
drummondii T.&G. 180
lasiantha Nutt. 178, 184
ligusticifolia Nutt. 178
pauciflora Nutt. 178
viorna L., see Viorna urnigera 180
virginiana L. 180
sp. 238
Cleome 159
Cleomella 159
Clinopodium vulgare L. 328
Clintonia 278
Cnidoscolus stimulosus Gray 310
Coccolobis uvifera (L.) Jacq. 392
Cochlearia 291
Coeloglossum, see Habenaria 383
Coelopleurum gmelini (DC.) Ledeb. 100, 280, 320
Cogswellia 317, also:
geyeri (Wats.) Jones 281
gormani (Howell) Jones 281, 317
Coleosanthus, see Brickellia 42, 339, 340, 388
Collinsia bicolor Benth. 258
parviflora Dougl. 258, 387
rattani Gray 258
Collomia *gilioides* Benth, see Gilia g. 254
gracilis Dougl., see Microsteris g. 326
grandiflora (Gray) Dougl. 254
linearis Nutt. 168
micrantha Kellogg, see Microsteris m. 326
Colutea arborescens L. 298
Comandra livida Richards. 28
pallida A.DC. 28, 122, 124
umbellata (L.) Nutt. 29, 122, 124
Commelina 216
COMMELINACEAE 216
COMPOSITAE, see CARDUACEAE
Comptonia peregrina (L.) Coult. 25, 360
Coneoselinum scopulorum (Gray) C.&R. 100, 281
Conoclinium 339
CONVALLARIACEAE 130, 168, 226, 278
Convolvulus 254, also:
sepium L. 39, 254
CONVOLVULACEAE 39, 253, 254, 325
Cooperia 227
Cordylanthus filifolius Nutt. 258
pilosus Gray 258
rigidus (Benth.) Jepson 29, 258
tenuis Gray 29
Coreopsis 46
Coriophyllus, see Aulospermum 317
CORNACEAE 251
Cornus canadensis L. 251
CORRIGIOLACEAE 392
Corydalis brandegei Wats. 290
micrantha (Engelm.) Gray 158
montana Engelm. 158
scouleri Hook. 290
CORYLACEAE 23
Coursetia glandulosa Gray 78
Cracca 69
CRASSULACEAE 239, 292
Crataegus *apiifolia* Michx., see C. marshallii 372
brevispina Dougl., see C. douglasii 358, 362, 374, 376
cerronis Nels., see C. erythropoda 374
chrysocarpa Ashe 362, 374, 376
clara Beadle 361

coccinea L. 362, 375
colonica Beadle 362
coloradensis Nels. 374
cordata Ait., see C. phaenopyrum 363, 372
crus-galli L. 362, 375
dispar Beadle 361, 362
douglasii Lindl. 358, 362, 374, 376
egens Beadle 361
egregia Beadle 361
erythropoda Ashe 374
flava Ait. 362
flavo-carnis Ashe 372
holmesiana Ashe 363
jonesae Sarg. 363
marshallii Eggl. 372
michauxii Pers. 361
modesta Sarg., see C. coccinea 362, 375
mohrii Beadle 375
mollis (T.&G.)Scheele 363, 375
monogyna Jacq. 372
munda Beadle 361
occidentalis Britt. 374
oxyacantha Auth., see C. monogyna 372
parvifolia Ait., see C. unifolia 363
pexa Beadle 361
phaenopyrum (L.f.)Medic. 363, 372
punctata Jacq. 363, 375
quasita Beadle 361
reverchoni Sarg. 363
rivularis Nutt. 374
rotundifolia Moench 363
saligna Greene 374
sheridana Nels., see C. chrysocarpa 362, 374, 376
spathulata Michx. 363, 378
tenuifolia Britt., see C. holmesiana 363
tracyi Ashe 368
tomentosa L. 375
unifolia Moench 363
viridis L. 361
visenda Beadle 361
williamsii Eggl. 376
Crepis acuminata Nutt. 141, 352
angustata Rydb. 352
barbigera Leib. 354
denticulata Rydb. 354
glauca (Nutt.)T.&G. 141, 352, 354
gracilis (Eaton)Rydb. 352
intermedia Gray 352, 354
occidentalis Nutt. 352, 354
pleurocarpa Gray 352
runcinata (James)T.&G. 352, 354
scopulorum Cov. 352
subacaulis (Kellogg)Cov. 352
spp. 199
Cressa 325
Croton 60, also:
monanthogynus Michx. 60, 129
Crotonopsis linearis Michx. 60, 129
CRUCIFERAE, see BRASSICACEAE
Cryptantha ambigua (Gray)Greene 256
barbigera (Gray)Greene 159
flaccida (Dougl.)Greene 256
microstachys Greene 256
pterocarya (Torr.)Greene 159
torreyana (Gray)Greene 256
Cryptogramma acrostichoides R.Br. 9
stelleri (S.G.Gmel.)Prantl 11
Cryptotaenia canadensis (L.)DC. 321
Cunila 328
Cupressus arizonica Greene 371
thyoides L., see Chamaecyparis t. 360, 361, 366
Cyclachaena, see Iva 263
Cydonia *japonica* Pers., see Choenomeles j. 358, 362
vulgaris (L.)Pers. 358, 363, 369, 373, 376
Cymopterus 317, also:
bipinnatus Wats., see Pseudocymopterus b. 316, 318
Cynanchum, see Philibertia 172
Cynodon dactylon (L.)Pers. 170
Cynomarathrum nuttallii Gray 319
parryi (Wats.)C.&R. 317
Cynthia dandelion (L.)DC. 220
virginica (L.)D.Don 203, 352
CYPERACEAE 189–214, 394
Cyperus bushii Britt. 191
cylindricus (Ell.)Britt. 189, 191
echinatus Wood, see C. globosus 191
erythrorhizos Muhl. 189
esculentus L. 189
fendlerianus Böck. 189
filiculmis Vahl 191
flavicomus Michx. 190
globosus Aubl. 191
grayi Torr. 191
hallii Britt. 189
houghtonii Torr. 189, 191
lancastriensis Porter 191
ovularis (Michx.)Torr. 191
pseudovegetus Steud. 191
refractus Engelm. 191
retrofractus (L.)Torr. 191
rotundus L. 189
schweinitzii Torr. 191
speciosus Vahl 189
strigosus L. 189, 191
surinamensis Rottb. 189
torreyi Britt., see C. cylindricus 189, 191
Cypripedium parviflorum Salisb. 229
Cyrilla racemiflora L. 385
CYRILLACEAE 385
Cyrtorhyncha neglecta Greene 288
ranunculina Nutt. 180, 288
Cystopteris, see Filix 4, 11

Dactylis glomerata L. 174, 184
Dalea, see Parosela 122
Dasiphora fruticosa (L.)Rydb. 80
Dasystephana, see Gentiana 253, 322, 323
Dasystoma *macrophylla* Raf., see Seymeria m. 121, 123
virginica Britt., see Aureolaria v. 121
Datura meteloides DC. 159
Daucophyllum tenuifolium (Nutt.) Rydb. 318
Decodon verticellatus (L.)Ell. 203
Delphinium 17, 18, also:
tricorne Michx. 180
virescens Nutt. 180
sp. 289
Dentaria tenella Pursh 239
Deringa, see Cryptotaenia 321
Deschampsia caespitosa (L.)Beauv. 151, 153, 174, 185
calycina Presl, see D. danthonioides 174, 185
danthonioides Trin. 174, 185
elongata (Hook.)Munro 174, 185
holciformis Presl 174
Desmanthus jamesii T.&G. 67
Desmodium 241, also:
dillenii Darl. 122, 241
grandiflorum (Walt.)DC. 122, 241
Deweya, see Velaea 317
Dianthus barbatus L. 236, 286
caryophyllus L. 286
chinensis L. 286

deltoides L. 236
pelviformis Heuffel 286
Dicentra cucullaria (L.)Bernh. 62
Dichelostemma, see Brodiaea 274, 275
Dichondra 253
Dichrophyllum bicolor (Engelm.&Gray) K.&G. 309
marginatum (Pursh)K.&G. 128, 309
Digitaria, see Syntherisma 127
Dimorphotheca cuneata (Thunb.)DC. 271
Diodella, see Diodia 261
Diodia 261
Diplachne, see Leptochloa 171
Dipterostemon, see Brodiaea 272, 275
Dirca palustris L. 200
Disella, see Sida 143, 247
Distichlis 159, 160
Dodecatheon 322, also:
meadia L. 168
pauciflorum (Durand)Greene 168
thornense Lunell 168
Doellingeria sericocarpoides Small 44
umbellata (Mill.)Nees 44
spp. 197
Dolicholus texanus (T.&G.)Vail 244
Dondia, see Suaeda 158, 160, 235, 282
Draba arabisans Michx. 291
arctica Vahl, see D. hirta 291
aurea Vahl. 291
cuneifolia Nutt. 158
globosa Payson 291
hirta L. 291
incana L. 291
incerta Payson 291
lutea Gilib. 158
spectabilis Greene 149
sp. 148
DRACAENACEAE 382
Dracocephalum, see Physostegia 330
Drudeophytum, see Velaea 317
Dryopteris dilatata (Hoffm.)Underw. 8
dryopteris Britt., see Phegopteris d. 5, 10
filix-mas (L.)Sw. 4
intermedia (Muhl.)Gray 8
marginalis (L.)Gray 9
spinulosa (Müll.)Ktze. 8
spinulosa americana (Fisch.)Fern. 8
spinulosa fructuosa (Gilbert)Trudell 8
thelypteris (L.)Gray 4
Duchesnea indica (Andr.)Focke 93
Dugaldea hoopesii (Gray)Rydb. 145
Dulichium arundinaceum (L.)Britt. 197, 198
Dyschoriste, see Calophanes 387

Eatonia, see Sphenopholis 147, 174
Echinochloa crus-galli (L.)Beauv. 125, 174
ELAEAGNACEAE 152, 211
Elaeagnus angustifolia L. 211
argentata Pursh, see E. commutata 152, 211
commutata Bernh. 152, 211
Eleocharis acicularis (L.)R.&S. 194
arenicola Torr. 193
intermedia (Muhl.)Schult. 193
montana (H.B.K.)R.&S. 194
obtusa (Willd.)Schult. 193
ovata (Roth)R.&S. 193
palustris (L.)R.&S. 193, 194
tenuis (Willd.)Schult. 193
Elephantella, see Pedicularis 30, 336
Elephantopus 42
Ellisia chrysanthemifolia Benth. 187
nyctelea L. 182
Elodea, see Triadenum 247
Elymus ambiguus (Vasey&Scribn.)Scribn. 179
arenarius L. 179
arenicola Scribn.&Sm. 179
australis Scribn.&Ball 175, 180
brachystachys Scribn.&Ball 179
canadensis L. 152, 153, 175, 179, 180, 182, 183, 186
condensatus Presl 175, 179, 187, 272
curvatus Piper 152, 175, 180
diversiglumis Scribn.&Ball 180
flavescens Scribn.&Sm. 175
glabriflorus Scribn.&Sm. 175
glaucus Buckl. 152, 175, 179, 182, 186
howellii Scribn.&Merr. 179, 186
innovatus Beal 153
jejunus (Ram.)Rydb. 180
macounii Vasey 152, 175, 180
marginalis Rydb. 186
mollis Trin. 179, 187
robustus Scribn.&Sm., see E. canadensis 152, 153, 175, 179, 180, 182, 183, 186
striatus Willd. 152, 175, 179, 183
striatus arkansanus (Scribn.&Ball) Hitchc. 183
triticoides Buckl. 175, 179, 272
vancouverensis Vasey 179
virescens Piper 179
virginicus L. 152, 175, 180, 182, 183
Emilia sonchifolia (L)DC. 271
EMPETRACEAE 31
Empetrum nigrum L. 31
Encelia viscida Gray 341
Enslenia albida Nutt., see Gonolobus laevis 172
Ephedra 390
EPHEDRACEAE 390
Epicampes rigens Benth. 139
Epilobium adenocaulon Haussk. 15, 313
adenocaulon occidentale Trel., see E. occidentale 16
alpinum L. 15, 273, 274
americanum Haussk. 313
anagallidifolium Lam. 273, 313
angustifolium L., see Chamaenerion spicatum 15, 199, 203
brevistylum Barbey 15
californicum Haussk. 15
clavatum Trel. 314
coloratum Muhl. 15
densum Raf., see E. lineare 16
franciscanum Barbey 15, 313
glandulosum Lehm. 15
hirsutum L. 15
holosericeum Trel. 16
hornemannii Reichenb. 273, 274
jucundum Gray 313
latifolium L., see Chamaenerion l. 15, 273
lineare Muhl. 16
minutum Lindl. 248, 313
novomexicanum Haussk. 16
occidentale (Trel.)Rydb. 16
palustre L. 16
paniculatum Nutt. 16, 273, 313
platyphyllum Rydb. 16
rubescens Rydb. 273
Eragrostis 162
Eremocarpus, see Piscaria 59
Erianthus 118
ERICACEAE 18, 34, 35, 36
Erigenia bulbosa (Michx.)Nutt. 315
Erigeron annuus (L.)Pers. 190
arenarioides Gray 142
caespitosus Nutt. 142
canadensis L., see Leptilon c. 190

eatonii Gray 142
filifolius (Hook.)Nutt. 142
flagellaris Gray 140
inornatus Gray 44
macranthus Nutt. 142
microlonchus Greene 142
peregrinus (Pursh)Greene 44
pumilus Nutt. 140
ramosus (Walt.)B.S.P. 190
salsuginosus Gray 142, 340
strigosus Muhl., see E. ramosus 190
spp. 198
Eriogonum 230, also:
trichopodum Torr. 158
Eriophorum 195
Eriophyllum 344, also:
staechadifolium (DC.)Lag. 217, 345
Ernodia 261
Erxlebenia, see Pyrola 16, 32
Erysimum *asperum* DC., see Cheirinia a. 158
pallasii (Pursh)Fern. 149
repandum L., see Cheirinia r. 158
Erythronium 278
Eucephalus glaucus Nutt. 142, 202
spp. 197
Euchlaena mexicana Schrad. 117
Eucrypta, see Ellisia 187
Eulobus californicus Nutt. 248
Eulophus parishii C.&R. 318
Eupatorium *ageratoides* L.f., see E. urticaefolium 193, 194, 264
aromaticum L. 193
coelestinum, L., see Conoclinium c. 339
incarnatum Walt. 339
maculatum L. 193
perfoliatum L. 193
purpureum L. 193
rotundifolium L. 193
serotinum Michx. 193
solidaginifolium Gray 339
urticaefolium Reich. 193, 194, 264
verbenaefolium Michx. 193
Euphorbia *albomarginata* T.&G., see Chamaesyce a. 309
arizonica Engelm., see Chamaesyce a. 309
arkansana Engelm.&Gray, see Tithymalus a. 310
barbellata Engelm., see Poinsettia b. 309
bicolor Engelm.&Gray, see Dichrophyllum b. 309
bilobata Engelm., see Zygophyllidium b. 310
chamaesula Boiss., see Tithymalus c. 297, 298
commutata Engelm., see Tithymalus c. 58, 381
corollata L., see Tithymalopsis c. 128
cuphusperma Boiss., see Poinsettia c. 310
cyathophora Murr., see Poinsettia c. 310
cyparissias L., see Tithymalus c. 58, 299, 301
dentata Michx., see Poinsettia d. 310
dictyosperma Fisch.&May., see Tithymalus d. 310
fendleri T.&G., see Chamaesyce f. 309
gerardiana Jacq. 286, 299
geyeri Engelm., see Chamaesyce g. 309
glyptosperma Engelm., see Chamaesyce g. 309
heterophylla L., see Poinsettia h. 310
hexagona Nutt., see Zygophyllidium h. 128
hirsuta Wieg., see Chamaesyce h. 309
hirta L., see Chamaesyce h. 309
humistrata Engelm., see Chamaesyce h. 309
hypericifolia L., see Chamaesyce h. 309
ipecacuanhae L., see Tithymalopsis i. 128
lata Engelm., see Chamaesyce l. 310
leptocera Engelm., see Tithymalus l. 58
lurdia Engelm., see Tithymalus l. 297
maculata L., see Chamaesyce m. 309
marginata Pursh, see Dichrophyllum m. 128, 309
missouriensis Norton, see Tithymalus m. 310, 381
montana Engelm., see Tithymalus m. 298
nutans Lag., see Chamaesyce hyssopifolia 309
nuttallii Engelm., see Chamaesyce n. 309
obtusata Pursh., see Tithymalus o. 310
palmeri Engelm., see Tithymalus p. 58, 298
petaloidea Engelm., see Chamaesyce p. 309
polycarpa Benth., see Chamaesyce p. 309
polygonifolia L., see Chamaesyce p. 309
preslii Guss., see Chamaesyce hyssopifolia 309
prostrata Ait., see Chamaesyce p. 309
robusta Engelm., see Tithymalus r. 58, 297, 298
serpens H.B.K., see Chamaesyce s. 309, 310
serphyllifolia Pers., see Chamaesyce s. 309
stictospora Engelm., see Chamaesyce s. 309
texana Boiss., see Tithymalus leiococcus 381
zygophylloides Boiss., see Chamaesyce nuttallii 309
EUPHORBIACEAE 58, 59, 60, 128, 129, 286, 297, 298, 299, 308, 309, 310, 381
Eurotia lanata (Pursh)Moq. 134
Euryptera 317
Euthamia caroliniana (L.)Greene 45, 198
graminifolia (L.)Nutt. 45, 198
gymnospermoides (Fern.)Greene 45
leptocephala (T.&G.)Greene 45
minor (Michx.)Greene 45
occidentalis Nutt. 198
Evolvulus 253
Eysenhardtia 77
Faba vulgaris Moench., see Vicia faba 243
FABACEAE 69, 76–78, 122, 241–245, 296–307, 392
FAGACEAE 26
Fagara, see Zanthoxylum 122
Falcata, see Amphicarpa 122
Fendlera 359
Festuca arizonica Vasey 174
californica Vasey 174
confinis Vasey 162
eastwoodae Piper 174
elatior L. 150, 153, 164, 174
elmeri Scribn.&Merr. 163, 174
ingrata (Hack.)Rydb. 163
megalura Nutt. 164, 174
myuros L. 174
occidentalis Hook. 163
octoflora Walt. 174, 177

ovina L. 155, 163
pacifica Piper 164, 174
reflexa Buckl. 164
rubra L. 163, 179
saximontana Rydb. 163
scabrella Torr. 163
subulata Trin. 163
tenella Willd., see F. octoflora 174, 177
thurberi Vasey 163
sp. 164
Ficus carica L. 61
Filipendula rubra (Hill) B.L.Rob. 99
Filix bulbifera (L.) Underw. 4
fragilis (L.) Underw. 11
Fimbristylis puberula (Michx.) Vahl 190
Flaveria 271
Fluminia festucacea (Willd.) Hitchc. 153, 180
Forestiera ligustrina Poir. 38
porulosa (Michx.) Poir. 165
Fouquieria splendens Engelm. 385
FOUQUIERIACEAE 385
Fragaria, see Duchesnea 93
Franseria 263
Frasera 324
Fraxinus 165
Fritillaria 277
Fuirena 191
FUMARIACEAE 62, 158, 290

Gaillardia aristata Pursh 44, 344
Galium 260, 261, also:
triflorum Michx. 19, 260
Galpinsia, see Oenothera 199
Gaura angustifolia Michx. 249
biennis L. 249
coccinea Nutt. 199, 249
glabra Lehm. 249
induta W.&S. 249
marginata Lehm., see G. coccinea 199, 249
neomexicana Wooton 249
parviflora Dougl. 199, 249
sinuata Nutt. 199, 249
villosa Torr. 249
Gaylussacia 18
Gayoides 144
Gayophytum 313, 314
Gentiana 322, 323, also:
calycosa Griseb. 253
GENTIANACEAE 159, 253, 322, 323, 324
Geraea, see Encelia 341
GERANIACEAE 232, 233, 245, 307
Geranium columbianum L. 232
erianthum DC. 245, 307
fremontii T.&G. 307
incisum Nutt. 232, 307
maculatum L. 232
nervosum Rydb. 307
pusillum L. 233
richardsonii Fisch.&Trautv. 307
viscosissimum Fisch.&Mey. 307
Gerardia besseyana Britt. 123
flava L., see Aureolaria f. 121
quercifolia Pursh., see Aureolaria flava 121
tenuifolia macrophylla Benth., see G. besseyana 123
virginica B.S.P., see Aureolaria v. 121
Gilia *bigelovii* (Gray) Greene, see Linanthus b. 159, 254
calcaria Jones 254
californica Benth., see Leptodactylon c. 326
capitata Hook. 254
ciliata Benth., see Linanthus c. 255, 326
filifolia Nutt. 254
gilioides (Benth.) Greene 254
grandiflora Gray, see Collomia g. 254
inconspicua (J.E.Sm.) Dougl. 159
leptomeria Gray 159
longiflora (Torr.) G.Don 159
nuttallii Gray, see Leptodactylon n. 326
pinnatifida Nutt., see G. calcaria 254
pungens Benth., see Leptodactylon p. 255
pungens hookeri Gray, see Leptodactylon hookeri 255, 326
spicata Nutt. 168
Gillenia, see Porteranthus 371
Glaux maritima L. 159, 167
Gleditsia triacanthos L. 67
Glyceria acutiflora Torr. 184
elata Hitchc. 153
grandis Wats., 153, 174, 180
nervata (Willd.) Trin. 153
pauciflora Presl 153, 174
septentrionalis Hitchc. 184
Glycine, see Apios 122
Glycosma, see Osmorrhiza 315
Glycyrrhiza 306
Gnaphalium chilense Spreng. 265
decurrens Ives, see G. macounii 265
macounii Greene 265
obtusifolium L. 265
purpureum L. 264
ramosissimum Nutt. 265
spathulatum Lam. 264
Godetia, see Clarkia 15, 248
Goniostachyum citrosum Small 256
Gonolobus *hirsutus* Michx., see Vincetoxicum h. 172
laevis Michx. 172
macrophyllus Michx., see Vincetoxicum gonocarpos 172, 325
productum Torr., see Vincetoxicum p. 172
suberosus R.Br., see Vincetoxicum s. 172
Gonopyrum, see Polygonella 233
Goodyera 12
Gormannia, see Sedum 292
Gossypium 62, 143
GRAMINEAE, see POACEAE
Grayia 283
Grindelia aphanactis Rydb. 142
cuneifolia Nutt. 44, 142
erecta Nels. 142
fastigiata Greene 142
inornata Greene 142
oregana Gray 44
perennis Nels. 142
robusta Nutt. 142, 217
squarrosa (Pursh) Dunal 44, 140, 142
subalpina Greene 142
texana Scheele 142
spp. 198
Grossularia cynosbati (L.) Mill. 27, 37, 208, 209
divaricata (Dougl.) Cov.&Britt. 27, 28, 56, 208, 211
hesperis (McCl.) Cov.&Britt. 208
hirtella (Michx.) Spach 208
inermis (Rydb.) Cov.&Britt. 27, 28, 37, 56, 139, 208
irrigua (Dougl.) Cov.&Britt. 27, 37
leptantha (Gray) Cov.&Britt. 28, 37, 56, 139, 208
missouriensis (Nutt.) Cov.&Britt. 27, 139, 208, 209
oxyacanthoides (L.) Mill. 27, 208
pinetorum (Greene) Cov.&Britt. 37
reclinata (L.) Mill. 27, 37, 208, 209

rotundifolia (Michx.)Cov.&Britt. 27, 208
setosa (Lindl.)Cov.&Britt. 27, 37, 208
velutina (Greene)Cov.&Britt. 28
GROSSULARIACEAE 27, 28, 37, 56, 139, 208, 209, 211, 295
Gutierrezia 142, also:
euthamiae T.&G., see G. sarothrae 140, 142
sarothrae (Pursh)Britt.&Rusby 140, 142
texana (DC.)T.&G. 44
Gymnogramma, see Pityrogramma 11
Gymnolomia, see Heliomeris 270

Habenaria 383
Halenia deflexa (J.E.Sm.)Griseb. 253
Halerpestes, see Ranunculus 178, 180
HALORAGIDACEAE 251
Harpaecarpus exiguus (Smith)Gray 46
Havardia, see Pithecolobium 66
Hazardia squarrosa (H.&A.)Greene 142
Hedeoma 328
Hedysarum 303
Helenium *hoopesii* Gray, see Dugaldea h. 145
spp. 198
Helianthella 341
Helianthus ambiguus (Gray)Britt. 267
angustifolius L. 267
annuus L. 217, 267
atrorubens L. 268
australis Small 47, 268
californicus DC. 268
ciliaris DC. 341
cucumerifolius T.&G. 268
debilis Nutt. 268
decapetalus L. 47, 217, 268
divaricatus L. 47, 218, 268
doronicoides Lam. 47, 268
eggertii Small 47
fascicularis Greene 268
giganteus L. 47, 218, 268
glaucus Small 47
grosseserratus Martens 47, 268
heterophyllus Nutt. 268
hirsutus Raf. 47, 268
kellermani Britt. 268
laetiflorus Pers. 268
lenticularis Dougl. 268
maximiliani Schrad. 217, 268
microcephalus T.&G. 47, 268
mollis Lam. 268
nitidus Lunell 268
nuttallii T.&G. 217, 268
occidentalis Ridd. 47, 217, 268
orgyalis DC., see H. salicifolius 268
parishii Gray 217, 268
petiolaris Nutt. 217, 268
rigidus (Cass.)Desf. 47, 217, 268
rybergii Britt. 268
salicifolius Dietr. 268
saxicola Small 47
scaberrimus Ell., see H. rigidus 47, 217, 268
strumosus L. 47, 218, 268
subrhomboideus Rydb. 217, 268
subtuberosus Bourg. 217
tomentosus Michx. 47, 268
trachelifolius Mill. 217, 268
tuberosus L. 47, 217, 268
Heliomeris multiflora Nutt. 270
Heliopsis helianthoides (L.)Sweet 218, 268, 269
laevis Pers., see H. helianthoides 218, 268, 269
scabra Dunal 269
Heliotropium 159
Hemizonella durandi Gray 46
Hemizonia citrina Greene 269
citriodora (Greene)Gray 46
clevelandii Greene 269
congesta DC. 46
durandi Gray, see Hemizonella d. 46
luzulaefolia DC. 269
pungens T.&G., see Centromadia p. 45
truncata Gray 269
Hepatica 72
Hesperochordon lactea Lindl., see Brodiaea l. 225
Heterisia, see Saxifraga 293, 294
Heteromeles, see Photinia 372
Heteropleura fendleri (Sch.-Bip.)Rydb. 352
Heterotheca subaxillaris (Lam.)Britt.& Rusby 44, 190
Heuchera 293
Heyderia, see Libocedrus 359
Hibiscus lasiocarpus Cav. 143
militaris Cav. 143
moscheutos L. 143
syriacus L. 95
Hieracium albertinum Farr 382
albiflorum Hook. 271, 352, 382
canadense Michx. 352
cinereum Howell 203, 352
columbianum Rydb. 352
fendleri Sch.-Bip., see Heteropleura f. 352
gracile Hook. 352
gracile detonsum Gray 352
griseum Rydb., see H. scouleri 203, 352
gronovii L. 352
horridum Fries 352
paniculatum L. 352
scabriusculum Schw. 352
scabrum Michx. 271, 352
scouleri Gray, see H. albertinum 382
scouleri Hook. 203, 352
umbellatum Auth., see H. scabriusculum 352
venosum L. 271, 352, 382
spp. 199
Hierochloa odorata (L.)Wahl. 153
Hilaria 159
HIPPOCASTANACEAE 385
Hoffmanseggia oxycarpa Benth. 68
Hoite, see Psoralea 245
Holcus *halepensis* L., see Sorghum h. 125
lanatus L. 153, 178
sorghum L., see Sorghum vulgare 125
Homalobus, see Astragalus 302, 303
Homalocenchrus, see Leersia 130
Honkenya peploides (L.)Ehrh. 236
Hookera, see Brodiaea 274
Hordeum boreale Scribn.&Sm. 185
caespitosum Scribn. 175, 186
depressum (Scribn.&Sm.)Rydb. 186
distichon L. 175
gussoneanum Parl. 175, 186
jubatum L., 152, 175, 180, 183, 185, 186, 187
montanense Scribn. 186
murinum L. 175, 186
nodosum L. 175, 177, 185, 186, 187
pusillum Nutt. 177, 186
tetrastichon L. 175
vulgare L. 175, 176, 180, 186
Horkelia *gordonii* Hook., see Ivesia g. 80, 90
tridentata Torr. 90
Hosackia 300
Houstonia angustifolia Michx. 228, 261
coerulea L. 228
longifolia Gaertn. 228

minima Beck 160, 228
minor (Michx.) Britt. 160
patens Ell., see H. minor 160
purpurea L. 160, 228
Hutchinsia procumbens (L.) Dev. 158
Hydrangea arborescens L. 17
HYDRANGEACEAE 17, 359
Hydrocotyle australis C.&R. 192
bonariensis Lam. 320
canbyi C.&R. 320
prolifera Kellogg 320
ranunculoides L.f. 320
umbellata L. 192, 320
verticillata Thunb. 192, 320
HYDROPHYLLACEAE 159, 182, 185, 187, 326, 327, 392
Hydrophyllum albifrons Heller 182
appendiculatum Michx. 182
capitatum Dougl. 182, 327
congestum Wieg., see H. albifrons 182
fendleri (Gray) Heller 182, 327
occidentale Gray 182, 327
tenuipes Heller 182
virginianum L. 182, 327
watsoni (Gray) Rydb. 182, 327
Hymenoclea 263
Hymenopappus arenosus Heller 141
carolinensis Porter, see H. scabiosaeus 142
scabiosaeus L'Her. 142
HYPERICACEAE 247
Hypericum 247
Hypochaeris 352
Hypoxis 279
Hyptis emoryi Torr. 331
radiata Willd. 256
Hyssopus, see Lophanthus 257
Hystrix 152, 175, 180, 183

Ichthyomethia, see Piscidia 69
Ilex opaca Ait. 31
ILICACEAE 31
Impatiens *aurea* Wats., see I. pallida 182, 308
balsamea L. 30
biflora Walt. 182, 308
fulva Nutt., see I. biflora 182, 308
maculata Muhl., see I. biflora 182, 308
pallida Nutt. 182, 308
Imperata hookeri Rupr. 125
Indigofera 244
Ipomoea 39, also:
trichocarpa Ell. 39, 254
trifida (H.B.K.) G.Don 254
triloba L. 39, 254
IRIDACEAE 131, 227, 228, 229, 383
Iris 227, 228, also:
versicolor L. 131, 227
Isnardia 250
Isocoma heterophylla (Gray) Greene 142
Isomeris arborea Nutt. 159
Isopyrum biternatum (Raf.) T.&G. 180
Iva axillaris Pursh 338
frutescens L. 387
xanthifolia Nutt. 263
Ivesia baileyi Wats. 80
baileyi setosa Wats., see I. setosa 80
gordonii (Hook.) T.&G. 80, 90
sericoleuca Rydb. 90
setosa (Wats.) Rydb. 80

Jatropha, see Cnidoscolus 310
JUNCACEAE 216, 217, 218, 220
Juncus 217, 218
JUNIPERACEAE 358–379
Juniperus barbadensis L. 375, 379
chinensis L. 367, 373
communis L. 363, 373
communis depressa Pursh, see J. sibirica 363, 366, 368, 370, 374
horizontalis Moench 365, 375–378
mexicana Spreng. 368
monosperma (Engelm.) Sarg. 359, 364, 377
nana Willd., see J. sibirica 363, 366, 368, 370, 374
occidentalis Hook. 364, 368, 374, 377
pachyphlaea Torr. 359, 364, 368
prostrata Pers., see J. horizontalis 365, 375, 376, 377, 378
scopulorum Sarg. 365, 374, 376, 377, 379
sibirica Burgsd. 363, 366, 368, 370, 374
utahensis (Engelm.) Lemm. 359, 362, 364, 377
virginiana L. 363, 365, 368, 369, 371, 372, 375, 378, 379
Jussiaea californica (Wats.) Jepson 385
decurrens (Walt.) DC. 250

Kneiffia, see Oenothera 199, 249
Kochia scoparia (L.) Schrad. 158
Koeleria cristata (L.) Pers. 141, 145, 146, 148, 150, 174
Koellia, see Pycnanthemum 194, 328
Krameria 240
KRAMERIACEAE 240
Krigia *amplexicaulis* Nutt., see Cynthia virginica 203, 352
dandelion Nutt., see Cynthia dandelion 220
spp. 199
Krynitzkia, see Cryptantha 256
Kuhnia 339

LABIATAE, see LAMIACEAE
Laciniaria, see Liatris 43
Lactuca canadensis L. 355
pulchella (Pursh) DC. 355
spp. 199
Lagophylla 269
Lamarckia aurea (L.) Moench 153, 175
LAMIACEAE 194, 256, 257, 328–331, 386, 393
Lamourouxia 124
Lantana 256
Laportea, see Urticastrum 62
Lappa, see Arctium 349
Lappula coerulescens Rydb. 159
floribunda (Lehm.) Greene 327
heterosperma Greene 159
occidentalis (Wats.) Greene 159
Lapsana communis L. 350
Larix *americana* Michx., see L. laricina 22, 51, 54
decidua Mill. 54
europaea DC., see L. decidua 54
laricina (DuRoi) Koch 22, 51, 54
lyallii Parl. 54
occidentalis Nutt. 54
sp. 23
Lathyrus 242, 243
Lavatera 246
Lavauxia, see Oenothera 199, 249
Ledum decumbens (Ait.) Lodd. 34
glandulosum Nutt. 35
groenlandicum Oeder 34, 35
latifolium Ait., see L. groenlandicum 34, 35
palustre angustifolium Hook., see L. decumbens 34
Leersia 130
LEGUMINOSAE, see FABACEAE
Leontodon autumnale L., see Apargia a. 352

dumetorum Rydb., see Taraxacum ceratophorum 352
erythrospermum Eichw., see Taraxacum e. 352
lyratus Ledeb., see Taraxacum l. 352
taraxacum L., see Taraxacum vulgare 351, 352
Lepachys columnaris (Sims) T.&G. 200
Lepadina, see Dichrophyllum 128, 309
Lepargyraea, see Shepherdia 152, 211
Lepidium 158
Leptandra, see Veronica 259
Leptasea *austromontana* Small, see Saxifraga a. 294
flagellaris (Willd.) Small 56
tricuspidata (Retz.) Haw. 294
Leptochloa dubia (H.B.K.) Nees 171
Leptilon 190, 198
Leptochloa dubia (H.B.K.) Nees. 171
filiformis (Lam.) Beauv. 170
Leptodactylon californica H.&A. 326
hookeri (Dougl.) Nutt. 255, 326
nuttallii (Gray) Rydb. 326
pungens (Torr.) Nutt. 255
Leptoloma cognatum (Schult.) Chase 126, 130
Leptotaenia dissecta Nutt. 318
eatonii C.&R. 317
multifida Nutt. 317
purpurea (Wats.) C.&R. 317
Lespedeza 242
Lesquerella gordoni (Gray) Wats. 158
Leucaena pulverulenta (Schl.) Benth. 66
Leucocrinum montanum Nutt. 145
Leucosyris spinosa (Benth.) Greene 266
Lewisia 285
Liatris 43, also:
aspera (Michx.) Greene, 43, 146
punctata Hook. 146
scariosa Auth., see L. aspera 43, 146
spicata Willd. 146
squarrosa (L.) Willd. 146
Libocedrus decurrens Torr. 359
Ligusticum apiifolium (Nutt.) Gray 280, 281
apiodorum (Gray) C.&R. 100
cusickii C.&R. 100, 281
filicinum Wats. 100, 281
grayi C.&R. 281
leibergii C.&R. 100, 281
porteri C.&R. 100, 281
purpureum C.&R. 100
scopulorum Gray, see Coneoselinum s. 100, 281
scoticum L. 386
simulans C.&R. 281
LILIACEAE 130, 135, 137, 145, 176, 177, 225, 276, 277, 278
Lilium 277, also:
umbellatum Pursh 135, 277
Limnia 283
Limnodea arkansana (Nutt.) Dewey 143
Limnorchis, see Habenaria 383
Limnodorum tuberosum L. 229
Limonium 252
LINACEAE 57, 385
Linanthus bigelovii (Gray) Greene 159, 254
ciliatus (Benth.) Greene 255, 326
Linaria canadensis (L.) Dumort 121
Linum 57, also:
virginianum L. 57, 385
Lithophragma 293
Lithospermum 182, also:
tuberosum Rugel 386
LOASACEAE 159, 392
Lobelia 262
LOBELIACEAE 159, 262
Lolium 153
Lomatium, see Cogswellia 281, 317
Lonicera 155
Lophanthus 257
LORANTHACEAE 391
Lorinseria areolata (L.) Presl 3
Lotus, see Hosackia 300
Ludwigia 250
Lupinus aduncus Greene 243, 297
albifrons Benth. 243
ammophilus Greene 297
amplus Greene, 243
arboreus Sims 297
argenteus Pursh 122, 243, 297
bakeri Greene 297
bridgesii (Wats.) Greene 243
caespitosus Nutt. 297
chamissonis Eschsch. 243
decumbens Torr., see L. argenteus 122, 243, 297
douglasii J.Ag. 243, 297
formosus Greene 243
holosericeus Nutt. 243, 297
kingii Wats. 297
latifolius J.Ag. 243, 297
laxiflorus Dougl. 243, 297
leptophyllus Benth. 297
leucophyllus Dougl. 243
lyallii Gray 297
monticola Rydb. 297
palmeri Wats. 298
parviflorus Nutt. 243, 298
perennis L. 122
polyphyllus Lindl. 243
pulcherrimus Rydb. 298
pusillus Pursh 298
rivularis Dougl. 243
sericeus Pursh 243, 298
suksdorfii B.L.Rob. 243
sulphureus Dougl. 243
Luzula 220
Lychnis alba Mill. 285
Lycium andersonii Gray 332
californicum Nutt. 332
fremontii Gray 332
gracilipes Gray, see L. fremontii 332
halimifolium Mill. 331
pallidum Miers 331, 387
parviflorum Gray 331
torreyi Gray 332
vulgare Dunal, see L. halimifolium 331
Lycopsis 181
Lycopus 194
Lygodesmia *aphylla* T.&G., see L. texana 353
juncea (Pursh) D.Don 141, 142
spinosa Nutt. 353
texana (T.&G.) Greene 353
Lymnobotrya, see Ribes 27, 37, 56, 209, 211
Lyonia *ligustrina* DC., see Xolisma l. 18
mariana D.Don, see Neopieris m. 18
nitida Fern., see Neopieris n. 18
Lysiloma bahamensis Benth. 66
Lysimachia 40, 212
LYTHRACEAE 203

Machaeranthera canescens (Pursh) Gray 142
tanacetifolia (H.B.K.) Nees 142
viscosula Rydb. 44
Maclura, see Toxylon 61
Macrocalyx, see Ellisia 182
Madaria corymbosa DC. 46
elegans (D.Don) DC. 46, 269
Madia 45, 46, also:
elegans D.Don, see Madaria l. 46, 269
sativa Molina 46, 269

Madronella 328
Mahonia aquifolium (Pursh) Nutt. 75, 149
dictyota (Jepson) Fedde 75
diversifolia Sweet, see M. aquifolium 75, 149
fremontii (Torr.) Fedde 75
haematocarpa (Wooton) Fedde 75
nervosa (Pursh) Nutt. 75
pinnata (Lag.) Fedde 75
pumila (Greene) Fedde 75
repens (Lindl.) Don 75, 150, 245
trifoliolata (Moric.) Fedde 76
sp. 173
Maianthemum canadense Desf. 130, 168
Mairania alpina (L.) Desv. 18
MALACEAE 357, 358, 360–379
Malacothrix arachnoidea McGreg. 353
saxatilis (Nutt.) T.&G. 352, 353
Malus angustifolia (Ait.) Michx. 375, 379
baccata (L.) Desf. 358, 379
coronaria (L.) Mill. 379
fragrans Rehder 379
glaucescens Rehder 375, 379
ioensis (Wood) Britt. 358, 379
malus Britt., see M. sylvestris 358, 363, 375, 379
rivularis (Doug.) Roem. 357, 358, 377
sylvestris Mill. 358, 363, 375, 379
Malva 246, also:
sylvestris L. 144, 246
MALVACEAE 62, 95, 131, 133, 143, 144, 246, 247
Malvastrum *arcuatum* B.L.Rob., see Sphaeralcea a. 133
coccineum Gray, see Sphaeralcea c. 133, 143
coromandelianum (L.) Garcke 144
dissectum Nels., see Sphaeralcea d. 133
elatum Nels., see Sphaeralcea e. 133
fasciculatum Greene, see Sphaeralcea f. 131, 133, 143
fremontii Torr., see Sphaeralcea f. 133
munroanum Gray, see Sphaeralcea m. 133
thurberi Gray, see Sphaeralcea fasciculata 131, 133, 143
Malvaviscus drummondii T.&G. 95
Mariscus, see Cladium 192
Matteuccia, see Pteretis 4
Medicago 299
Megapterium, see Oenothera 249
Meibomia, see Desmodium 122, 241
Melampyrum lineare Lam. 121
Melandrium see Lychnis 285
MELANTHACEAE 220, 221, 273
Melanthera angustifolia A.Rich. 342
hastata Michx. 343
parvifolia Small 343
Melanthium parviflorum Wats., see Veratrum p. 220
Melica *bromoides* Gray, see M. geyeri 179
diffusa Pursh, see M. mutica 144
geyeri Munro 179
imperfecta Trin. 151
mutica Walt. 144
porteri Scribn. 144
purpurascens (Torr.) Hitchc. 153
smithii (Porter) Vasey 272
subulata (Griseb.) Scribn. 138
Mentha 328, also:
arvensis L. 194, 328
canadensis L. 194, 328
Mentzelia 159, also:
floridana Nutt. 392
Menziesia pilosa (Michx.) Pers. 18
Merckia physodes Fisch. 236
Meriolix, see Oenothera 199
Mertensia arizonica Greene 327
bakeri Greene 327
ciliata (James) G.Don 327
coronata Nels. 327
foliosa Nels. 327
laevigata Piper 182
lanceolata (Pursh) DC. 182
paniculata (Ait.) G.Don 182
subcordata Greene 182
Mesadenia, see Cacalia 388
Metastelma 172
Micranthes 293
Micromeria 328
Microsteris 326
Mikania 264
Milium effusum L. 138, 174
Mimosa 67
MIMOSACEAE 65, 66, 67
Mirabilis multiflora Gray 384
Mitella 293, also:
nuda L. 293, 384
Moehringia lateriflora (L.) Fenzl 168, 236
Monanthochloë littoralis Engelm. 144
Monarda 328, also: 870
fistulosa L. 194, 328
Monardella, see Madronella 328
Moneses *grandiflora* S.F.Gray, see M. uniflora, 16, 32
reticulata Nutt. 32
uniflora (L.) Gray 16, 32
Monolepis nuttalliana (Schult.) Engelm. 158
Montia, see Limnia 283
Morongia uncinata (Willd.) Britt. 67
Muhlenbergia comata (Thurb.) Benth. 137
cuspidata (Torr.) Rydb. 143, 174
diffusa Willd., see M. schreberi 143
filiformis (Thurb.) Rydb. 143
glomerata Trin., see M. racemosa 137, 143
gracillima Torr. 143
mexicana (L.) Trin. 143, 174
parviglumis Vasey 143
porteri Scribn. 143
racemosa (Michx.) B.S.P. 137, 143
repens (Presl) Hitchc. 143
reverchonii Vasey 137
schreberi Gmel. 143
sobolifera (Muhl.) Trin. 143
squarrosa (Trin.) Rydb. 143
sylvatica Torr., see M. torreyi 137, 143
tenuiflora (Willd.) B.S.P. 143
torreyi (Kunth) Hitchc. 137, 143
trifida Hack. 143
umbrosa Scribn., see M. torreyi 137, 143
Muricauda dracontinum (L.) Small 215
Muscadinia munsoniana (Simpson) Small 60
Musineon divaricatum (Pursh) C.&R. 317, 386
hookeri Nutt., see M. trachyspermum 317
tenuifolium Nutt., see Daucophyllum t. 318
trachyspermum Nutt. 317
Myosotis virginica (L.) B.S.P. 147
Myrica *asplenifolia* L., see Comptonia peregrina 25, 360
carolinensis Mill. 360
cerifera L. 360
gale L. 25
MYRICACEAE 25, 360

Nabalus albus (L.) Hook. 355
altissimus (L.) Hook. 355
boottii DC. 355
hastatus (Less.) Heller 351

racemosus (Michx.)DC. 203, 355
trifoliolatus Cass. 220, 355
spp. 199
Napaea dioica L. 143
Naumburgia thyrsiflora (L.)Duby 212
Navarretia 255
Nemexia, see Smilax 145, 226
Nemocladus ramosissimus Nutt. 159
Neopieris 18
Nesaea, see Decodon 203
Nicotiana bigelovii Wats. 393
trigonophylla Dunal 159
Nitrophila occidentalis (Nutt.)Wats. 158
Nota, see Sisymbrium 158
Nothocalais, see Agoseris 352, 354
Notholaena sinuata (Sw.)Kaulf. 11
Notholcus, see Holcus 153, 178
Nothoscordium bivalve (L.)Britt. 177, 276
Nuttallia, see Mentzelia 159
Nyctelea, see Ellisia 182
Nyssa aquatica L. 59
NYSSACEAE 59

Oakesia, see Uvularia 131, 169
Ocrearia nudicaulis (D.Don)Small 240
Odostemon, see Mahonia 75, 149, 150, 245
Oenanthe 100, 192
Oenothera *alyssoides* H.&A., see Sphaerostigma a. 248
biennis L. 199, 249
brachycarpa Gray 249
caespitosa Nutt., see Pachylophus c. 249
cardiophylla Torr., see Chylismia c. 248
fremontii Wats. 249
fruticosa L. 199
heterantha Nutt., see Taraxia subacaulis 249
hookeri T.&G. 199
laciniata Hill 199, 249
lavandulaefolia (T.&G.)Small 199
linifolia Nutt. 249
marginata Nutt., see Pachylophus m. 249
montana Nutt., see Pachylophus m. 249
muricata L. 249
ovata Nutt., see Taraxia o. 249
pumila L. 199
rhombipetala Nutt. 199, 249
scapoidea Nutt., see Chylismia s. 159, 313
serrulata Nutt. 199
sinuata L., see O. laciniata 199, 249
strigosa (Rydb.)Mack.&Bush 199, 248
tanacetifolia T.&G., see Taraxia t. 249
triloba Nutt. 199
OLEACEAE 38, 165
Oligoneuron canescens Rydb. 44
Olsynium grandiflorum (Dougl.)Raf. 228
Onagra, see Oenothera 199, 249
ONAGRACEAE 15, 159, 199, 203, 248–250, 273, 274, 313, 314, 385
Onoclea sensibilis L. 3
Onopordon acanthium L. 346
Onosmodium occidentale Mack. 182
ORCHIDACEAE 12, 229, 383, 392
Orchis aristata Fisch. 383
Oreobatus 81
Oreochrysum 198
Oreoxis alpina (Gray)C.&R. 317
humilis Raf. 318
Ornithogalum 176
Orthocarpus luteus Nutt. 30
Oryzopsis asperifolia Michx. 138
cuspidata Benth., see O. hymenoides 134, 140, 141
hymenoides (R.&S.)Ricker 134, 140, 141
micrantha (Trin.&Rupr.)Thurb. 139
Osmorrhiza 315
Osmunda 3
OSMUNDACEAE 3
Ostrya virginiana (Mill.)K.Koch 23
OXALIDACEAE 117, 123, 245
Oxalis corniculata L. 117, 123
cymosa Small 117
martiana Zucc. 245
stricta L. 117
violacea L. 117, 245
Oxycoccus macrocarpus (Ait.)Pursh 18
Oxypolis fendleri (Gray)Heller 280, 281
occidentalis C.&R. 281
Oxyria digyna (L.)Hill 281
Oxytheca dendroidea Nutt. 230
Oxytropis 302, also:
albiflora (Nels.)Schum. 302, 303
Ozomelis, see Mitella 293

Pachylophus caespitosus (Nutt.)Raim. 249
hirsutus Rydb., see P. macroglottis 199, 249
macroglottis Rydb. 199, 249
marginatus (Nutt.)Rydb. 249
montanus (Nutt.)Nels. 249
Padus 72
Panax trifolium L. 314
Panicularia, see Glyceria 153, 174, 180, 184
Panicum altum Hitchc.&Chase 129
amarulum Hitchc.&Chase 129
amarum Ell. 128
autumnale Bosc, see Leptoloma cognatum 126, 130
barbinode Trin. 126
bulbosum sciaphillum (Rupr.)Hitchc. &Chase 130
capillare L. 128
cognatum Schult., see Leptoloma c. 126, 130
commutatum Schult. 128
condensatum Nash 128
crus-galli L., see Echinochloa c. 125, 174
depauperatum Muhl. 129
flexile (Gatt.)Scribn. 128
maximum Jacq. 129
miliaceum L. 128
philadelphicum Bernh. 128
saccharatum Buckl., see Valota s. 130
sanguinale L., see Syntherisma s. 127
virgatum L. 129
virgatum cubense Griseb. 129
PAPAVERACEAE 384
Paranassia fimbriata Banks 295
palustris L. 212
PARNASSIACEAE 212, 295
Paronychia chilensis DC. 392
Parosela enneandra (Nutt.)Britt. 122
Parrya platycarpa Rydb. 290
Parthenice mollis Gray 269
Parthenium *hysterophorum lyratum* Gray, see P. lyratum 270
incanum H.B.K. 341
integrifolium L. 48
lyratum Gray 270
Pasania densiflora Oerst. 26
Paspalum *bushii* Nash, see P. stramineum 127, 128
ciliatifolium Michx. 127
conjugatum Berg. 127
curtisianum Steud. 127
denticulatum Trin. 127
floridanum Michx. 127
larrañagai Arech., see P. urvillei 126

setaceum Michx. 127, 153
stramineum Nash 127, 128
urvillei Steud. 126
Pavonia lasiopetala Scheele 95
Pectiantia, see Mitella 293
Pectocarya linearis (R.&P.)DC. 159
Pedicularis bracteosa Benth. 336
canadensis L. 335, 336
centranthera Gray 335
densiflora Benth. 335
fluviatilis Heller 336
grayi Nels. 30
groenlandica Retz. 30, 336
procera Gray, see P. grayi 30
semibarbata Gray 30, 335
surrecta Benth. 30
Pellaea 11
Peltandra 215
Pentstemon acuminatus Dougl. 121
albidus Nutt. 121
alpinus Torr. 121
ambiguus Torr. 121
angustifolius Pursh 121
antirrhinoides Benth. 333
attenuatus Dougl. 333
australis Small 121
azureus Benth. 123
bridgesii Gray 123
canescens Britt. 121
chionophilus Greene 333
coeruleus Nutt., see P. angustifolius 121
comarrhenus Gray 333
confertus Dougl. 333
davidsonii Greene 333
deustus Dougl. 123
diffusus Dougl. 123
digitalis (Sweet)Nutt. 121
ellipticus Coult.&Fisher 333
eriantherus Pursh 121
fruticosus (Pursh)Greene 121
glaber Pursh 121
gracilis Nutt. 121
grandiflorus Nutt. 121
harbourii Gray 333
hirsutus (L.)Willd. 121
humilis Gray, see P. virens 121, 333
laevigatus Sol. 121
linarioides Gray 123
newberryi Gray 121, 333
nitidus Dougl. 121
pallidus Small 121
pentstemon Britt., see P. laevigatus 121
pinetorum Piper 333
procerus Dougl. 333
pubescens Sol., see P. hirsutus 121
radicosus Nels. 121
roezli Regel 123
secundiflorus Benth. 121
spectabilis Thurb. 123
strictus Benth. 333
tenuiflorus Pennell 121
torreyi Benth. 121
unilateralis Rydb. 121
venustus Dougl. 333
virens Pennell 121, 333
virgatus Gray 121
Peramium, see Goodyera 12
Peraphyllum ramosissimum Nutt. 362, 377
Peritoma, see Cleome 159
Persicaria, see Polygonum 232, 233
Petalostemon candidus (Willd.)Michx. 76, 122
compactus (Spreng.)Swezey 76
multiflorus Nutt. 76
oligophyllus (Torr.)Rydb. 76, 77, 122
purpureus (Vent.)Rydb. 76, 122
villosus Nutt. 122
violaceus Michx., see P. purpureus 76, 122
Petasites corymbosus (R.Br.)Rydb. 164
frigidus (L.)Fries 164, 346
palmatus (Ait.)Gray 346
PETIVERIACEAE 283
Petradoria pumila (Nutt.)Greene 142
Petunia parviflora Juss. 159
Peucedanus, see Cogswellia 281, 317
Phaca 303
Phacelia alpina Rydb. 182
californica Cham. 182, 392
circinata Jacq. 182
crenulata Torr. 159
distans Benth. 182, 187
heterophylla Pursh 182
hispida Gray 182
leucophylla Torr. 182
ramosissima Dougl. 182
sericea (Grah.)Gray 185
tanacetifolia Benth. 182, 392
Phaethusa laciniata (Poir.)Small 47
Phalaris angusta Nees 131, 174
arundinacea L. 131, 174
californica H.&A. 131
canariensis L. 131
minor Retz. 131
Pharbitis, see Ipomoea 39
Phaseolus 296, 297
Phegopteris dryopteris (L.)Fée 5, 10
Phellopterus montanus Nutt. 317
Philadelphus 359
Philibertella, see Philibertia 171, 172
Philibertia clausa (Jacq.)Schum. 172
cynanchoides Gray 172
heterophylla (Engelm.)Jepson 171, 172
hirtella (Gray)Parish 172
Phleum alpinum L. 150
pratense L. 176
Phlox alyssifolia Greene 255
canescens T.&G. 255
depressa (Nels.)Rydb. 255, 326
diapensioides Rydb. 255
diffusa Benth. 255
divaricata L. 168, 326
glabrata (E.Nels.)Brand 255
hoodii Richards. 255
longifolia Nutt. 326
maculata L. 168
multiflora Nels. 326
nana Nutt. 255
paniculata L. 168
pilosa L. 168, 326
rigida Benth. 255
scleranthifolia Rydb. 255
speciosa Pursh 326
standburyii (Torr.)Heller 326
subulata L. 255
Phoenocaulis 148
Phoradendron 391
Photinia arbutifolia Lindl. 372
Phragmites 155, 156
Phryma leptostachia L. 200
PHRYMACEAE 200
Phyllostachys 188
Phymosia rivularis (Dougl.)Rydb. 131
Physalis comata Rydb. 382
heterophylla Nees 332, 382
lanceolata Michx. 332, 382
lobata Torr. 159
longifolia Nutt. 382
virginiana Mill. 332, 382
viscosa Pursh, see P. heterophylla 332, 382
Physostegia 330

Picea *abies* Karst., see P. excelsa 17, 21, 32
alba Link, see P. canadensis 13, 21, 32, 33
albertiana S.Brown 21
canadensis (Mill.)B.S.P. 13, 21, 32, 33
engelmanni (Parry)Engelm. 21, 32, 33
excelsa (Lam.)Link 17, 21, 32
glauca Voss., see P. canadensis 13, 21, 32, 33
mariana (Mill.)B.S.P. 21, 32, 33, 34
nigra Ait., see P. mariana 21, 32, 33, 34
pungens Engelm. 21, 33, 34
rubens Sarg. 21, 32, 33, 34
rubra Dietr., see P. rubens 21, 32, 33, 34
sitchensis (Bong.)Carr. 21, 33, 389
vulgaris Link, see P. excelsa 17, 21, 32
Pieris, see Neopieris 18
Pimpinella, see Taenidia 319
PINACEAE 3–55, 389, 390, 391
Pinaropappus roseus Less. 350
Pinus attenuata Lemm. 29
australis Michx., see P. palustris 25, 38, 39, 41, 42, 43, 44, 46, 389
austriaca Höss, see P. nigra 25, 41
banksiana Lamb. 25, 28, 43
caribaea Morelet 25, 38, 39, 41, 42, 44
chihuahuana Engelm. 25, 39
contorta Dougl. 25, 28, 29, 41, 43, 389
contorta jeffreyi Vasey, see P. jeffreyi 25, 29
coulteri Lamb. 29
divaricata Sudw., see P. banksiana 25, 28, 43
echinata Mill. 25, 39, 41, 42, 43, 44, 46, 47, 48
edulis Engelm. 28, 37
elliottii Engelm., see P. caribaea 25, 38, 39, 41, 42, 44
glabra Walt. 38, 41
heterophylla Sudw., see P. caribaea 25, 38, 39, 41, 42, 44
inops Ait., see P. virginiana 25, 26, 43, 46, 47, 48
insignis Dougl., see P. radiata 29, 45
jeffreyi Murr. 25, 29
mitis Michx., see P. echinata 25, 39, 41, 42, 43, 44, 46, 47, 48
monophylla Torr.&Frém. 28
montana Mill. 25
montana mughus Willk. 25
monticola Dougl. 27
murrayana Balf., see P. contorta 25, 28, 29, 41, 43, 389
nigra Arnold 25, 41
nigra austriaca Asch.&Graebn. 25
palustris Mill. 25, 38, 39, 41, 42, 43, 44, 46, 389
ponderosa Dougl. 25, 28, 29, 41
ponderosa scopulorum Engelm., see P. scopulorum 25, 28, 29, 41, 43
pungens Lamb. 25, 28, 43
radiata D.Don 29, 45
resinosa Ait. 25, 40, 43, 44
rigida Mill. 25, 39, 40, 41, 42, 43, 44
sabiniana Dougl. 29
scopulorum (Engelm.)Lemm. 25, 28, 29, 41, 43
serotina Michx. 39, 41, 42, 44, 48
strobus L. 27
sylvestris L. 25, 26, 41, 49
sylvestris divaricata Ait., see P. banksiana 25, 28, 43
taeda L. 25, 26, 38, 39, 41, 42, 43, 44, 48
thunbergii Parl. 43
tuberculata Gordon, see P. attenuata 29
virginiana Mill. 25, 26, 43, 46, 47, 48
Piscaria setigera (Hook.)Piper 59
Piscidia erythrina L. 69
Pisum sativum L. 243
Pithecolobium 65, 66
Pityrogramma triangularis (Kaulf.) Maxon 11
PLANTAGINACEAE 159, 160, 169, 259
Plantago 160, also:
decipiens Barn. 259
eriopoda Torr. 159, 160
maritima Auth., see P. decipiens 259
sp. 169
Pleiacanthus, see Lygodesmia 353
Pleuraphis, see Hilaria 159
Pleurogyne rotata (L.)Griseb. 323
Pluchea 265
PLUMBAGINACEAE 252
Plumiera acutifolium Poir. 39
Poa alpina L. 150
ampla Merr. 150, 179
annua L. 150
arachnifera Torr. 150, 153
arida Vasey 150, 175, 179
bigelovii Vasey&Scribn. 150
brevipaniculata Scribn.&Will. 163
compressa L. 151, 153, 175
crocata Michx. 151, 184
fendleriana (Steud.)Vasey 179
howellii Vasey&Scribn. 175
interior Rydb. 151, 179
juncifolia Scribn. 179
kingii Wats., see Festuca confinis 162
longiligula Scribn.&Will. 163
longipedunculata Scribn. 151, 179
lucida Vasey 151, 179
macrantha Vasey 151
nemoralis L. 151
nervosa (Hook.)Vasey 179
nevadensis Vasey 179
nuttaliana Schult., see Puccinellia n. 175, 179
palustris L. 151
pratensiformis Rydb. 151
pratensis L. 151, 175, 179, 184
pratericola Rydb., see P. arida 150, 175, 179
reflexa Vasey&Scribn. 151
sandbergii Vasey 175, 179
scabrella (Thurb.)Benth. 179
scabriuscula T.A.Will. 179
serotina Ehrh., see P. palustris 151
trivialis L., 151, 175, 184
vaseyochloa Scribn. 151
wheeleri Vasey 151, 179
sp. 164
POACEAE 117–188, 272, 273
Podophyllum peltatum L. 289
Poinsettia 309, 310
POLEMONIACEAE 159, 168, 254, 255, 256, 326
Polemonium intermedium (Brand)Rydb. 256
occidentale Greene 256
pulcherrimum Hook. 326
reptans L. 168, 256
Polygala longa Blake 381
paucifolia Willd. 246
senega L. 122
POLYGALACEAE 122, 246, 381
POLYGONACEAE 155, 156, 158, 230–234, 279–282, 384, 392
Polygonatum *biflorum* Gray, see P. pubescens 131
commutatum (R.&S.)Dietr. 130, 168
pubescens (Willd.)Pursh 131

Polygonella articulata (L.)Meissn. 233
Polygonum *acre* H.B.K., see P. punctatum 233
alpinum Am. auth., see P. phytolaccaefolium 279
amphibium Am.auth., see P. hartwrightii 232
aviculare L. 158, 230
bistortoides Pursh, see Bistorta b. 280
buxiforme Small 231
coccineum Muhl. 232
convolvulus L. 233
cristatum Engelm.&Gr. 233
davisiae Brewer 279
dumetorum L. 233
erectum L. 158, 231
fowleri B.L.Rob. 231
glaucum Nutt. 231
hartwrightii Gray 232
hirsutum Walt. 232
hydropiper L. 232
hydropiperoides Michx. 232
incarnatum Ell. 232
lapathifolium L. 232
maritimum Auth., see P. glaucum 231
muhlenbergii (Meissn.)Wats. 232
newberryi Small 279, 280
opelousanum Ridd. 233
pennsylvanicum L. 233
persicaria L. 233
phytolaccaefolium Meissn. 279
portoricensis Bert. 233
punctatum Ell. 233
ramosissimum Michx. 231
sawatchense Small 231
scandens L. 232, 233
setaceum Baldw. 233
spergulariaeforme Meissn. 231, 280
virginianum L. 233
viviparum L., see Bistorta v. 231, 280
watsonii Small 280
Polymnia 198
POLYPODIACEAE 3–11
Polypodium 7, also:
dryopteris L., see Phegopteris d. 5, 10
Polypogon monspeliensis (L.)Desv. 153, 174
Polystichum munitum (Kaulf.)Presl 7, 9
Pontederia cordata L. 216
PONTEDERIACEAE 216
Populus acuminata Rydb. 52
alba L. 54
angustifolia James 52
balsamifera L. 51, 52
canadensis Moench, see P. deltoides 51
candicans Michx. 51, 52, 53
deltoides Marsh. 51
dilatata Ait. 51, 52
fremontii Wats. 52
grandidentata Michx. 53
hastata Dode 52
heterophylla L. 53
medusa Benth., see P. deltoides 51
monilifera Ait., see P. deltoides 51
occidentalis (Rydb.)Britt. 51, 52, 53
pyramidalis Salisb., see P. dilatata 51, 52
sargentii Dode, see P. occidentalis 51, 52, 53
tremuloides Michx. 51, 52, 53
trichocarpa T.&G. 52
wislizeni (Wats.)Sarg. 51
Porteranthus 371
PORTULACACEAE 283, 284, 285
Potentilla arachnoidea Dougl. 81
bakeri Rydb. 90
bipinnatifida Dougl. 81
blaschkeana Turcz. 90
breweri Wats. 90
canadensis L. 93
coloradensis Rydb. 90
concinna Richards. 90
diversifolia Lehm. 90
divisa Rydb. 81
effusa Dougl. 90
elmeri Rydb. 90
fastigiata Nutt. 90
filipes Rydb. 90
flabellifolia Hook. 90
flabelliformis Lehm. 90
fruticosa L., see Dasiphora f. 80
gelida Wats., see P. flabellifolia 90
glabrella Rydb. 81
glaucophylla Lehm. 90
glomerata Nels. 90
gracilis Port.&Coult., see P. filipes 90
grosseserrata Rydb. 90
hallii Rydb. 90
hippiana Lehm. 81, 90
litoralis Rydb., see P. pectinata 81
monspeliensis L. 81, 90
norvegica Gray, see P. monspeliensis 81, 90
nuttallii Lehm. 90, 91
paradoxa Nutt. 90
parishii Rydb. 90
pectinata Raf. 81
pennsylvanica L. 81
propinqua Rydb. 90
pulcherrima Lehm. 90
rubripes Rydb. 90
strigosa Pall. 81
tridentata Sol., see Sibbaldiopsis t. 14
trina Nels. 91
viridescens Rydb. 90
Prenanthes, see Nabalus 203, 220, 355
Primula suffrutescens Gray 322
PRIMULACEAE 40, 159, 167, 168, 169, 212, 214, 252, 322
Prionopsis ciliata Nutt. 142
Proserpinaca 251
Prosopis 65
Prunus 72
Pseudocymopterus anisatus (Gray)C.&R. 316, 318
bipinnatus (Wats.)C.&R. 316, 318
montanus (Gray)C.&R. 316
multifidus Rydb. 316
Pseudopteryxia, see Pseudocymopterus 316, 318
Pseudoreoxis, see Pseudocymopterus 316, 318
Pseudotsuga 52
Psilactis asteroides Gray 44, 202
Psilostrophe 142
Psoralea 244, 245, also:
onobrychis Nutt. 122
Psoralidium, see Psoralea 244, 245
Ptelea trifoliata L. 161
Pteretis nodulosa (Michx.)Nieuwl. 4
Pteridium 5
Pteris, see Pteridium 5
Pteryxia 317
Ptilocalais 352
Ptiloria 353
Puccinellia angustata (R.Br.)Rand&Redf. 180
maritima (Huds.)Parl. 180
nuttalliana (Schult.)Hitchc. 175, 179
tenuiflora (Griseb.)Scribn.&Merr. 180
Pulsatilla 74, 184
Pycnanthemum 328, also:
lanceolatum Pursh, see P. virginianum 194, 328
virginianum (L.)Dur.&Jacks. 194, 328

Pyrola americana Sweet 16, 32
asarifolia Michx. 16, 32
bracteata Hook. 32
chlorantha Sw. 16, 32
elliptica Nutt. 16, 32
grandifolia Radius 32
groenlandica Hornem., see P. grandifolia 32
minor L. 16, 32
picta Smith 16, 32
rotundifolia Michx., see P. americana 16, 32
secunda L. 16, 32
uliginosa T.&G. 32
uniflora L., see Moneses u. 16, 32
PYROLACEAE 16, 32
Pyrrhopappus 352
Pyrrocoma lanceolata (Hook.) Greene, 44
vaseyi (Parry) Rydb. 142
Pyrus *angustifolia* Ait., see Malus a. 375, 379
arbutifolia L.f., see Aronia a. 362, 365, 366, 373
baccata L., see Malus b. 358, 379
betulaefolia Bunge 357
communis L. 358, 364, 373, 375, 377
coronaria L., see Malus c. 379
diversifolia Bong., see Malus rivularis 357, 358, 377
ioensis Bailey, see Malus i. 358, 379
japonica Auth., see P. sinensis 363, 367
japonica Thunb., see Choenomeles j. 358, 362
malus L., see Malus sylvestris 358, 363, 375, 379
sinensis Lindl. 363, 367
vulgaris L., see Cydonia v. 358, 363, 369, 373, 376

Quamoclidion multiflorum Torr. 158
Quamoclit 39
Quercus 26
Quincula lobata Raf., see Physalis l. 159

Radicula 158
Raimannia, see Oenothera 199, 249
Ramischia, see Pyrola 16, 32
Ramona, see Audibertiella 257
RANUNCULACEAE 72–74, 147, 156, 157, 163, 178, 180, 181, 183, 184, 231, 237, 238, 287–289
Ranunculus abortivus L. 147, 180
acris L. 180
affinis R.Br. 180
aleophilus Nels. 178
alismaefolius Geyer 287
alismellus (Gray) Greene 287
bolanderi Greene 147
californicus Benth. 147, 178
calthaeflorus Greene 147
cardiophyllus Hook. 180
cymbalaria Pursh 178, 180
eremogenes Greene, see R. sceleratus 180, 183
eschscholtzii Schl. 288
glaberrimus Hook. 178, 288
hartwegii Greene 287
lobbii Gray 147
macounii Britt. 183
micranthus Nutt. 147, 183
nuttallii Gray, see Cyrtorhyncha ranunculina 180, 288
occidentalis Nutt. 178
recurvatus Poir. 72
repens L. 184
sceleratus L. 180, 183
septentrionalis Poir. 180, 289
stenolobus Rydb. 288
subsagittatus (Gray) Greene 288
suksdorfii Gray 288
Raphanus sativus L. 158
Ratibida, see Lepachys 200
Redfieldia flexuosa (Thurb.) Vasey 161
RHAMNACEAE 124, 152, 154
Rhamnus 152, 154
Rheum rhaponticum L. 155
Rhododendron californicum Hook. 35
canescens Porter, see Azalea c. 18
catawbiense Michx. 35
nudiflorum T.&G., see Azalea n. 18
punctatum Andr. 35
viscosum Torr., see Azalea v. 18
Rhodiola integrifolia Raf. 292
Rhodora canadensis L. 18
Rhus 70, also:
chloriophylla W.&S. 71
trilobata Nutt. 71
Rhynchosia, see Dolicholus 244
Rhynchospora alba (L.) Vahl 196
alba macra Clarke, see R. macra 196
axillaris (Lam.) Britt. 196
corniculata (Lam.) Gray 195, 196
distans (Michx.) Vahl 196
fasciculata (Michx.) Vahl 196
glomerata (L.) Vahl 192, 196
glomerata paniculata (Gray) Chapm. 196
gracilenta Gray 196
macra (Clarke) Small 196
macrostachya Torr., see R. corniculata 195, 196
microcarpa Baldw. 196
perplexa Britt. 196
Ribes acerifolium Howell 208
alpinum L. 209
americanum Mill. 27, 37, 209
aureum Pursh 28, 37, 56, 139, 209
bracteosum Dougl. 27, 209
coloradense Cov. 37
cynosbati L., see Grossularia c. 27, 37, 208, 209
divaricatum Dougl., see Grossularia d. 27, 28, 56, 208, 211
echinatum Lindl. 27, 37, 56, 209, 211
floridum L'Her., see R. americanum 27, 37, 209
glandulosum Weber 27, 209, 295
gordonianum Lem. 209
gracile Michx., see Grossularia cynosbati 27, 37, 208, 209
gracile Pursh, see Grossularia missouriensis 27, 139, 208, 209
gracillimum Cov.&Britt. 28
grossularia L., see Grossularia reclinata 27, 37, 208, 209
hudsonianum Richards. 209
inebrians Lindl. 28, 37, 209
inerme Rydb., see Grossularia i. 27, 28, 37, 56, 139, 208
lacustre (Pers.) Poir. 27, 209
laxiflorum Pursh 209
leptanthum Gray, see Grossularia l. 28, 37, 56, 139, 208
longiflorum Nutt., see R. odoratum 27, 28, 38, 209
malvaceum Smith 209
missouriense Nutt., see Grossularia m. 27, 139, 208, 209
montigenum McCl. 38
nigrum L. 27
nevadense Kellogg 38, 56
odoratum Wendl. 27, 28, 38, 209
oxyacanthoides L., see Grossularia o. 27, 208
petiolare Dougl. 27, 56, 209

pinetorum Greene, see Grossularia p. 37
prostratum L'Her., see R. glandulosum 27, 209, 295
pumilum Nutt., see R. inebrians 28, 37, 209
rotundifolium Michx., see Grossularia r. 27, 208
rubrum Gray, see R. triste 27, 56, 209, 295
rubrum L. 295
sanguineum Dougl. 27, 209
setosum Lindl., see Grossularia s. 27, 37, 208
triste Pall. 27, 56, 209, 295
uva-crispa L., see Grossularia reclinata 27, 37, 208, 209
vallicola Greene, see Grossularia inermis 27, 28, 37, 56, 139, 208
velutinum Greene, see Grossularia v. 28
viscossimum Pursh 27, 38
vulgare Lam. 27, 209, 295
wolfii Rothr. 38
Rivina humilis L. 283
Romanzoffia sitchensis Bong. 326
Rosa acicularis Lindl. 86
aciculata Cockerell 86
alba L. 84
arizonica Rydb. 88
arkansana Porter 84
arvensis Huds. 88
arkansana Wats., see R. suffulta 84, 86, 88, 89
bakeri Rydb., see R. oreophila 86
blanda Ait. 87, 88
bourgeauiana Crépin 86, 88
bridgesii Crépin 86, 88
californica C.&S. 88
carolina L. 87, 88
centifolia L., see R. gallica 84
chinensis Jacq. 88
corymbosa Ehrh., see R. palustris 88
eglanteria L. 85
eglanteria Mill., see R. rubiginosa 85
engelmannii Wats. 86, 89
fendleri Crépin 84, 86, 88
foliosa Nutt. 88
gallica L. 84
grosseserrata E.Nels., see R. macounii 86, 88
gymnocarpa Nutt. 86, 88
gymnocarpa pubescens Wats., see R. bridgesii 86, 88
heliophila Greene, see R. suffulta 84, 86, 88, 89
hemisphaerica Herrm. 85
humilis Marsh., see R. carolina 87, 88
lucida Ehrh., see R. virginiana 87, 88
lutea Mill., see R. eglanteria 85
macounii Greene 86, 88
macdougali Holz. 86
manca Greene 86
maximiliana Nees, see R. woodsii 86, 88
minutifolia Engelm. 88
neomexicana Cockerell 86
nutkana Presl 86, 88
nutallii Presl 86
oreophila Rydb. 86
palustris Marsh. 88
pecosensis Cockerell 88
pilifera Rydb. 88
pimpinellifolia L., see R. spinosissima 85
pisocarpa Gray 86, 88
pratincola Greene, see R. suffulta 84, 86, 88, 89
pulverulenta Rydb. 86
rubiginosa L. 85
rugosa Thunb. 85, 88
sayi Schw., see R. acicularis 86
sayi Wats., see R. bourgeauiana 86. 88
setigera Michx. 87
sonomensis Greene 88
spinosissima L. 85
suffulta Greene 84, 86, 88, 89
sulphurea Ait., see R. hemisphaerica 85
underwoodii Rydb. 86
virginiana Mill. 87, 88
woodsii Lindl. 86, 88
ROSACEAE 13, 14, 80–99, 240, 295, 296, 371
Rubacer, see Rubus 83, 97
RUBIACEAE 19, 160, 166, 228, 260, 261, 337, 393
Rubus *abbrevians* Blanch., see R. nigricans 94
acaulis Michx. 14
andrewsianus Blanch., see R. argutus 94, 96, 97
arcticus L. 96
argutus Link 94, 96, 97
arizonicus (Greene) Rydb. 82
canadensis L. 94, 96, 97
canadensis T.&G., see R. procumbens 94, 96, 97
chamaemorus L. 14
cuneifolius Pursh 94, 97
deliciosus Torr., see Oreobatus d. 81
enslenii Tratt. 97
floridus Tratt. 94
frondosus Bigel. 94, 97
hispidus L. 94, 97
idaeus aculeatissimus Rob.&Fern., see R. strigosus 13, 82
idaeus canadensis Rich., see R. strigosus 13, 82
leucodermis Dougl. 13, 82
lucidus Rydb. 94
melanolasius Focke 13, 82
millspaughii Britt., see R. canadensis 94, 96, 97
multiformis Blanch., see R. plicatifolius 94
neglectus Peck 13, 82, 96
neomexicanus Gray, see Oreobatus n. 81
nigricans Rydb. 94
nigrobaccus Bailey 94, 96, 97
nutkanus Moc., see R. parviflorus 83, 97
occidentalis L. 82, 96
odoratus L. 83
parviflorus Nutt. 83, 97
pergratus Blanch. 94
plicatifolius Blanch. 94
procumbens Muhl. 94, 96, 97
pubescens Raf. 14, 94, 96, 97
randii (Bailey) Rydb. 96
recurvans Blanch. 94
rossbergianus Blanch., see R. frondosus 94, 97
rubrisetus Rydb. 94
setosus Bigel. 96
stellatus Smith 14, 91
strigosus Michx. 13, 82
triflorus Richards., see R. pubescens 14, 94, 96, 97
trivialis Michx. 94, 95, 97
ursinus C.&S. 94, 97
villosus Ait., see R. plicatifolius 94
villosus Auth., see R. nigrobaccus 94, 96, 97
villosus Bailey, see R. procumbens 94, 96, 97
vitifolius C.&S. 94, 97

Rudbeckia hirta L. 388
laciniata L. 200, 201
maxima Nutt. 202
triloba L. 200
sp. 198
Ruellia 336
Rumex acetosella L. 282
altissimus Wood 155, 234
britannica L. 155, 156
geyeri Trel., see R. paucifolius 282
hastatulus Bald. 282
hymenosepalus Torr. 158, 234
mexicanus Meisn. 155
occidentalis Wats. 234
orbiculatus Gray, see R. britannica 155, 156
paucifolius Nutt. 282
salicifolius Hook., see R. mexicanus 155
salicifolius Weinm. 234
venosus Pursh 155
sp. 384
RUTACEAE 122, 161

SALICACEAE 51–56
Salicornia 160
Salix amygdaloides Anders. 54
anglorum Cham. 56
arbusculoides Anders. 56
balsamifera (Hook.) Barratt 56
chamissonis Anders. 56
cordata Muhl. 55
fuscescens Anders. 56
glauca L. 56
glaucops Anders. 56
groenlandica (Anders.) Lundst. 57
herbacea L. 57
interior Rowlee 55
longifolia Muhl., see S. interior 55
myrtillifolia Anders. 57
nigra Marsh. 55
ovalifolia Trautv. 57
petrophila Rydb. 57
polaris Wahl. 57
sitchensis Bong. 57
stolonifera Cov. 57
Salsola pestifer Nels. 158
Salvia azurea Lam. 330
ballotaeflora Benth. 329
coccinia Juss. 329
farinacea Benth. 330
lanceaefolia Auth., see S. lanceolata 329
lanceolata Willd. 329
lemmoni Gray 386
mellifera Greene, see Audibertiella stachyoides 257
pinguifolia (Fern.) W.&S. 330
pitcheri Torr. 330
sonomensis Greene, see Audibertiella humilis 257
Sambucus 204
Sanguisorba 92
Sanicula 314, 315, also:
nevadensis Wats. 281
tuberosa Torr. 281
SANTALACEAE 28, 122, 124
SAPINDACEAE 246
Saponaria vaccaria L. 158
Sarcobatus vermiculatus (Hook.) Torr. 157, 158
Satureja, see Clinopodium 328
Saxifraga *arguta* D.Don, see Micranthes a. 293
austromontana (Wieg.) Small 294
bracteata D.Don 56
bronchialis Pursh, see S. austromontana 294
californica Greene, see Micranthes c. 293
cernua L. 293
columbiana Piper, see Micranthes c. 293
debilis Engelm. 293
flagellaris Willd., see Leptasea f. 56
fragosa Greene, see Micranthes f. 293
integrifolia Hook., see Micranthes i. 293
lyalli Small, see Micranthes l. 293
marshallii Greene, see Micranthes m. 293
mertensiana Bong. 293, 294
nelsoniana D.Don, see Micranthes n. 293
nivalis L., see Micranthes n. 293
nootkana Moc. 294
nudicaulis D.Don, see Ocrearia n. 240
occidentalis Wats., see Micranthes o. 293
oppositifolia L., see Antiphylla o. 56
oregana Howell, see Micranthes o. 293
pennsylvanica L., see Micranthes p. 293
punctata Am.auth., see Micranthes arguta 293
rhomboidea Greene, see Micranthes r. 293
rivularis L. 293
tricuspidata Retz., see Leptasea t. 294
virginiensis Michx., see Micranthes v. 293
SAXIFRAGACEAE 56, 240, 293, 294, 384
Schedonnardus 144
SCHEUCHZERIACEAE 158
Schizachyrium, see Andropogon 119, 120
Schmaltzia, see Rhus 70, 71
Schoenocaulon 220
Schoenocrambe linifolia (Nutt.) Greene 148, 149
pinnata Greene 148, 149
Schoenus nigricans L. 197
Schrankia, see Morongia 67
Scilla 225
Scirpus americanus Pers. 189, 192, 195
atrocinctus Fern. 195
atrovirens Muhl. 195
caespitosus L. 195
californicus (C.A.Mey.) Britt. 189, 192, 195
campestris Britt. 192
congdonii Britt. 195
cyperinus (L.) Kunth 195
fernaldi Bickn. 192
fluviatilis (Torr.) Gray 192, 195
georgianus Harper 195
hudsonianus Fern., see Eriophorum alpinum 195
lacustris Bart., see S. validus 189, 192
microcarpus Presl 191, 195
occidentalis (Wats.) Chase 189
olneyi Gray 189
pacificus Britt. 192
pallidus (Britt.) Fern. 195
paludosus Nels. 192
pedicellatus Fern. 195
polyphyllus Vahl 195
pungens Vahl, see S. americanus 189, 192, 195
robustus Pursh 192
rubrotinctus Fern., see S. microcarpus 191, 195
validus Vahl 189, 192
Scleria 193
Scleropogon brevifolius Phil. 159
Scolochloa, see Fluminia 153, 180

Scorzonella 199
Scribneria bolanderi (Thurb.) Hack. 185
SCROPHULARIACEAE 29, 121, 123, 124, 258, 259, 333–336, 387
Sebastiana ligustrina (Michx.) Muell.-Arg. 129
Secale cereale L. 175, 181, 186
Sedum 292
Selinum pacificum Wats. 100
Sempervivum punctatum C.Sm. 239
Senecio aronicoides DC. 48, 346
aureus L. 194, 196
canus Hook. 48
columbianus Greene 199, 346
cassulus Gray 345
crocatus Rydb. 196
cymbalarioides Nutt. 194
densus Greene 141
dimorphophyllus Greene 346
dispar Nels., see S. perplexus 141, 346
douglasii DC. 62
ductoris Piper 194
fendleri Gray 48
flavulus Greene 199
fremontii T.&G. 345
harfordii Greenm. 196
hydrophiloides Rydb. 48
hydrophilus Nutt. 345
integerrimus Nutt. 141, 199, 345
lugens Richards. 346
nelsoni Rydb., see S. fendleri 48
oblanceolatus Rydb. 141
perplexus Nels. 141, 346
pseudaureus Rydb. 196
pudicus Greene 141
riddellii T.&G. 141
robbinsii Oakes 194, 196
salicinus Rydb. 141
serra Hook. 48
spartioides T.&G. 141
taraxacoides (Gray) Greene 345
triangularis Hook. 48, 194, 345
uintahensis (Nels.) Greene 48
vulgaris L. 49
willingii Greenm. 196
Sericocarpus 198
Sesuvium 158
Setaria geniculata (Lam.) Beauv. 127, 129
imberbis R.&S., see S. geniculata 127, 129
macrosperma (Scribn.&Merr.) Schum. 129
macrostachya H.B.K. 126
scheelei (Steud.) Hitchc. 126
Seutera palustris (Pursh) Vail 172
Seymeria macrophylla Nutt. 121, 123
Shepherdia argentea Nutt. 211
canadensis (L.) Nutt. 152, 211
Sibbaldiopsis tridentata (Sol.) Rydb. 14
Sida hastata St.Hil. 144
hederacea (Dougl.) Torr. 143, 247
lepidota Gray 247
physocalyx Gray 144
spinosa L. 144
texana (T.&G.) Small 144
Sidalcea asprella Greene 131
candida Gray 131, 133, 143
glaucescens Greene 133
malvaeflora (Moc.&Sessé) Gray 131, 133
neomexicana Gray 131, 133
nervata Nels. 131
oregana (Nutt.) Gray 133
spicata Greene 133
virgata Howell 133
Sideranthus 142, also:
grindelioides (Nutt.) Rydb. 140, 142
megacephalus (Nash) Small 267
Siderocarpus, see Pithecolobium 65
Sieglingia, see Triodia 161
Sieversia turbinata (Rydb.) Greene 296
Silene antirrhina L. 158
douglasii Hook. 236
drummondii Hook. 286
hallii Wats. 286
lemmonii Wats. 236
multicaulis Nutt. 236
nivea (Nutt.) Otth 236
noctiflora L. 236
occidentalis Wats. 236, 286
oregana Wats. 286
scouleri Hook. 286
verecunda Wats. 286
Silphium angustum (Gray) Small 48
asperrimum Hook. 48, 219
asteriscus L. 48, 219
compositum Michx. 48, 219
dentatum Ell. 48
glabrum Eggert 48
integrifolium Michx. 48, 218, 219
laciniatum L. 48, 218, 219
perfoliatum L. 48, 218, 219
pinnatifidum Ell. 48
scaberrimum Ell. 48
terebinthinaceum Jacq. 48, 218
trifoliatum L. 48, 219
Sisymbrium altissimum L. 158
canescens Nutt., see Sophia pinnata 148
incisum Engelm., see Sophia i. 148, 158
linifolium Nutt., see Schoenocrambe l. 148, 149
nasturtium-aquaticum L., see Radicula n. 158
Sisyrinchium angustifolium Mill. 229
gramineum Curtis, see S. graminoides 229, 383
graminoides Bickn. 229, 383
grandiflorum Dougl., see Olsynium g. 228
Sitanion californicum J.G.Sm. 179
elymoides Raf., see S. hystrix 152, 175, 179, 182, 186
hystrix (Nutt.) J.G.Sm. 152, 175, 179, 182, 186
jubatum J.G.Sm. 179, 186, 272
Sitilias, see Pyrrhopappus 352
Sium cicutaefolium Schr. 192
Smelowskia americana Rydb. 148, 291
calycina Am.auth., see S. americana 148, 291
calycina (Desv.) C.A.Mey. 148
fremontii Wats. 149
lobata Rydb. 291
SMILACEAE 145, 205, 226, 383
Smilacina amplexicaulis Nutt. 131
racemosa (L.) Desf. 131, 168
sessilifolia Nutt. 131
stellata (L.) Desf. 131, 169
Smilax bona-nox L. 145, 226
glauca Walt. 205, 226
havanensis Jacq. 226
herbacea L. 145, 226
hispida Muhl. 145, 205, 226
laurifolia L. 226
pseudo-china L. 226, 383
rotundifolia L. 205, 226, 383
tamnifolia Michx. 226
SOLANACEAE 127, 159, 331, 332, 333, 382, 387, 393
Solanum carolinense L. 127
elaeagnifolium Cav. 127
triquetrum Cov. 333
Solidago californica Nutt. 142
concinna Nels. 140
elongata Nutt. 140, 201

glaberrima Martens 140
gymnospermoides Fern., see Euthamia g. 45
lanceolata L., see Euthamia graminifolia 45, 198
leptocephala T.&G., see Euthamia l. 45
minor Fern., see Euthamia m. 45
missouriensis Nutt. 142
mollis Bartl. 140, 142
nana Nutt. 142
nemoralis Ait. 142
oreophila Rydb. 142
pauciflosculosa Michx., see Chrysoma p. 44
pitcheri Nutt., see S. serotina 141, 201
puberula Nutt. 202
pulcherrima Nels. 142, 201
pumila T.&G., see Petradoria p. 142
rigida L. 141
rigida humilis Porter, see Oligoneuron canescens 44
rigidiuscula (T.&G.) Porter 142
rugosa Mill. 200, 202
serotina Ait. 141, 201
tenuifolia Pursh, see Euthamia caroliniana 45, 198
trinervata Greene 142
ulmifolia Muhl. 202
spp. 44, 198
Sonchus asper (L.) Hill 49
sp. 216
Sophia andrenarum Cockerell 158
incisa (Engelm.) Greene 148, 158
intermedia Rydb. 158
leptostylis Rydb. 148
pinnata (Walt.) Howell 148
Sophora sericea Nutt. 307
Sorbus americana Marsh. 370, 375
aucuparia L. 358, 370
hybrida L. 358
occidentalis (Wats.) Greene 358, 368, 377
sambucifolia Gray, see S. scopulina 368, 370, 377
scopulina Greene 368, 370, 377
sitchensis Roem. 358, 368, 370, 377
Sorghastrum nutans (L.) Nash 118
Sorghum 125
SPARGANIACEAE 116
Sparganium eurycarpum Engelm. 116
Spartina alterniflora glabra (Muhl.) Fern. 165, 166, 167, 169
bakeri Merr. 165
cynosuroides Gray see S. michauxiana 165, 166, 167
cynosuroides (L.) Roth 165, 166, 167
glabra Muhl., see S. alterniflora g. 165, 166, 167, 169
gracilis Trin. 165, 167
juncea Michx., see S. patens 165, 167
junciformis Engelm.&Gray 166
michauxiana Hitchc. 165, 166, 167
patens (Ait.) Muhl. 165, 167
pectinata Bosc 167
polystachya Ell., see S. cynosuroides 165, 166, 167
spartinae Merr., see S. junciformis 166
Spatularia, see Saxifraga 294
Specularia perfoliata (L.) A.DC. 40
Spergula arvensis L. 236
Spergularia canadensis (Pers.) D.Don 168
macrotheca (Hornem.) Heynh. 158, 168
marina (L.) Griseb. 168
Spermacoce 261
Sphacele calycina Benth. 393
Sphaeralcea ambigua Gray 133, 143
angustifolia (Cav.) G.Don 133
arcuata (Greene) Arth. 133
arenaria W.&S. 133
arizonica Heller 133
coccinea (Nutt.) Rydb. 133, 143
cuspidata (Gray) Britt. 133
dissecta (Nutt.) Rydb. 133
elata (E.G.Baker) Rydb. 133
fasciculata (Nutt.) Arth. 131, 133, 143
fendleri Gray 133, 143
fremontii (Torr.) Jepson 133
grossulariaefolia (H.&A.) Rydb. 143
incana Torr. 133
lobata Wooton 133, 143
marginata York 133
munroana (Dougl.) Spach 133
orcuttii Rose 247
rivularis Torr., see Phymosia r. 131
subrhomboidea Rydb. 133
Sphaeromeria 343, 344
Sphaerostigma 248, also:
chamaenerioides (Gray) Small 159
Sphenopholis nitida (Spreng.) Scribn. 147
obtusata (Michx.) Scribn. 147, 174
obtusata lobata (Trin.) Scribn. 147, 174
pallens (Spreng.) Scribn. 147
Sphenosciadium capitellatum (B.&H.) Gray 319
Spinacea oleracea L. 158
Spiraea *lobata* Gron., see Filipendula rubra 99
stipulata Muhl., see Porteranthus s. 371
trifoliata L., see Porteranthus t. 371
Spirostachys, see Allenrolfea 392
Sporobolus airoides Torr. 143, 157
asper (Michx.) Kunth 135, 136, 137, 174
asperifolius (Nees&Meyen) Thurb. 143
auriculatus Vasey 143
buckleyi Vasey 143
contractus Hitchc. 136
cryptandrus (Torr.) Gray 136, 137, 174
cuspidatus Wood, see Muhlenbergia c. 143, 174
drummondii (Trin.) Vasey 135
heterolepis Gray 136
longifolius Wood, see S. asper 135, 136, 137, 174
neglectus Nash 135, 137
repens Presl, see Muhlenbergia r. 143
strictus Merr., see S. contractus 136
vaginaeflorus (Torr.) Wood 137
wrightii Munro 136
Spraguea 284
Stachytarpheta 256
Statice, see Armeria 252
Stanleya pinnata (Pursh) Britt. 158
Steironema ciliatum (L.) Raf. 167, 168, 169
lanceolatum (Walt.) Gray 169
lunellii Greene, see S. verticillatum 168
verticillatum Greene 168
Stellaria borealis Bigel. 21, 236
brachypetala Bong. 21
laeta Richards. 236
longifolia Muhl. 21
longipes Goldie 21, 236
media (L.) Cyrill 21, 158
umbellata Turcz. 21
Stenanthium gramineum (Ker) Morong 220
occidentale Gray 221
Stenotus 142
Stephanomeria, see Ptiloria 353
Stillingia 129

Stipa arida Jones 141
californica Merr.&Davy 141
comata Trin.&Rupr. 132, 141
comata intermedia Scribn.&Vasey, see S. tweedyi 141
coronata Thunb. 174
elmeri Piper&Brodie 148
eminens andersoni Vasey, see S. lepida a. 132, 141
lepida Hitchc. 132
lepida andersoni (Vasey) Hitchc. 132, 141
lettermani Vasey 132, 140
minor (Vasey) Scribn. 132, 140, 141
nelsonii Scribn. 140
neo-mexicana (Thurb.) Vasey 141
occidentalis Thurb. 148
pulchra Hitchc. 132, 141
robusta Scribn., see S. vaseyi 140
scribneri Vasey 140
spartea Trin. 141
speciosa Trin.&Rupr. 132
tweedyi Scribn. 141
vaseyi Scribn. 140
viridula Trin. 140
Strobus, see Pinus 27
Strophostyles 297
Struthiopteris, see Pteretis 4
Suaeda brevifolia (Standl.) Eastw. 235
californica Wats. 235
depressa (Pursh) Wats. 158
intermedia Wats. 282
maritima (L.) Dumort 160
ramosissima (Standl.) I.M.Johnst. 235
suffrutescens Wats. 235
taxifolia Standl. 235
torreyana Wats. 158, 235
Suckleya suckleyana (Torr.) Rydb. 158
Swertia 323
Symphoricarpos 162, 163
Syndesmon thalictroides (L.) Hoffm. 180
Syntherisma sanguinale (L.) Dulac 127
Synthyris 334

Taenidia intergerrima (L.) Drude 319
Taraxacum 352, also:
officinale Weber, see T. vulgare 351, 352
vulgare (Lam.) Schr. 351, 352
Taraxia 249
Tellima 293
Tephrosia, see Cracca 69
Tetradymia 142
TETRAGONIACEAE 158
Tetramerium hispidum Nees 337
Tetraneuris 142, also:
arizonica Greene 141, 142
Thalictrum alpinum L. 178, 231
cornuti T.&G., see T. polygamum 72, 74
dasycarpum Fisch.&Lall. 72, 74, 180
dioicum L. 72, 74, 180
fendleri Engelm. 74, 163, 178
megacarpum Torr. 74, 180
occidentalis Gray 74, 178
polygamum Muhl. 72, 74
purpurascens Auth., see T. dasycarpum 72, 74, 180
revolutum DC. 74, 180
sparsiflorum Turcz. 74, 178
thyrsoideum Greene, see T. venulosum 74, 180
venulosum Trel. 74, 180
wrightii Gray 74
sp. 181
Thelypodium laciniatum Endl. 158
linearifolium Wats. 148
sagittatum (Nutt.) Endl. 159
Thlaspi *alpestre* Am.auth., see T. purpurascens 239
glaucum Nels. 239, 290
nuttallii Rydb. 239
purpurascens Rydb. 239
Thyella tamnifolia (L.) Raf. 39
THYMELAEACEAE 200
Thymus serpyllum L. 331
Tiarella 293
Tiniaria, see Polygonum 232, 233
Tissa, see Spergularia 158, 168
Tithymalopsis 128
Tithymalus arkansanus (Engelm.&Gray) K.&G. 310
chamaesula (Boiss.) W.&S. 297, 298
commutatus (Engelm.) K.&G. 58, 381
cyparissias (L.) Hill 58
dictyosperma (Fisch.&Mey.) Heller 310
leiococcus (Engelm.) Small 381
leptocerus (Engelm.) Arth. 58
luridus (Engelm.) W.&S. 297
missouriensis (Norton) Small 310, 381
montanus (Engelm.) Small 298
obtusatus (Pursh) Small 310
palmeri (Engelm.) Abrams 58, 298
robustus (Engelm.) Small 58, 297, 298
Tium alpinum Rydb., see Astragalus a. 303
Tolmiea menziesii T.&G. 293
Tonella 258
Torresia, see Hierochloa 153
Tovaria, see Polygonum 233
Townsendia grandiflora Nutt. 141
Toxylon pomiferum Raf. 61
Trautvetteria grandis Nutt. 184
Triadenum 247
Tridens *flavus* Hitchc., see Triodia f. 161
strictus (Nutt.) Nash 136
Trientalis 214
Trifolium 305, 306, also:
carolinianum Michx. 300
hybridum L. 304
incarnatum L. 304, 305
repens L. 304, 305
Triglochin 158
Trillium 130
Triodia flava (L.) Hitchc. 161
purpurea Hack., see Triplasis p. 144
Triosteum angustifolium L. 387
Triplasis purpurea (Walt.) Chapm. 144
Tripsacum dactyloides L. 118, 124
latifolium Hitchc. 118
laxum Nash 118
monostachyum Willd., see T. dactyloides 118, 124
Tripterocalyx micranthus (Torr.) Hook. 158
Trisetum canescens Buckl. 174
cernuum (Kunth) Trin. 153
montanum Vasey 178
spicatum (L.) Richter 148, 150, 178
subspicatum Beauv., see T. spicatum 148, 150, 178
Triteleia, see Brodiaea 225, 272, 274
Triticum aestivum L. 175, 181, 186
compactum Host 175, 181, 186
dicoccoides Körn. 175, 181
dicoccum Schr. 175, 181, 186
durum Desf. 175, 181, 187
freycenctii Host 175
monococcum L. 175, 181
polonicum L. 175, 181
spelta L. 175, 181, 187
tumonica Schrad. 175
turgidum L. 175
vulgare Vill., see T. aestivum 175, 181, 186
TROPAEOLACEAE 159

Tropaeolum majus L. 159
Troximon, see Agoseris 203, 352, 354
Tsuga canadensis (L.)Carr. 17, 18, 53
caroliniana Engelm. 17
heterophylla (Raf.)Sarg. 390, 391
mertensiana (Bong.)Carr. 391
Tussilago 164

Ulmaria, see Filipendula 99
UMBELLIFERAE, see AMMIACEAE
Unifolium, see Maianthemum 130, 168
Uropappus lindleyi (DC.)Nutt. 352
Urtica 208, also:
chamaedryoides Pursh 381
URTICACEAE 62, 208, 381, 383
Urticastrum divaricatum (L.)Ktze. 62
Uvularia grandiflora Smith 131
perfoliata L. 131
sessilifolia L. 131, 169

Vaccaria, see Saponaria 158
VACCINIACEAE 18, 20, 33
Vaccinium alaskense Howell 18
caespitosum Michx. 18, 20
canadense Rich. 18, 20
chandleri Jepson 20
corymbosum L. 18, 20
erythrocarpon Michx. 18
globulare Rydb. 18
macrocarpon Ait., see Oxycoccus m. 18
macrophyllum (Hook.)Piper 18
membranaceum Dougl. 18, 20
myrsinites Lam. 19
myrtillus L. 19, 20
myrtilloides Hook., see V. membranaceum 18, 20
oreophilum Rydb. 19, 20
ovalifolium J.E.Sm. 19, 20
ovatum Pursh 20
parvifolium J.E.Sm. 19, 20
pennsylvanicum Lam. 19, 20
scoparium Leiberg, see V. myrtillus 19, 20
uliginosum L. 19
vacillans Kalm 19
virgatum Ait. 19
vitis-idaea L. 19, 20
Vachellia farnesiana (L.)W.&A. 65, 66
Vagnera, see Smilacina 131, 168, 169
Valeriana *acutiloba* Rydb., see V. occidentalis 200
edulis Nutt. 200
occidentalis Heller 200
septentrionalis Rydb. 262
sitchensis Bong. 262
uliginosa Rydb. 262
VALERIANACEAE 200, 262, 382
Valerianella congesta Lindl. 382
Valerianodes, see Stachytarpheta 256
Valota saccharata (Buckl.)Chase 130
Velaea 317
Veratrum californicum Durand 273
eschscholtzianum (R.&S.)Rydb. 273
parviflorum Michx. 220
speciosum Rydb., see V. californicum 273
tenuipetalum Heller 273
viride Ait. 220, 273
woodii Robb. 220
Verbena 135, also:
ciliata Benth. 159
VERBENACEAE 135, 159, 256
Verbesina dissita Gray 341
laciniata Poir., see Phaethusa l. 47
occidentalis (L.)Walt. 267
texana Buckl. 47, 267
virginica L. 267
Vernonia altissima Nutt. 41, 338
angustifolia Michx. 41
baldwinii Torr. 41, 338
blodgettii Small 41
corymbosa Schw. 338
crinita Raf. 41, 338
drummondii Shuttl., see V. missurica 41, 338
fasciculata Michx. 41, 338
flaccidifolia Small 41
gigantea (Nutt.)Britt. 41
glauca (L.)Britt. 41
guadalupensis Heller 41, 338
illinoensis Gleason 41
interior Small 41, 338
marginata (Torr.)Raf. 338
maxima Small, see V. altissima 41, 338
missurica Raf. 41, 338
noveboracensis (L.)Willd. 41, 338
oligantha Greene 41
ovalifolia T.&G. 41
pulchella Small 41, 338
texana (Gray)Small 41
tomentosa (Walt.)Ell. 41
Veronica cusickii Gray 335
serpyllifolia L. 335
virginica L. 259
wormskjoldii R.&S. 335
Viburnum 40, also:
pauciflorum Pylaie 337
Vicia americana Muhl. 243, 301
angustifolia (L.)Richard. 243
californica Greene 243, 301
caroliniana Walt. 243
cracca L. 243
dissitifolia (Nutt.)Rydb. 243
faba L. 243
linearis Greene, see V. sparsifolia 243, 301
melilotoides W.&S. 243
oregana Nutt. 243, 301
sativa L. 243
sparsifolia Nutt. 243, 301
trifida Dietr. 301
truncata Nutt., see V. oregana 243, 301
Vigna 297
Viguiera 341
Vinca major L. 324
Vincetoxicum 172, also:
gonocarpos Walt. 172, 325
shortii (Gray)Britt. 325
Viola adunca J.E.Sm. 311
affinis LeConte 311
arenaria Am.auth., see V. adunca 311
blanda Willd. 311
brittoniana Pollard 311
canadensis L. 311, 312
conspersa Reichenb. 311
cucullata Ait. 311
cuneata Wats. 312
delphinifolia Nutt., see V. pedatifida 119, 311
eriocarpa Schw. 118, 311
fimbriatula J.E.Sm. 118, 311
glabella Nutt. 311, 312
hastata Michx. 311
hirsutula Brain. 311
howellii Gray 311
incognita Brain. 311
lanceolata L. 118, 119, 311
langsdorfii Fisch., 311, 313
lobata Benth. 312
lovelliana Brain. 119
mackloskeyi Lloyd 313
missouriensis Greene 311
montanensis Rydb. 311
monticola Rydb. 311

muhlenbergii Torr., see V. conspersa 311
nephrophylla Greene 118, 311, 313
nuttallii Pursh 119
ocellata T.&G. 311
orbiculata Geyer 312
pallens (Banks) Brain. 311
palmata L. 119, 311
palmata cuculata Gray, see V. papilionacea 119, 311
palustris L. 311, 313
papilionacea Pursh 119, 311
pedata L. 119
pedatifida G.Don 119, 311
praemorsa Dougl. 312
primulifolia L. 119, 311
pubescens Ait. 311
purpurea Kellogg 312
renifolia Gray 311
rostrata Pursh 119, 311
rugulosa Greene 311, 312
rydbergii Greene, see V. rugulosa 311, 312
sagittata Ait. 119, 311
scabriuscula Schw., see V. eriocarpa 118, 311
scopulorum (Gray) Greene 311
selkirkii Pursh 311
septentrionalis Greene 119, 311
sororia Willd. 119, 311
striata Ait. 119, 311
tricolor L. 119
villosa Walt. 311
vittata Greene 311
VIOLACEAE 118, 119, 311, 312, 313
Viorna fremontii (Wats.) Heller 180
hirsutissima (Pursh) Heller 178
jonesii (Ktze.) Rydb. 178
reticulata (Walt.) Small 180
scottii (Porter) Rydb. 178
urnigera Spach 180
viorna Small, see V. urnigera 180 sp. 74
VITACEAE 60, 385
Vitis 60

Wahlbergella, see Silene 286
Waldsteinia 240
Windsoria, see Triodia 161
Wissadula 144
Woodsia glabella R.Br. 11
Woodwardia *areolata* Moore, see Lorinseria a. 3
virginica J.E.Sm., see Anchistea v. 4
Wulfenia, see Synthyris 334
Wyethia 342

Xanthium 189, 190
Xanthoxylum, see Zanthoxylum 122
Xerophyllum asphodeloides (L.) Nutt. 220
Ximenesia encelioides Cav. 267, 341
exauriculata (Rob.&Greenm.) Rydb. 47
Xolisma ligustrina (L.) Britt. 18
Xylophacos, see Astragalus 301
Xylorrhiza 142

Yucca glauca Nutt. 382

Zanthoxylum 122
Zauschneria 248
Zea mays L. 117
Zexmenia podocephala Gray 341
Zizia aurea (L.) Koch 319
cordata (Walt.) Koch 320
intergerrima DC., see Taenidia i. 319
Zonanthemis corymbosa (DC.) Greene 46
Zornia 244
Zygadenus 221, also:
chloranthus Richards. 220, 221
Zygophyllidium bilobatum (Engelm.) Standl. 310
hexagonum (Nutt.) Small 128

INDEX OF RUST NAMES

AECIDIEAE 1, 63
Aecidiolum
hydrocotyles Speg. 320
Aecidium **380**
abietinum A.&S. 34
abundans Peck 162
aesculi E.&K. **385**
alaskanum Trel. 383
album G.W.Clint. 242
allenii G.W.Clint. 211
alliicola Wint. 136
amorphae Cooke 77
amphigenum E.&K. 122
anisacanthi Peck 337
anograe Arth. **385**
apocyni Schw. **386**
arctoum Arth. 211
arcularium Arth. **388**
argentatum Schultz 307
asperifolii Pers. 177
asteris Thüm. 197
asterum Schw. 197
atriplicis Shear 235
batesii Arth. **388**
berberidis Pers. 173
betae Kühn 234
betheli Arth. **385**
biforme Peck 157
bifrons DC. 238
bigeloviae Peck 140
blasdaleanum D.&H. 358
boehmeriae Arth. **383**
borrichiae Syd. **387**
butlerianum Rosen&Arth. 75
caladii Schw. 214
calthae Grev. 237
campanulastri G.W.Wilson **387**
cannonii Griff. **385**
carneum Nees 302
cassiae E.&K. 384
ceanothi E.&K. 124
cephalanthi Seym. 166
chamaecristae Arth. 123, **384**
chelonis Ger. 120
chenopodii-fruticosi DC. 234
clarkiae D.&H. 248
clematitis DC. 178
clemensae Arth. 385
collinsiae E.&E. 258
coloradense Diet. 21
columbiense E.&E. **382**
columnare A.&S. 19
compositarum bellidis Dur.&Mont. 219
compositarum bidentis Burr. 188
compositarum eupatorii De-T. 193
compositarum liatridis Webber 146
compositarum silphii Burr. 218
compositarum xanthii Ellis 189
conorum-piceae Reess 31
conspicuum Arth. 145
cornutum Pers. 370
crepidis-montanae Syd. 353
cressae DC. 325
crotonopsidis Burr. 129
cyrillae Arth. **385**
daleae Kellerm.&Sw. 122
dandelionis Schw. 220
desmium B.&Br. 62
desmodii P.Henn. 241
dicentrae Trel. 61
dracunculi Thüm. 205
elatinum A.&S. 20
ephedrae Diet. 390
epilobii DC. 313
erigerontis Kern&Whetzel 190
euphorbiae-gerardianae Fisch. 286
eurotiae E.&E. 134
falcatae Arth. 122
fediae Berg. 382
fendleri Tr.&Earle 151
fluxum Arth. 122
fraseri Trel. 323
fraxini Schw. 165
friesii Bubák 259
fuscum Pers. 73
galii ambiguum A.&S. 260
gaurinum Peck 249
geranii-maculati Schw. 232
gerardiae Peck 121
giliae Peck 325
gossypii E.&E. 143
gracilens Peck 359
graebnerianum P.Henn. **383**
graminellum Speg. 132
grindeliae Griff. 140
hamiltoniae Thüm. 122
harknessianum Farl. 367
helianthi-mollis Schw. 267
hemisphaericum Peck 355
hepaticatum Schw. 72
hesleri Arth. **386**
hieraciatum Schw. 199
holboellii Hornem. 149
hydnoideum B.&C. 200
hydrocotylinum Speg. 320
hyperici-frondosi Schw. 247
ilicinum E.&E. 31
indecisum Arth. 146
ingenuum Arth. 13
insulsum Arth. **387**
iridis Ger. 130
ivae Jacks. **387**
jamesianum Peck 171
jussiaeae Speg. 249
laceratum Sow. 373
lapsanae Schultz 350
laricis Kleb. 22
leucostictum B.&C. 241
liatridis Ellis&And. 146
libertum Arth. **381**
ligustici E.&E. **386**
lini Dearn.&House **384**
ludwigiae E.&E. 249
lupini Peck 122
lycii Arth. **387**
lycopi Ger. 194
lygodesmiae Shear 140
lysimachiae Schw. 212
macrosporum Peck 204
majanthae Schum. 130
malvastri P.Henn. 131
mariae-wilsoni Peck 118
martianoffianum Thüm. 205
mesadeniae Arth. **388**
mexicanum D.&H. **385**
micropunctum E.&E. 121
minutulum Jacks. **384**
mirabilis D.&H. **384**
mitellae E.&E. **384**
modiolae Thüm. 131
monoicum Peck 147
mutum Arth. **386**
myosotidis Burr. 146
myricatum Schw. 359
myrtilli Schum. 18
nesaeae Ger. 203

nitens Schw. 96
oenotherae Mont. 199
oldenlandianum Ellis&Tr. 160
onobrychidis Burr. 122, 241
ornithogaleum Bubák 176
orobi elegans Berk. 300
oxalidis Thüm. 117
pammelii Trel. 128
parryi Peck 147
peckii De-T. 199
penicillatum Pers. 368
pentastemonis Schw. 120
periclymeni Schum. 154
petalostemonis Kellerm.&Carl. 122
phacae-frigidae Wahl. 303
phaceliae Peck 177
phascoli Funck 296
phrymae Halst. 200
physalidis Burr. **381**
plantaginis Burr. 160
plantaginis Ces. 169
plenum Arth. **384**
podophylli Schw. 289
polemonii Peck 167, 168
polygalinum Peck 122
porosum Peck 300
pourthiaeae Syd. 372
proserpinacae B.&C. 251
pseudo-balsameum D.&H. 5
pseudo-columnare Kühn 3
psoraleae Peck 244
pteleae B.&C. 161
punctatum Pers. 71
pustulatum Curt. 122
pyrolae DC. 31
pyrolae Pers. 16
quadrifidum DC. 72
ranunculi Schw. 146
renatum Arth. **381**
residuum Arth. **383**
rhamni Pers. 152
rivinae B.&C. 283
rubellum Pers. 155
rumicis β grossulariae Pers. 207
rusbyi Ger. 359
sambuci Schw. 204
sanguinolentum Lindr. 232
sarcobati Peck 157
smilacis Schw. 226, **382**
solanitum Schw. 127
solidaginis Schw. 198
sommerfeltii Johans. 231
sorbi Arth. 357
stillingiae Tr.&Earle 129
suaedae Thüm. 234
subsimulans Arth.&Mains **386**
swertiae Opiz 323
tithymali Arth. **381**
tracyanum Syd. **387**
trientalis Tranz. 214
trifolii-repentis Cast. 304
trilii Burr. 130
triostei Arth. **387**
tuberculatum E.&K. 133
tubulosum P.&G. 127
tussilaginis Pers. 164
urticae Schum. 207
uvulariae Schw. 130
valerianellae Biv. 187, **382**
velenovskyi Bubák 382
verbenicolum E.&K. 135
verbesinae Schw. 267
violaceum Trel. 245
violae Schum. 311
xanthoxyli Peck 122
yuccae Arth. **382**

Allodus
ambigua Arth. 260
arabicola Arth.&Orton 290
asperior Orton 318
batesiana Arth. 269
calochorti Arth. 276
carnegiana Orton 275
chamaesarachae Arth. 332
claytoniata Arth. 283
commutata Arth. 261
complicata Arth.&Orton 333
consimilis Orton 148
crassipes Arth. 254
dichelostemmae Orton 274
douglasii Orton 255
effusa Arth. 312
erigeniae Orton 315
gigantispora Arth. 238
giliae Orton 325
gnaphaliata Arth. 265
graminella Arth. 132
intermixta Arth. 338
interveniens Arth.&Orton 131
jonesii Arth. 317
jusiaeae Arth.&Orton 249
lindrothii Orton 317
melanconioides Arth. 322
mellifera Arth. 257
microica Orton 321
opposita Orton 238
podophylli Arth. 289
rufescens Arth. 335
scaberistipes Arth.&Orton 337
subangulata Orton 275
subcircinata Arth. 345
swertiae Orton 323
tenuis Arth. 264
vertisepta Arth. 330
yosemitana Arth.&Orton 255

Ameris
rosicola Arth. 89

Aplopsora 2, **59**
nyssae (Ellis&Tr.)Mains **59**

Aregma
mucronata Fries 84
obtusata Fries 80
speciosa Fries 88
triarticulata B.&C. 92

Ascophora
disciflora β byssina Tode 81
disciflora (*α solida*) Tode 84
limbiflora Tode 81

Baeodromus 2, **62**
californicus Arth. **62**

Bubakia 2, **59**
crotonis (Cooke)Arth. **60**

Bullaria
absinthii Arth.&Mains 343
angelicae Arth. 319
arachidis Arth.&Mains 244
balsamorhizae Arth.&Mains 342
bardanae Arth. 348
carthami Arth.&Mains 349
chondrillina Arth.&Mains 355
chrysanthemi Arth. 270
cirsii Arth. 348
coelopleuri Arth.&Mains 320
conoclinii Arth.&Mains 338
cyani Arth. 349
cynomarathri Arth.&Mains 318
ellisii Arth.&Mains 318
encliae Arth. 341
gaillardiae Arth.&Mains 344
globosipes Jacks. 331
hieracii Arth. 351
hydrocotyles Arth.&Mains 320
irrequisita Arth.&Mains 349
kuhniae Kern 339
pinaropappi Arth.&Mains 350

suaveolens Arth. 347
subdecora Arth.&Mains 340
triannulata Arth.&Mains 342
tumidipes Arth. 331
vernoniae Arth. 338
vincae Arth. 324
ziziae Arth. 319
zorniae Arth. 244

Caeoma 380, **390**
abietis-canadensis Farl. 53
abietis-pectinatae Reess 55
agrimoniae Schw. 14
andropogi Schw. 118
apocynatum Link 386
appendiculatum Sommer. 303
armeriae Schl. 252
azaleae Schw. 18
botryapites Schw. 360
carpini Nees 23
caryophyllacearum Link 20
cheilanthis Peck 11
chenopodiatum Link 234
claytoniatum Schw. 283
conigenum Pat. 25
dubium C.A.Ludwig **390**
erigeronatum Schw. 198
fraxinatum Link 165
galii Link 19
germinale Schw. 362
gnaphaliatum Schw. 265
helianthi Schw. 47
hibisciatum Schw. 143
houstoniatum Schw. 228
hydrocotyles Link 320
impatientis Link 307
interstitiale Schl. 96
luminatum Link 96
myricatum Schw. 359
occidentale Arth. 51
parnassiae Schl. 212
pedatatum Schw. 119
piperianum Sacc.&Trott. 35
pseudotsugae-douglasii Tubeuf 51
punctato-striatum Diet.&Neg. 266
pyrolatum Schw. 31
ribesii Link 55, 56
rosae-gumnocarpae Diet. 87
sagittatum Schw. 119
silenes Schl. 235
smilacinatum Schw. 382
solidaginis Sommerf. 201
strobilinum Arth. 25
tenue Schw. 264
thalictri Schw. 74
thalictri Sommerf. 231
Calliospora
holwayi Arth. 77
petalostemonis Arth. 76
Calyptospora
columnaris Kühn 19
goeppertiana Kühn 19
Cerotelium 2, **61**
desmium (B.&Br.)Arth. **62**
dicentrae [Trel.]Mains&And. **61**
fici Arth. 61
urticastri Mains 61
Chrysomyxa 2, **30**
abietis 31
albida Kühn 94
arctostaphyli Diet. **36**
cassandrae (P.&C.)Tranz. **34**
chiogenis Diet. **33**
empetri (Pers.)Schroet. **31**
farlowii Sacc.&Trav. 53
illicina (E.&E.)Arth. **31**
ledi (A.&S.)deBary **34**
ledicola (Peck)Lagerh. **33**
piperiana (Arth.)Sacc.&Trott. **35,** 389
pirolatum Wint. 31
pyrolae (DC.)Rostr. **31,** 33
ramischiae Lagerh. 32
roanensis Arth. **35**
weirii Jacks. **32**
Cionothrix 24
Coleosporium 2, **36**
adenocaulonis Jacks. **45**
apocynaceum Cooke **38**
aridum Jacks. **42**
arnicale Arth. 45
asterum Syd. 43
baccharidis Cooke&Hark. 265
campanulae (Pers.)Lév. **40**
carneum Jacks. 41
delicatulum (A.&K.)Hedgc.&Long **44**
domingense (Berk.)Arth. **39**
elephantopodis (Schw.)Thüm. **41,** 42
helianthi (Schw.)Arth. **47,** 48
heterothecae Hedgc.&Hunt 43
inconspicuum (Long)Hedgc.&Long **46,** 47
ipomoeae (Schw.)Burr. **39**
jonesii (Peck)Arth. **37**
laciniariae Arth. **42**
madiae Cooke **45**
miniatum Bon. 84
minutum Hedgc.&Hunt **38**
occidentale Arth. **48**
ochraceum Bon. 14
pini Gall. 46
pini-asteris Orish. 43
pinicola Arth. **46**
plumierae Pat. 39
ribicola Arth. 37
senecionis (Pers.)Fries **49**
solidaginis (Schw.)Thüm. **43**
sonchi Schroet. 49
sonchi-arvensis (Pers.)Lév. **49**
terebinthinaceae (Schw.)Arth. **48**
verbesinae D.&H. 47
vernoniae B.&C. **40,** 42
viburni Arth. **40**
viguierae D.&H. **47**
Cronartieae 1, 2
Cronartium 2, **24**
asclepiadeum quercium Berk. 25
asclepiadeum thesii Berk. 28
cerebrum Hedgc.&Long 25
coleosporioides (D.&H.)Arth. 26, **29**
coleosporioides filamentosum 30
coleosporioides harknessii 30
coleosporioides stalactiforme 30
comandrae Peck **28**
comptoniae Arth. **24**
conigenum Hedgc.&Hunt 25
filamentosum Hedgc. 29
flaccidum (A.&S.)Wint. **30**
fusiforme Hedgc.&Hunt 25
harknessii Meinecke 24, 29
occidentale Hedgc.,Bethel&Hunt **27**
pyriforme Hedgc.&Long 28
quercuum (Berk.)Miyabe 24, **25,** 30
ribicola Fischer **26**
ribicola Dietr. 26
stalactiforme A.&K. 29
strobilinum Hedgc.&Hahn 25
thesii Lagerh. 28
Crossopsora 24
Cumminsiella 63, **74**
sanguinea (Peck)Arth. **75**
texana (Holw.&Long)Arth. **75**
wootoniana Arth. **75**
Cystingophora
hieronymi Arth. 65

Dendroecia
opaca Arth. 67
Dicaeoma
abruptum A.&J. 341
abundans A.&F. 162
acetosae Ktze. 281
aemulans A.&J. 269
aletridis Ktze. 226
allenii A.&F. 211
allii Ktze. 222
amphigenum Ktze. 144
amphispilusum Arth. 279
andropogonis Ktze. 120
angustatoides Arth. 196
angustatum Ktze. 194
anisacanthi Arth. 337
anomalum A.&F. 176
apocryptum Ktze. 182
areolatum Ktze. 237
arundinariae Ktze. 188
asparagi Ktze. 225
asperifolii Ktze. 181
asterum A.&K. 197
atrofuscum Arth. 205
atropunctum Ktze. 220
atrum Arth. 129
baccharidis A.&J. 266
ballotaeflorae Arth. 329
bistortae Ktze. 280
bouteloues A.&F. 173
burnettii Arth. 134
calthae Ktze. 237
calthaecola Arth. 287
cameliae A.&F. 125
canaliculatum Ktze. 189
caricis-strictae A.&K. 207
caulicola Ktze. 329
ceanothi A.&F. 124
cenchri Arth. 126
cephalanthi Jacks. 166
chaetochloae A.&F. 129
chloridis Ktze. 170
cicutae Ktze. 316
cladii Arth. 192
clematidis Arth. 177
cnici Arth. 346
cockerellianum A.&F. 163
cognatum A.&J. 267
convolvuli Ktze. 253
cooperiae Arth. 227
crepidis-montanae Arth. 353
cressae Ktze. 325
cryptanthes Arth. 256
cynodontis Ktze. 169
cyperi Ktze. 190
cypripedii Arth. 229
cyperi-tagetiformis Arth. 190
distichlidis Ktze. 166
dracunculi A.&K. 205
eatoniae Arth. 146
emaculatum Ktze. 127
eminens A.&K. 207
eleocharidis Ktze. 193
epilobii-tetragoni Arth. 313
epiphyllum Ktze. 164
eriophori Ktze. 195
eurotiae A.&F. 134
evadens A.&J. 265
exasperans A.&F. 173
farinaceum Arth. 330
fimbristylidis Arth. 190
flaccidum Ktze. 125
fraxini Arth. 165
fuirenae Ktze. 191
gentianae Ktze. 322
giliae Ktze. 254
glumarum A.&F. 186
granulisporum Ktze. 223
grossulariae Kern 207
grumosum Arth. 221
guillemineae Arth. 235
harknessii Ktze. 353
helianthellae Arth. 340
helianthi-mollis Arth. 267
hemisphaericum Arth. 355
hibisciatum Arth. 143
hieraciatum A.&K. 199
holcinum A.&F. 177
hordei A.&F. 185
hyptidis Arth. 256
impatientis Arth. 182
impositum A.&F. 126
inspiratum Arth. 351
interveniens A.&F. 131
iridis Ktze. 227
jamesianum Arth. 171
kaernbachii A.&F. 125
kansense Arth. 272
koeleriae A.&F. 149
lapsanae Ktze. 350
leptochloae A.&F. 170
leve A.&F. 126
liatridis A.&F. 146
libertum Arth. 194
lithospermi Ktze. 253
luxuriosum A.&F. 157
lysimachiae Ktze. 212
macrosporum A.&K. 204
magnusianum Ktze. 156
majanthae Arth. 130
mariae-wilsoni A.&F. 118
marylandicum Arth. 314
massale A.&J. 341
mcclatchieanum Arth. 191
melanocephalum A.&F. 188
menthae S.F.Gray 327
micranthum A.&F. 139
micromeriae Arth. 327
microsorum Ktze. 213
minutissimum Jacks. 203
minutum Arth. 213
monardellae Arth. 327
monoicum A.&F. 147
montanense Ktze. 151
mutabile Ktze. 224
myosotidis A.&F. 146
nodosum Ktze. 274
nolitangeris Arth. 307
obscurum Ktze. 219
obtectum Ktze. 188
orbicula Ktze. 354
ortonii Arth. 321
oxalidis Ktze. 245
oxyriae Ktze. 281
pammelii Arth. 128
paradoxicum A.&F. 271
parcum Arth. 231
parnassiae A.&K. 212
parryi Arth. 147
pattersonianum A.&F. 272
peckii Arth. 199
periclymeni A.&F. 154
phrymae A.&K. 200
pimpinellae Ktze. 315
piperi A.&F. 164
pistorica Arth. 266
poculiforme Ktze. 173
polygoni-alpini Arth. 279
polygoni-amphibii Arth. 232
polygoni-vivipari Arth. 280
polysorum Arth. 117
porri Ktze. 221
procerum Ktze. 187
proserpinacae Ktze. 251
pseudocymopteri Arth. 316
punctatum Arth. 259

punctiforme Arth. 234
purpureum Ktze. 125
pygmaeum A.&F. 137
redfieldiae Ktze. 161
rhamni Ktze. 152
rivinae Arth. 283
rosenii Arth. 197
rubellum A.&F. 155
ruelliae Ktze. 336
salviicola Arth. 329
sambuci Arth. 204
sarcobati Arth. 158
scaber Arth. 140
scleriicola Arth. 193
setariae Arth. 129
simulans A.&F. 136
smilacis Ktze. 226
sommerfeltii Arth. 231
sorghi Ktze. 117
spatiosum A.&K. 213
splendens Ktze. 263
sporoboli Ktze. 135
stephanomeriae Arth. 353
stipae Ktze. 140
substriatum Arth. 127
tardissimum Arth. 285
tetramerii Arth. 337
trientalis A.&K. 214
tripsaci Arth. 124
troglodytes Jacks. 260
tubulosum A.&F. 127
urticae Ktze. 207
variabile Ktze. 350
veratri Ktze. 273
verbenicola Arth. 135
verbesinae Ktze. 267
vexans Ktze. 172
violae Ktze. 311
virgatum Ktze. 118
windsoriae Ktze. 161
xanthiifoliae Ktze. 263

Diorchidium
boutelouae Jennings 173
Discospora
effusa Arth. 70

Earlea
alaskana Arth. 91
bilocularis Arth. 90
horkeliae Arth. 90
speciosa Arth. 88
Endophyllum 63, 101
persoonis Lév. 239
sempervivi (A.&S.)deBary **239**
tuberculatum (E.&K.)A.&F. 132, **133**
Eriosporangium
evadens Arth. 265
pistoricum Arth. 266
punctato-striatum Arth. 266

Form-Genera 1, **380**
Frommea 63, **92**
duchesneae Arth. 93
obtusa (Str.)Arth. **92**
obtusa duchesneae Arth. **93**

Gallowaya
pini Arth. 46
pinicola Arth. 46
Gymnoconia 63, **95**
bilocularis Arth. 90
interstitialis Lagerh. 96
nitens Kern&Thurston 97
peckiana (Howe)Trotter **96**
rosae-gymnocarpae Arth. 87
Gymnosporangium 63, **356**
asiaticum Miyabe 366
aurantiacum Chev. 369, **370**
aurantiacum Syd. 358
bermudianum (Farl.)Earle **379**
betheli Kern **374**
biseptatum Ellis **360**
blasdaleanum Kern 358
botryapites Kern 360
chinense Long 366
clavariaeforme (Jacq.)DC. **373**
clavipes C.&P. **362**
conicum Farl. 369
corniculans Kern **377**
cornutum Arth. 370
cupressi Long&Goodd. **371**
davisii Kern **366**
durum Kern 376
effusum Kern **371**
ellisii (Berk.)Farl. **359**
exiguum Kern **368**
exterum A.&K. **370**
flaviforme Earle 378
floriforme Thaxt. **378**
fraternum Kern 365
fuscum globosum Farl. 375
germinale Kern 362
globosum Farl. **375**
gracilens Kern&Bethel 359
haraeanum Syd. **366**
harknessianum [E.&E.]Kern **367**
hyalinum [Cooke]Kern **361**
inconspicuum Kern **361**
japonicum Syd. **372**
juniperi Link 370
juniperinum Fries 369, 370
juniperinum (L.)Mart. **368,** 370
juniperi-virginianae Schw. **378**
juvenescens Kern **364,** 377
kernianum Bethel **364**
koreaense Jacks. 366
libocedri (P.Henn.)Kern **358**
macropus Link 378
multiporum Kern **363**
myricatum Fromme 360
nelsoni Arth. 365, **376**
nidus-avis Thaxt. **369**
nootkatense (Trel.)Arth. **357**
photiniae Kern 372
sorbi Kern 357
speciosum Peck **359**
spiniferum Syd. 372
trachysorum Kern **372**
transformans [Ellis]Kern 361, **365**
tremelloides Hartig 368, 369
tubulatum Kern **375**
Gymnotelium
blasdaleanum Arth. 358
myricatum Arth. 360
nootkatense Syd. 357

Hamaspora
ellisii Körn. 360
Haploravenelia
cassiaecola Syd. 67
igualica Syd. 66
mesillana Syd. 68
papillifera Syd. 68
siliquae Syd. 66
versatilis Syd. 66
Hyalopsora 1, **10**
aspidiotus (Peck)Magn. **10**
cheilanthis (Peck)Arth. **11**
laeviuscula Arth. 7
polypodii (Pers.)Magn. **11**
polypodii-dryopteridis Magn. 10
Hypodermium
obtegens Link 347

Klebahnia
bidentis Arth. 342

glycyrrhizae Arth. 306
hyalina Arth. 306
Kuehneola 63, **93**
duchesneae Arth. 93
fici Butler 61
gossypii Arth. 62
malvicola (Speg.) Arth. **94**
obtusa Arth. 93
tormentillae Arth. 92
uredinis (Link) Arth. **94**
Kunkelia 63, **96**
nitens (Schw.) Arth. **96**

Lecythea
macrosora Peck 54
speciosa Peck 81
Lipospora
tucsonensis Arth. 73
Lycoperdon
caryophyllinum Schr. 285
epiphyllum L. 164
lineare Schr. 173, 175
poculiforme Jacq. 173
subcorticinum Schr. 84

Mainsia 63, **95**
epiphylla (Arth.) Jacks. **95**
Melampsora 2, **50**
abietis-canadensis [Farl.] C.A.Ludwig **53**, 54
abieti-capraearum Tubeuf **55**
aecidioides (DC.) Schroet. **54**
albertensis Arth. **51**
alni Thüm. 23
alpina Juel 56
americana Arth. 55
arctica Rostr. 55, **56**
bigelowii Thüm. **54**
carpini Fckl. 23
confluens Jacks. 55
crotonis Burr. 60
cyparissiae W.Müll. 58
euphorbiae (Schub.) Cast. **58**
euphorbiae-cyparissiae W.Müll. 58
euphorbiae-exiguae W.Müll. 58
euphorbiae-gerardianae W.Müll. **58**
euphorbiae-pepli W.Müll. 58
farlowii (Arth.) J.J.Davis **53**
guttata Schroet. 19
humboldtiana Speg. 55
lini (Pers.) Lév. **57**
lini liniperda Körn. 57
liniperda Palm 57
medusae Thüm. **51**, 53
monticola Mains **57**
occidentalis Jacks. **52**
paradoxa D.&H. 54
piscariae Jacks. **58**
populi-tsugae J.J.Davis 53
pseudotsugae Tubeuf 51
ribesii-auritae Kleb. 55, 56
ribesii-purpureae Kleb. **55**, 56
ribesii-salicum Bubák 55
sparsa Wint. 17
MELAMPSORACEAE **1**
MELAMPSOREAE 1, 2
Melampsorella 2, **20**
caryophyllacearum Schroet. 20
cerastii (Pers.) Schroet. **20**
elatina Arth. 21
Melampsoridium 2, **22**
alni (Thüm.) Diet. **23**
betulae Arth. 22
betulinum (Pers.) Kleb. **22**
carpini (Nees) Diet. **23**
Melampsoropsis
abietina Arth. 34
arctostaphyli Arth. 36
cassandrae Arth. 34
chiogenis Arth. 33
empetri Arth. 31
ilicina Arth. 31
ledi Arth. 34
ledicola Arth. 33
piperiana Arth. 35
pyrolae Arth. 32
roanensis Arth. 35
Micropuccinia
aberrans A.&J. 291
acrophila A.&J. 334
adoxae A.&J. 308
agnita A.&J. 284
albulensis A.&J. 334
andina A.&J. 288
anemones-virginianae A.&J. 157
araliae A.&J. 314
arechavaletae A.&J. 246
arenariae A.&J. 236
asarina A.&J. 229
asteris A.&J. 202
brandegei A.&J. 290
campanulae A.&J. 262
canadensis A.&J. 312
chelonis A.&J. 333
circaeae A.&J. 250
clintonii A.&J. 336
columbiensis A.&J. 203
comandrae A.&J. 123
conglomerata A.&J. 346
cruciferarum A.&J. 292
cryptotaeniae A.&J. 321
curtipes A.&J. 293
dayi A.&J. 169
delphinii A.&J. 289
dentariae A.&J. 239
dichondrae A.&J. 253
distorta Arth. 331
drabae A.&J. 291
emiliae A.&J. 271
epilobii Rostr. 274
eurotiae A.&J. 134
expansa A.&J. 345
fergussoni A.&J. 312
flaveriae A.&J. 270
fraseri A.&J. 271
gemella A.&J. 237
gigantea A.&J. 202
grindeliae A.&J. 141
gulosa A.&J. 326
haleniae A.&J. 252
heterisiae A.&J. 294
heterospora A.&J. 144
heucherae A.&J. 293
holboellii A.&J. 149
hydrophylli A.&J. 327
hyssopi A.&J. 257
hysteriiformis A.&J. 236
incondita A.&J. 333
jueliana A.&J. 294
lantanae A.&J. 256
lateritia A.&J. 261
laurentiana A.&J. 240
leveillei A.&J. 307
ligustici A.&J. 280
linkii A.&J. 337
lithophragmae A.&J. 293
lobata A.&J. 247
lobeliae A.&J. 262
maculosa A.&J. 203
malvacearum A.&J. 246
marianae A.&J. 266
melampodii A.&J. 270
mertensiae A.&J. 327
mesnieriana A.&J. 154
mesomajalis A.&J. 278
millefolii A.&J. 206

moreniana A.&J. 272
musenii A.&J. 318
nesodes A.&J. 124
novae-zembliae Arth. 262
obliqua A.&J. 172
ornata A.&J. 156
ornatula A.&J. 312
pallido-maculata A.&J. 293
parkerae A.&J. 211
parnassiae A.&J. 294
pentstemonis A.&J. 123
phaceliae A.&J. 185
physalidis A.&J. 332
physostegiae A.&J. 330
polemonii A.&J. 255
poromera A.&J. 279
porphyrogenita A.&J. 251
pulsatillae A.&J. 184
pyrolae A.&J. 246
ranunculi A.&J. 288
recedens A.&J. 196
retecta A.&J. 288
rhaetica A.&J. 335
rhodiolae A.&J. 292
ribis Rostr. 295
romanzoffiae A.&J. 326
rubefaciens A.&J. 260
rudbeckiae A.&J. 201
rydbergii A.&J. 292
saxifragae-tricuspidatae A.&J. 294
scandica A.&J. 314
schneideri A.&J. 331
seymeriae A.&J. 123
sherardiana A.&J. 133
sidalceae A.&J. 133
sieversiae A.&J. 295
silphii A.&J. 218
solanita A.&J. 127
spezazzinii A.&J. 264
suksdorfii A.&J. 354
symphoricarpi A.&J. 163
thlaspeos A.&J. 239
tolimensis A.&J. 193
treleasiana A.&J. 287
tumamocensis A.&J. 275
turrita A.&J. 294
urbaniana A.&J. 256
utahensis A.&J. 290
veronicarum A.&J. 259
virgaureae A.&J. 202
waldsteiniae A.&J. 240
wulfeniae A.&J. 334
xanthii A.&J. 189

Milesia 1, **5**
darkeri Faull **9**
dilatata Faull **8**
fructuosa Faull **8**
intermedia Faull 8
kriegeriana Arth. 8
kriegeriana Magn. 8, 9
laeviuscula (D.&H.)Faull **7**
marginalis Faull&Wats. **8**
polypodophila (Bell)Faull **6**, 389
polystichi Wineland **9**
pycnograndis Arth. 6
vogesiaca (Syd.)Faull **7**

Milesina
polypodophila Faull 6
pteridis Syd. 5
vogesiaca Syd. 7

Necium
farlowii Arth. 53

Neoravenelia
holwayi Long 65
subtortuosae Arth. 65

Nigredo
aemula Arth. 224
affinis Arth. 278
alliicola Arth. 136
alopecuri Arth. 183
amphidyma Arth. 184
andropogonis Arth. 119
appendiculata Arth. 296
archeriana Arth. 170
arguta Arth. 169
aristidae Arth. 138
armeriae Arth. 252
beckmanniae Arth. 170
betae Arth. 234
bicolor Arth. 223
bifrons Arth. 238
caladii Arth. 214
caryophyllina Arth. 286
chenopodii-fruticosa Arth. 235
columbiana Arth. 341
coluteae Arth. 298
commelinae Arth. 215
compacta Arth. 266
dactylidis Arth. 184
dictyosperma Arth. 310
dolicholi Arth. 244
eleocharidis Arth. 194
epicampis Arth. 139
eragrostidis Arth. 162
fabae Arth. 242
fallens Arth. 304
gentianae Arth. 323
geranii Arth. 245
graminicola Arth. 129
halstedii Arth. 130
hedysari-paniculati Arth. 240
holwayi Arth. 277
hordei Arth. 177
hordeina Arth. 177
houstoniata Sheldon 228
howei Arth. 324
hyperici-frondosi Arth. 247
ignobilis Arth. 137
indigoferae Arth. 243
intricata Arth. 229
jacksonii Arth. 185
junci Arth. 216
junci-effusi Arth. 217
leptoderma Arth. 126
lespedezae-procumbentis Arth. 241
lilii Arth. 277
limonii Arth. 252
lupini Arth. 243
martinii Arth. 343
medicaginis Arth. 299
minima Arth. 137
minuta Arth. 394
mystica Arth. 187
occidentalis Arth. 297
peckiana Arth. 160
pedatata Arth. 119
perigynia Arth. 200
plumbaria Arth. 249
poae Arth. 184
polemonii Arth. 167
polygoni Arth. 230
pontederiae Arth. 216
proba Arth. 228
proëminens Arth. 308
punctata Arth. 301
pyriformis Arth. 215
rhyncosporae Arth. 196
rickeriana Arth. 282
ruelliae Arth. 337
scirpi Arth. 192
seditiosa Arth. 160
silenes Arth. 236
silphii Arth. 218
sparganii Arth. 116
speciosa Arth. 323

spermacoces Arth. 261
sporoboli Arth. 136
substriata Arth. 297
suksdorfii Arth. 286
trifolii Arth. 304
uniporula Arth. 210
valens Arth. 210
verruculosa Arth. 285
zygadeni Arth. 221
Nyssopsora 63, **99**
clavellosa (Berk.)Arth. **100**
echinata (Lév.)Arth. **99**

Oidium
uredinis Link 94
Oplophora
cedrelae Syd. 99
koelreuteriae Syd. 99

Peridermium 380, **388**
abietinum Thüm. 34
acicolum Underw.&Earle 43
apocynaceum Hedgc.&Hunt 38
balsameum Peck 3, 4, 8
betheli Hedgc.&Long 28
boreale A.&K. 21
californicum A.&K. 45
carneum Seym.&Earle 41
cerebroides Meinecke 29
cerebrum Peck 25
coloradense A.&K. 21
comptoniae Orton&Adams 24
conorum Thüm. 31
conorum-piceae A.&K. 32
consimile A.&K. 34
decolorans Peck 33
delicatulum A.&K. 44
elatinum S.&K. 20
elephantopodis Hedgc.&Hahn 42
ephedrae Cooke **390**
filamentosum Peck, 29, 30
fischeri Kleb. 49
fragile Hedgc.&Hunt 42
fructigenum Arth. 53
fusiforme A.&K. 25
giganteum Tubeuf 25
guatemalense A.&K. **389**
harknessi J.P.Moore 29, 30
helianthi Hedgc.&Hunt 47
holwayi Syd. 19
hydrangeae J.F.Adams 17
inconspicuum Long 46
intermedium A.&K. 41, 42
ipomoeae Hedgc.&Hunt 39
laricis Kleb. 22
minutum Hedgc.&Hunt 38
montanum A.&K. 43, 44
oblongisporum Fckl. 49
occidentale Hedgc.,Bethel&Hunt 27
ornamentale Arth. 19
parksianum Faull **389**
peckii Thüm. 18
pini 24, 26
pini minor B.&C. 390
pycnoconspicuum Bell 10
pycnogrande Bell 6
pyriforme Peck 28
ravenelii Kleb. 41
ribicola Long 37
rostrupi Fisch. 40
rugosum Jacks **389**
stalactiforme A.&K. 29, 30
strobi Kleb. 26
terebinthinaceae Hedgc.&Hunt 48
weirii Arth. **389**
Phakopsora
crotonis Arth. 60
vitis Syd. 60

PHAKOPSOREAE 1, 2
PHRAGMIDIEAE 1, 63
Phragmidium 63, **78**
alaskanum (Arth.)Syd. **91**
albidum Lagerh. 94
americanum (Peck)Diet. **86**
andersoni Shear **79**
biloculare D.&H. **90**
byssinum Sacc.&Trav. 81
carbonarium Wint. 92
disciflorum (Tode)J.F.James 79, **84,** 85
ellisii De-T. 360
gracile Cooke 81
horkeliae Garrett **90**
imitans Arth. 81
ivesiae Syd. 79, **89**
jonesii Diet. **80**
libocedri P.Henn. 358
minor Syd. 91
montivagum Arth. **86**
mucronatum Schl. 84
mucronatum americanum Peck 86
obtusum S.&K. 80
occidentale Arth. **83**
peckianum Arth. **81**
potentillae (Pers.)Karst. **80**
potentillae-canadensis Diet. 92
rosae Rostr. 84
rosae-acicularis Liro **85**
rosae-arkansanae Diet. **83,** 89
rosae-californicae Diet. **87**
rosae-pimpinellifoliae Diet. 84
rosae-setigerae Diet. 86
rosicola (E.&E.)Arth. **89**
rubi-idaei (DC.)Karst. **81**
rubi-odorati Diet. **82**
speciosum (Fries)Cooke **88,** 89
subcorticinum Wint. **84**
tormentillae Fckl. 92
tuberculatum 85
Phragmopyxis 63, **77**
acuminata (Long)Syd. **78**
deglubens (B.&C.)Diet. **78**
Physopella 2, **60**
fici (Cast.)Arth. **61**
vitis (Thüm.)Arth. **60**
Pileolaria 63, **69**
brevipes Berk.&Rav. 69
effusa Peck **70**
mexicana Arth. **71**
patzcuarensis (Holw.)Arth. **70**
toxicodendri (Berk.&Rav.)Arth. **69,** 70
Pleoravenelia
epiphylla Long 68
Podisoma
ellisii Berk. 359
gymnosporangium clavipes C.&P. 362
juniperinum Oerst. 370
tremelloides A.Br. 368
Polythelis
fusca Arth. 73
pulsatillae Arth. 73
retecta Arth. 288
suffusca Arth. 73, 288
thalictri Arth. 74
Puccinia 63, **100**
(§ Bullaria 111, 271)
(§ Eupuccinia 101, 116)
aberrans Peck **291**
abnormis P.Henn. 125
abrupta D.&H. **341**
absinthii (Hedw.f.)DC. **343,** 344
acetosae (Schum.)Körn. **281**
acrophila Peck **334**
aculeata Link 289
acuminata Peck 251
adenostegiae Arth. 257

adoxae Hedw.f. **308**
aemulans Syd. **269**
agnita Arth. **284**
agrimoniae Arth. **295**
agropyri E.&E. 178, 179
agropyrina Erikss. 180
airae Cruch.&Mayor 151
albiperidia Arth. 209, 210
albulensis Magn. **334**
aletridis B.&C. **226**
allii 223
alpina Fckl. 312
alternans Arth. 177, 179
ambigua Lagerh. 260
americana Lagerh. 118
amorphae Curt. 77
amphigena Diet. **144**
amphispilusa D.&H. **279**
andina Diet.&Neg. **288**
andropogonis Schw. **120,** 123, 124, 241
andropogonis gerardiae (Peck) Arth. **121,** 123
andropogonis melampyri Arth. **121**
andropogonis micropuncta (E.&E.) Arth. **121,** 124
andropogonis onobrychidis (Burr.) Arth. **122**
andropogonis oxalidis Arth. **122**
andropogonis pentstemonis (Schw.) Arth. **120,** 123
andropogonis polygalina (Peck) Arth. **122**
andropogonis pustulata (Curt.) Arth. **122,** 124
andropogonis xanthoxyli (Peck) Arth. **122**
anemones Pers. 73
anemones-virginianae Schw. **157**
angelicae E.&E. 318
angelicae (Schum.) Fckl. **319**
angustata Peck **194,** 196
angustata angustatoides (R.E.Stone) Arth. **196**
angustata eriophori (Thüm.) Arth. **195,** 196
angustata typica Arth. **195**
angustatoides R.E.Stone 196
anisacanthi [Peck] D.&H. **337**
anomala Rostr. **176,** 177
antirrhini D.&H. **257**
apocrypta Ellis&Tr. 182
arabicola E.&E. **290**
arachidis Speg. **244**
araliae E.&E. **314**
arechavaletae Speg. **246**
arenariae (Schum.) Wint. 169, **236**
areolata D.&H. **237**
argentata (Schultz) Wint. **307,** 308
aristidae Tracy **157,** 160, 169, 170
ari-triphylli Schw. 214
arnicalis Peck **345**
artemisiella Syd. 343
artemisiicola Syd. 206
arundinacea Hedw.f. 155
arundinariae Schw. **188,** 383
asarina Kunze **229**
asparagi DC. **225**
aspera D.&H. 294
asperifolii Wettst. 181
asperior E.&E. **318**
asteris Duby **202**
asterum Kern 197
atkinsoniana Diet. 204
atra D.&H. **129**
atrofusca (Dudl.&Thomp.) Holw. **205,** 206
atropuncta P.&C. **220**
baccharidis D.&H. **266**
ballotaeflorae Long **329**
balsamorhizae Peck **342**
bardanae (Wallr.) Cda. **348**
barroetiae Syd. 339
bartholomaei Diet. **171,** 172
batesiana Arth. **269**
beckmanniae McA. 152
biocellata Arth. 264
bistortae (Str.) DC. **280,** 281
blasdalei D.&H. **222,** 224
boisduvaliae Peck 248
bolleyana Sacc. **204**
boutelouae (Jennings) Holw. **173**
bouvardiae Griff. **337**
brandegei Peck **290**
brickelliae Peck 339
buchloës Schof. 158, 159
bullata Schw. 338
burnettii Griff. 132, **134**
calochorti Peck **276**
calthae (Grev.) Link **237**
calthaecola Schroet. **287**
cameliae (Mayor) Arth. **125**
campanulae Carm. **262,** 263
campanulae novae-zembliae (Jørstad) Arth. **262**
canadensis Arth. **312**
canaliculata (Schw.) Largerh. **189,** 190
cardamines-bellidifoliae Diet. 292
caricis (Schum.) Schroet. **207**
caricis-asteris Arth. 197
caricis-erigerontis Arth. 198
caricis grossulariata Arth. **208,** 209, 210, 211, 394
caricis quadriporula Arth. **210**
caricis-shepherdiae J.J.Davis **211**
caricis-solidaginis Arth. 198
caricis caricis-strictae (Diet.) Arth. **208**
caricis-strictae Diet. 207, 208
caricis uniporula (Orton) Arth. **209,** 210
caricis urticata (Kern) Arth. **208,** 209
carnegiana Arth. **275**
carthami Cda. **349**
castillejae (D.&H.) Arth. **258**
caulicola T.&G. **329**
caulincola W.G.Schneid. 330
ceanothi Arth. 124
cenchri D.&H. **126**
chaetochloae Arth. **129**
chamaesarachae Syd. **332**
chelonis D.&H. **333**
chloridis Speg. **170**
chondrillina Bubák&Syd. **335**
chrysanthemi Roze **270**
cicutae Lasch **316**
circaeae Pers. **250**
circinans E.&E. 123
cirsii Lasch **348**
cirsii-lanceolati Schroet. 346
cladii Ellis&Tr. **192**
cladophila Peck 353
clarkiae Peck 248
claviformis Lagerh. **127**
clavispora Ellis&Barth. 118
claytoniata Peck 283
clematidis Lagerh. 177
clintonii Peck **336**
cnici Mart. **346**
cochleariae Lindr. 291
cockerelliana Bethel **163**
coelopleuri Arth. **320**
cognata Syd. **267**
cohaesa Long 73
collinsiae [E.&E.] P.Henn. **258**
columbiensis E.&E. 203

comandrae Peck **123**
commutata Syd. 200, **261**
compacta deBary 184
conferta D.&H. 206
confraga Arth.&Cumm. **333**
conglomerata (Str.)S.&K. **346**
conoclinii Seym. **338**
consimilis E.&E. **148**
conspicua (Arth.)Mains **145**
convolvuli (Pers.)Cast. **253**
cooperiae Long **227**
cordylanthi Blasd. 257
coronata Cda. **152,** 153, 154, 155, 211
coronata avenae F.&L. **154**
coronata bromi F.&L. **154**
coronata calamagrostis F.&L. **154**
coronata elaeagni F.&L. **154**
coronifera Kleb. 152, 153
crandallii Pam.&Hume **162,** 163
crassipes B.&C. **254**
crepidis-acuminatae Syd. 351
crepidis-montanae [Syd.]Magn. **353**
cressae [DC.]Lagerh. **325**
cretica Holw. 325
cribrata Arth.&Cumm. 324
cruciferarum Rud. **292**
cryptandri Ellis&Barth. 136, 140
cryptanthes D.&H. **256**
cryptotaeniae Peck **321**
curtipes Howe 293
cyani [Schleich.]Pass. **349**
cymopteri D.&H. 316
cynanchi Lagerh. 172
cynodontis Lacroix **169**
cynomarathri Holw. 318
cyperi Arth. **190,** 198
cyperi-tagetiformis (P.Henn.)Kern **190**
cypripedii A.&H. **229**
dayi G.W.Clint. **169**
de baryana Thüm. 184
delphinii D.&H. **289**
densa D.&H. 311
dentariae (A.&S.)Fckl. **239**
deschampsiae Arth. 151
dianthi DC. 236
dichelostemmae D.&H. **274**
dichondrae Mont. **253**
difformis Kunze **260**
diffusa Holw. 288
digitata Ellis&Hark. 154
digna 132
diplachnis Arth. 171
dispersa Erikss.&Henn. 181
distichlidis E.&E. **166,** 167, 169
distorta Holw. **331**
dondiae Arth. **282**
douglasii E.&E. **255**
drabae Rud. **291**
dulichii Syd. 198
eatoniae Arth. **146**
eatoniae myosotidis Mains **147**
eatoniae ranunculi Mains **147**
effusa D.&H. **312**
eleocharidis Arth. **193,** 194
ellisiana Thüm. **118,** 119, 121
ellisii De-T. **318**
elongata Schroet. 237
elymi Westend. 177
emaculata Schw. **127**
emiliae P.Henn. **271**
eminens Kern 207, 209
enceliae D.&H. **341**
endiviae Pass. 351
enecta Speg. 253
epicampis Arth. **138,** 139
epilobii DC. **274**
epilobii-tetragoni Wint. 313
epiphylla Wettst. 164
erigeniae (Orton)Arth. **315**
eriophori Thüm. 195
eriophylli Jacks. **344**
eulobi D.&H. 248
eurotiae Griff. **134**
eutremae Lindr. **291**
evadens Hark. **265**
exasperans Holw. 173
expansa Link **345**
extensicola Plowr. 191, **197,** 200, 201, 202, 203, 218, 219, 220
extensicola asteris (Thüm.)Arth. **197,** 202
extensicola erigerontis Arth. **198**
extensicola euthamii Arth. **198**
extensicola hieraciata (Schw.)Arth. **199,** 203, 220
extensicola hydnoidea (B.&C.)Arth. **200**
extensicola oenotherae (Mont.)Arth. **199,** 203
extensicola phrymae (Halst.)Arth. **200**
extensicola rudbeckiae Arth. **198,** 201, 202
extensicola solidaginis (Schw.)Arth. **198,** 201, 202
extensicola valerianae Arth. **200,** 262
farinacea Long **330**
fergussoni B.&Br. **312**
festucae (DC.)Plowr. **154**
fimbristylidis Arth. **190**
flaccida B.&Br. **125**
flaveriae Jacks. **270**
fraseri Arth. **271**
fraseriae Syd. 263
fraxinata Arth. 165
fuirenae Cooke **191**
fusca Wint. 73
gaillardiae (D.&H.)Barth. **344**
galii Schw. 259
garrettii Arth. 207, 209
gayophyti Billings 313
gemella D.&H. **237**
gentianae (Str.)Link **322,** 323
geranii Lév. 307
geranii-silvatici Karst. 307
gerardiae Syd. 123
gigantea Karst. **202**
gigantispora Bubák **238**
giliae Hark. **254,** 255
giliicola P.Henn. 325
glabella Holw. **250**
glaucis Arth. 236
globosipes Peck **331**
glumarum (Schmidt)Erikss.&Henn. 152, **186,** 382
gnaphaliata Arth.&Bisby 265
gnaphalii (Speg.)P.Henn. **264**
gnaphalii Speg. 264
gnaphaliicola P.Henn. 264
gonolobi Rav. 172
graminella [Speg.]D.&H. **132**
graminis Pers. **173**
graminis agrostidis Erikss. 175
graminis airae Erikss.&Henn. 175
graminis avenae Erikss.&Henn. 175
graminis bromi Erikss. 175
graminis phlei-pratensis (Erikss.& Henn.)Stak.&Piem. **176**
graminis poae Erikss.&Henn. 175
graminis secalis Erikss.&Henn. 175
graminis tritici Erikss.&Henn. 175
granulispora Ellis&Gall. **223,** 224
grayiae Arth. **282**
grindeliae Peck **141**
grossulariae Lagerh. 207, 210

grumosa Syd.&Holw. **221**
guillemineae D.&H. **235**
gulosa Jacks **326**
haleniae A.&H. **252**
harknessii Vize **353**
harknessii major Arth. **353**
hedysari-obscuri DC. 303
hedysari-paniculati Schw. 240
helianthellae (Peck)Arth. **340**
helianthi Schw. 218, 264, **267,** 269
helianthorum Schw. 267
heliopsidis Schw. 267
hemisphaerica E.&E. 355
hemizoniae Ellis&Tr. 269
heteranthae E.&E. 248, 249
heterisiae Jacks. 294
heterospora B.&C. **144**
heucherae (Schw.)Diet. **292**
hibisciata Kellerm. 139, 143
hieraciata Jacks. 199
hieracii (Schum.)Mart. **351,** 353
holboellii (Hornem.)Rostr. **149,** 239
holcina Erikss. 177
holwayi Diet 276
hordei Fckl. **185**
hordei Otth 176
houstoniae Syd. 261
huberi P.Henn. 126
hydrocotyles (Link)Cooke **320**
hydrophylli P.&C. **327**
hypochaeridis Oud. 351
hyptidis (Curt.)Tr.&Earle **256**
hyssopi Schw. **257**
hysteriiformis Peck 236
impatientis Arth. 182
imposita Arth. **126**
inclusa Syd. 348
incondita Arth. **333**
inquinans bardanae Wallr. 348
insperata Jacks. **351**
intermedia D.&H. 313
intermixta Peck **338**
interveniens [Peck]Bethel **131,** 132, 133, 134
investita Schw. **265**
iridis (DC.)Wallr. **227**
irrequisita Jacks. **349**
jonesii Peck **316**
jonesii cymopteri (D.&H.)Arth. **317**
jonesii lindrothii (Syd.)Arth. **317**
jonesii typica Arth. **317**
jueliana Diet. 294
junci Desmaz. 216
junci Schw. 217
junci Wint. 216
jussiaeae Speg. **249**
kaernbachii (P.Henn.)Arth. **125**
kansensis Ellis&Barth. **272**
karelica Tranz. **214**
kelseyi Syd. 166
koeleriae Arth. **149**
krigiae Syd. 351
kuhniae Schw. **339**
lagophyllae D.&H. 269
lantanae Farl. **256**
lappae Cast. 348
lapsanae (Cooke)Fckl. **350**
lateripes Berk.&Rav. 336
lateritia B.&C. **261**
laurentiana Trel. **240**
leontodontis Jacky 351
leptochloae A.&F. **170**
lespedezae-procumbentis Schw. 241
leveillei Mont. **307**
levis (Sacc.&Bizz.)Magn. **126**
liatridis [Webber]Bethel **146**
liberta Kern **194**
ligustici E.&E. **280**
limonii DC. 252
limosae Magn. **212**
lindrothii Syd. 317
linearis Röhl. 173
linkii Klotzsch **337**
lithospermi E.&K. **253**
lithophragmae Holw. 293
littoralis Rostr. **216,** 217, 218, 219
lobata B.&C. **247**
lobeliae Ger. **262**
lolii Niels. 152
longissima 240
luxuriosa Syd. **157**
lygodesmiae E.&E. 141
macrospora [Peck]Arth. **204**
maculosa Schw. **203**
madiae Syd. 269
magnoecia E.&E. 202
magnusiana Körn. **156,** 157
majanthae A.&H. 130
malvacearum Bert. **246**
malvastri Peck 133
mariae-wilsoni G.W.Clint. **283,** 284
marianae Syd. **266**
marylandica Lindr. **314**
massalis Arth. **341**
maydis Bérenger 116
mcclatchieana D.&H. **191,** 192
melampodii D.&H. **270**
melanconioides Ellis&Hark. **322**
melanocephala Syd. **188**
melanthii Bubák 220
mellifera D.&H. **257**
menthae Pers. **327**
mertensiae Peck **327**
mesnieriana Thüm. **154**
mesomajalis B.&C. **278**
mexicana D.&H. 123
micrantha Griff. **139**
microica Ellis **321**
micromeriae Dudl.&Thomps. 327
microsora Körn. **213**
microsperma B.&C. 262
milii Erikss. 137
millefolii Fckl. **206**
minussensis Thüm. 345, **355**
minuta Diet. **213**
minutissima Arth. **203**
minutula Peck 202
mirabilissima Peck 75
mirifica D.&H. 342
mixta Fckl. 221
moehringiae Fckl. 236
monardellae Dudl.&Thomps. 327, 329
monoica [Peck]Arth. **147,** 148, 149, 239
montanensis Ellis **151**
moreniana Dudl.&Thomp. **272**
morthieri Körn. 234
mucronata a rosae Pers. 84
muhlenbergiae A.&H. 143
musenii E.&E. **318**
mutabilis Ellis&Gall. **224**
nardosmiae E.&E. 346
neglecta Westend. 186
nerviphila Grognot 305
nesaeae E.&E. 249
nesodes A.&H. **124**
neurophila Grognot 305
nigrescens Peck 329
nodosa Ellis&Hark. **274,** 275
nolitangeris Cda. 307
novae-zembliae Jørstad 262
nuda E.&E. **269**
nuttalii E.&E. 288
obliqua B.&C. **172**
obliterata Arth. 177, 179
obscura Schroet. **219**

obtecta Peck **188**
obtegens [Link] Tul. **347**
oenotherae Vize **248,** 249, 250
oenotherae heteranthae (E.&E.)Arth. **248,** 249
offuscata Arth. **244**
onopordi Syd. **346**
opizii Bubák 199
opposita Arth. 238
orbicula P.&C. **354**
ornata A.&H. **156**
ornatula Holw. **312**
ortonii Jacks. **321,** 322
osmorrhizae C.&P. 315
oudemansii Tranz. **290**
oxalidis (Lév.)Diet.&Ellis **245**
oxyriae Fckl. **281**
pacifica Blasd. **259**
pagana Arth. **276**
pallido-maculata E.&E. 293
palmeri D.&H. **333**
pammelii Arth. 128
panici Diet. **128,** 129
paradoxica Ricker **271**
parca Arth. **231**
parkerae D.&H. **211**
parnassiae Arth. **294**
parnassiae Barth. 212
parnassiaecola Barth. 294
parthenices Jacks. **269**
parthenii (Speg.)Arth. **341**
paspali Tr.&Earle 126
paspalicola (P.Henn.)Arth. **127**
patruelis Arth. 199
pattersoniana Arth. **272**
pattersoniae Syd. 124
pazschkei Diet. **294**
peckiana Howe 96
peckii Kellerm. 199
pentstemonis Peck **123**
peridermiospora (Ellis&Tr.)Arth. **165**
perminuta Arth. 177
perplexans Plowr. 177, 181
persicariae Mart. 232
persistens Plowr. 177, 181
petalostemonis Farl. 76
petasiti-pulchellae Lüdi 164
phaceliae Syd.&Holw. **185**
phalaridis Plowr. 130
phaseoli Rebent. 296
philibertiae E.&E. 172
phlei-pratensis Erikss.&Henn. 176
phragmitis (Schum.)Körn. **155,** 156
phrymae Arth. 200
physalidis Peck **332**
physostegiae P.&C. **330**
pimpinellae (Str.)Mart. **315**
pinaropappi Syd. **350**
piperi Ricker **164**
pistorica Arth. **266**
plucheae (Syd.)Arth. **264**
plumbaria Peck **325**
poae-sudeticae (Westend.)Jørstad **150**
poae-sudeticae airae (Lagerh.)Arth. **151**
poarum Auth. 150
poarum Niels. 151, **164**
poculiformis Wettst. 173
podophylli Schw. **289**
polemonii D.&H. **255**
polygalae Paz. 246
polygoni A.&S. 232, 233
polygoni Pers. 230
polygoni-alpini Cruch.&May. **279,** 280
polygoni-amphibii Pers. **232,** 234
polygoni-amphibii convolvuli (A.&S.) Arth. **233**
polygoni-amphibii persicariae (Str.) Arth. **232,** 233
polygoni-amphibii tovariae Arth. **233**
polygoni-avicularіae Pers. 230
polygoni-convolvuli Hedw.f. 232
polygoni-vivipari Dietr. 280
polysora Underw. **117**
poromera Holw. **279**
porphyrogenita Curt. **251**
porri (Sow.)Wint. **221,** 223
potentillae Pers. 80
potentillae Schw. 92
prenanthis-racemosae Syd. 354
pringsheimiana Kleb. 207
probabilis Arth.&Cumm. **335**
procera D.&H. **187**
proserpinacae (B.&C.)Farl. **251**
pruni DC. 71
pruni-spinosae Pers. 71
pseudocymopteri Holw. **316**
ptiloriae Bubák 353
pulchella Peck 295
pulsatillae Kalchb. **184**
pulsatillae Rostr. 73
pulverulenta Grev. 313
punctata Link **259,** 260, 261
punctata troglodytes (Lindr.)Arth. **260**
punctiformis D.&H. **234**
purpurea Cooke **124**
pustulata Arth. 122
pycnanthemi Schw. 327
pygmaea Erikss. **137**
pyrolae Cooke **246**
quadriporula Arth. 210
ranunculi Blytt **288**
ranunculi Seym. 288
raunkaerii Ferd.&Winge **283**
recedens Syd. **196**
recondita D.&H. 206
redfieldiae Tracy **161**
retecta Syd. **288**
rhaetica Fisch. **335**
rhamni Wettst. 152
rhodiolae B.&Br. 292
ribis DC. **295**
richardsoni Syd. 255
romanzoffiae Jacks. **326**
rosae Schum. 84
rosenii Arth. **197**
rubefaciens Johans. **260**
rubi-idaei DC. 81
rubigo-vera (DC.)Wint. **177,** 183, 184, 185
rubigo-vera agropyri (Erikss.)Arth. **178,** 181, 185
rubigo-vera agropyrina (Erikss.)Arth. **180,** 181, 183, 184
rubigo-vera apocrypta(Ellis&Tr.)Arth. **182,** 185
rubigo-vera impatientis (Arth.)Mains **182**
rubigo-vera secalis (Erikss.)Carl. **181**
rubigo-vera tritici (Erikss.&Henn.) Carl. **181**
rudbeckiae Barth. 199, **201**
ruelliae (B.&Br.)Lagerh. **336**
ruelliae-bourgaei D.&H. 336
rufescens D.&H. **335**
russa Arth.&Cumm. **340**
rydbergii Garrett **292**
salviae-lanceolatae Bubák 329
salviicola D.&H. **329**
saxifragae Schl. 292
saxifragae-tricuspidatae P.Henn. 294
scaber (E.&E.)Barth. **139**
scandica Johans. **314**
schedonnardi Kellerm.&Sw. **143,** 144

schneideri Schroet. **330**
scleriicola Arth. **193**
scribneriana Arth. 138
secalina Grove 181
sejuncta Syd. 351
septentrionalis Juel **231**
sessilis Schneid. **130**
setariae D.&H. **129**
seymeriae Burr. **123**
seymouriana Arth. **166**
sherardiana Körn. **133**
sidalceae Holw. 133
sieversiae Arth. **295**
silphii Schw. **218,** 219
similis E.&E. 343
similis Long 267
simillima Arth. 156
simplex Erikss.&Henn. 176
simulans (Peck) Barth. **136,** 137
smilacis Schw. **226,** 383, 386
solani Schw. 127
sorghi Schw. **116**
sorghi-halepensis Speg. 125
sparganioides Ellis&Barth. 165
spatiosa Kern **213**
spegazzinii De-T. **264**
spermacoces B.&C. 261
spermacoces Schw. 261
sphaeralceae E.&E. 133
sphaerostigmatis Diet.&Neg. 248
splendens Vize **263**
sporoboli Arth. **135,** 137
stephanomeriae Syd. 353
stipae Arth. **140,** 141, 142
straminis simplex Körn. 176
stromatica B.&C. **238**
suaveolens Rostr. 347
subangulata Holw. **275**
subcircinata E.&E. **345,** 346
subdecora Syd.&Holw. **340**
subnitens Diet. 158
substerilis E.&E. 139
substriata Ellis&Barth. **127**
suffusca Holw. 73
suksdorfii E.&E. **354**
swertiae Wint. **323**
sydowiana Diet. 135
symphoricarpi Hark. **163**
synthyridis E.&E. 334
taraxaci Plowr. 351
tradissima Garrett **285**
tenuis [Schw.] Burr. **264**
tetramerii Seym. **337**
texana Holw.&Long 75
thalictri Chev. 74
thlaspeos Schub. **239**
tolimensis Mayor **193**
tomipara Trel. 177, 181
tosta luxurians Arth. 157
toumeyi Syd. 123
trailii Plowr. 155
trautvetteriae Syd.&Holw. 184
treleasiana Paz. **287**
triannulata (B.&C.) Jacks. **342**
trifolii Hedw.f. 304
tripsaci D.&H. **124**
tripustulata Peck 96
triticina Erikss. 181
troglodytes Lindr. 260
troximontis Peck 351
tubulosa Arth. 127
tumamocensis Arth. **275**
tumidipes Peck **331**
turgidipes Jacks. **341**
turrita Arth. **294**
tuyutensis 253
uliginosa Juel **212**
ulmariae Hedw.f. 98
umbilici Guep. **292**
uniporula Orton 209, 210
universalis Arth. 205
urbaniana P. Henn. **256**
urticata Kern 208
utahensis Garrett 290
vagans (DC.) Arth. 250, **313,** 314
vagans epilobii-tetragoni DC. **313**
vagans gayophyti Arth. **313**
variabilis Grev. **350**
veratri (DC.) Duby **273,** 274
veratri Niessl 273
verbenicola Arth. 135
verbesinae Schw. **267**
vernoniae Schw. **338**
veronicae Schum. 334
veronicarum DC. **259**
vertisepta T.&G. **330**
vexans Farl. **172,** 173
viguierae Peck 267
vilfae A.&H. **135**
vincae (DC.) Berk. **324**
violae (Schum.) DC. **311,** 312
viornae Arth. 74
virgata E.&E. **118**
virgaureae (DC.) Lib. **202**
volkartiana Fisch. **251**
waldsteiniae Curt. **240**
windsoriae Schw. **161**
wulfeniae D.&H. **334**
wyethiae Peck 342
xanthii Schw. **189**
xanthiifoliae E.&E. **263**
xylorrhizae Arth. 141
yosemitana Blasd. **255**
zauschneriae Syd. 248
zeae Bérenger 117
ziziae E.&E. **319**
zopfii Wint. 287
zygadeni Trel. 220

PUCCINIACEAE 1, **63**
PUCCINIASTREAE 1
Pucciniastrum 2, **12**
abieti-chamaenerii Kleb. 15, 16
agrimoniae (Schw.) Tranz. **14**
americanum (Farl.) Arth. **13,** 14
arbuti D.&H. 17
arcticum (Lagerh.) Tranz. **13**
arcticum americanum Farl. 13
crotonis De-T. 60
epilobii Otth 15
galii (Link) Fisch. **19**
goeppertianum (Kühn) Kleb. **19**
goodyerae (Tranz.) Arth. **12**
hydrangeae (B.&C.) Arth. **17**
minimum Arth. 18
myrtilli (Schum.) Arth. **18**
potentillae Kom. **14**
pustulatum (Pers.) Diet. **15**
pyrolae (Pers.) Schroet. **16**
sparsum (Wint.) Fisch. **17**
vacciniorum Lagerh. 18
Pucciniola
argophyllae Arth. 244
atriplicis Arth. 235
aurea Arth. 224
brodiaeae Arth. 225
carnea Arth. 302
claytoniae Arth. 284
coördinata Arth. 298
elegans Arth. 300
hedysari-obscuri Arth. 303
jonesii Arth. 287
miurae Arth. 277
nerviphila Arth. 305
oblonga Arth. 305
porosa Arth. 300
primaverilis Arth. 276

psoraleae Arth. 244
rickeriana Arth. 282
spragueae Arth. 284
unita Arth. 284

Ravenelia **63**
annulata Long **66**
arizonica E.&E. **65**
australis Diet.&Neg. **66**
cassiaecola Atk. **67**
cassiae-covesii Long&Goodd. **68**
epiphylla (Schw.)Diet. **68**
fragrans Long **67**
glandulosa B.&C. 68
gooddingii Long **67**
gracilis Arth. **66**
hieronymi Speg. **65**
hoffmanseggii Long **68**
holwayi Diet. **65**
igualica Arth. **66**
leucaenae Long **66**
longiana Syd. 68
mesillana Ellis&Barth. **68**
morongiae Long **67**
opaca Diet. **67**
papillifera Syd. **68**
piscidiae Long **69**
pithecolobii Arth. **65**
prosopidis Long 65
reticulatae Long **67**
roemerianae Long **66**
siderocarpi Long **65**
siliquae Long **66**
subtortuosae Long **65**
texensis Ellis&Gall. **67**
thornberiana Long **66**
versatilis (Peck)Diet. **66**
RAVENELIEAE 1, 63
Roestelia
aurantiaca Peck 362
betheli Kern 374
ellisii Peck 360
flaviformis Atk. 378
harknessiana E.&E. 367
harknessianoides Kern 361
hyalina Cooke 361
interveniens Peck 131
koreaensis P. Henn. 366
lacerata Fries 373
nelsoni Arth. 376
nidus-avis Thaxt. 369
penicillata Fries 368
photiniae P.Henn. 372
pyrata Thaxt. 378
transformans Ellis 365
tubulata Kern 375
Rostrupia
elymi Lagerh. 177

Schroeteriaster
crotonis Diet. 60
Septoria
mirabilis Peck 3
Sphaeria
canaliculata Schw. 189
epiphylla Schw. 68
Spirechina
epiphylla Arth. 95
Stichopsora
asterum Diet. 43
elephantopodis Diet. 42
madiae Syd. 45
vernoniae Diet. 41

Teleutospora
abbreviata Arth.&Bisby 245
amoena Arth.&Bisby 265
bidentis Arth.&Bisby 342
heteroderma Arth.&Bisby 278
nevadensis Arth.&Bisby 322
rudbeckiae Arth. 201
solidaginis Arth.&Bisby 201
tranzschelii Arth.&Bisby 298
Thecopsora
agrimoniae Diet. 14
empetri Karst. 31
galii De-T. 19
guttata Syd. 19
hydrangeae Magn. 17
laeviuscula Diet. 7
pyrolae Karst. 16
sparsa Magn. 17
vacciniorum Karst. 18
Trachyspora 63, **97**
alchemillae Fckl. 97
intrusa (Grev.)Arth. **97**
Tranzschelia 63, **71**
cohaesa (Long)Arth. 72, **73**
fusca (Pers.)Diet. **73**
pruni-spinosae (Pers.)Diet. **71**, 73, 74
pulsatillae Diet. 73
punctata Arth. 72
suffusca (Holw.)Arth. **73**, 288
thalictri (Chev.)Diet. **74**
tucsonensis (Arth.)Diet. **73**
viornae Arth. **74**
Tremella
clavariaeformis Pers. 373
clavariaeformis Jacq. 373
juniperina Wahl. 373
juniperina L. 368, 370
Tricella
acuminata Long 78
Trichobasis
balsamorhizae Peck 342
crotonis Cooke 60
euphorbiaecola B.&C. 308
helianthellae Peck 340
howei Peck 324
lapsanae Cooke 350
Triphragmium 63, **98**
clavellosum Berk. 100
echinatum Lév. 99
ulmariae (Hedw.f.)Link **98**
Tuberculariа
carnea Bosc 40

Uraecium 380, **390**
holwayi Arth. **390**
lucumae (A.&J.)Arth. 390
Uredinopsis 1, **2**
americana Syd. 3
atkinsonii Magn. 4
copelandi Syd. 4
macrosperma (Cooke)Magn. **5**
mirabilis (Peck) Magn. **3**
osmundae Magn. **3**, 4, 5
phegopteridis Arth. **4**
polypodophila Bell 6
pteridis D.&H. 5
struthiopteridis Störmer **4**
Uredo 380, **391**
abdita Jacks. 344
absinthii Hedw.f. 343
acetosae Schum. 281
acuminata Kirchn. 301
aecidioides DC. 54
airae Lagerh. 151
alchemillae Pers. 97
alpina Arth. 56
amsonia Cooke 38
andromedae Cooke 18
andropogonis-hirti Maire 125
angelicae Schum. 319
anthoxanthina Bubák 150
apiculata arctii Str. 348

appendiculata Pers. 296
appendiculata phaseoli Pers. 296
arbuti D.&H. 17
arcticus Lagerh. 13
arenariae Schum. 236
asclepiadis Schw. 324
aspidiotus Peck 10
behnickiana P.Henn. 391
betae Pers. 234
betae convolvuli A.&S. 233
betae convolvuli Pers. 253
betulae Schum. 22
bidenticola P.Henn. 342
bidentis P. Henn. 342
bigelowii Arth. 54
boutelouae Arth. 150
caladii Schw. 214
cameliae Mayor 125
campanulae Pers. 40
caraganae Thüm. 299
caricis Schum. 207
carpini Desmaz. 23
cassandrae P.&C. 34
castillejae D.&H. 258
cephalanthi Arth. **393**
cerastii Mart. 20
chenopodii Duby 234
chenopodii Spreng. 234
cherimoliae Lagerh. **292**
chimaphilae Peck 16
chondrillae Opiz 355
coccolobae P.Henn. **391**
coleosporioides D.&H. 29
commelinae Speg. 215
confluens Pers. 55, 56
conglomerata Str. 346
contraria Arth. **392**
copelandi Syd. 17
cyani Schleich. 349
dentariae A.&S. 239
dianthi Pers. 285
elephantopodis Schw. 41
elevata Schum. 84
empetri Pers. 31
epilobii DC. 15
euphorbiae-heliosopiae β euphorbiae-exiguae Pers. 58
fabae Pers. 242
fabae medicaginis-falcatae DC. 299
fallens Desm. 304
farinosa β senecionis Pers. 49
festucae DC. 154
fici Cast. 61
floridana Syd. **392**
fuchsiae A.&H. 391
gaillardiae D.&H. 344
gentianae Str. 322
geranii DC. 245
glumarum Schmidt 186
gnaphalii Speg. 264
goodyerae Tranz. 12
gossypii Lagerh. 62
grayiae Arth. 282
heucherae Schw. 292
hibisci Syd. 94
hieracii Schum. 351
holwayi Arth. 390
hydrangeae B.&C. 17
hyperici Spreng. 247
hyptidis Curt. 256
ignobilis Syd. 137
intrusa Grev. 97
ipomoeae Schw. 39
iridis DC. 227
jonesii Peck 37
junci Str. 216
kansensis Kellerm.&Sw. 77
laeviuscula D.&H. 7
ledi A.&S. 34
ledicola Peck 33
leguminosarum α astragali α, β, γ Opiz 301
leguminosarum glycyrrhizae Rab. 306
linearis β polypodii Pers. 11
lucumae A.&J. 390
lupini B.&C. 243
luxurians E.&E. 140
lychnidis Schroet. 285
lycotoni Kalchb. 238
macrospermum Cooke 5
malvicola Speg. 94
medusae Arth. 51
menthae Pers. 327
miniata α eglanteriae Pers. 84
miniata β lini Pers. 57
minima Schw. 18
moricola P.Henn. 61
muelleri Schroet. 94
muhlenbergiae Diet. 126
nicotianae Arth. 393
nicotianae A.S.S. **393**
nigropuncta P.Henn. **392**
nootkatensis Trel. 357
nyssae Ellis&Tr. 59
obtusa Str. 92, 93
paronychiae Jacks. **392**
paspalicola P.Henn. 127
pellaeae Diet.&Neg. 11
peridermiospora Ellis&Tr. 165
phoradendri Jacks. **391**
phragmitis Schum. 155
pimpinellae Str. 315
pirolatum Körn. 31
plucheae Syd. 264
poae-sudeticae Westend. 150
polygoni-bistortae Str. 280
polygoni-persicariae Str. 232
polypodii DC. 11
polypodii β polypodii-dryopteridis Moug.&Nestl. 10
populina β betulina Pers. 22
porri Sow. 221
posita J.J.Davis **392**
proëminens DC. 308
pteridis D.&H. 5
pustulata β cerastii Pers. 20
pustulata (α epilobii) Pers. 15
pyrolae Mart. 16
quercus Brondeau 26
ribicola C.&E. 37
ribicola Lasch 55, 56
rosae-centifoliae Pers. 84
rostrupiana Arth. 56
rubi-idaei Pers. 81, 82
rubigo-vera DC. 177
ruelliae B.&Br. 336
scillarum Grev. 225
scirpi Cast. 191
sempervivi A.&S. 239
senecionis Schum. 49
smilacis Schw. 226
solidaginis Schw. 43
sonchi Schum. 49
sonchi-arvensis Pers. 49
sorghi Fckl. 124
sphacelicola D.&H. **392**
spiraeae Sow. 98
spirostachydis Arth. **392**
statices Desmaz. 252
suaveolens Pers. 347
terebinthinaceae Schw. 48
ulmariae Schum. 98
vaccinioram DC. 18
vagans α epilobii-tetragoni DC. 313
veratri DC. 273
viciae Rebent. 242

viciae-fabae Pers. 242
vincae DC. 324
violae Schum. 311
vogesiaca Sacc.&Trott. 7
zorniae Diet. 244
Uromyces 63, **100**
abbreviatus Arth. **245**
aconiti Fckl. 238
aconiti-lycoctoni Wint. 238
acuminatus Arth. **167**
acuminatus magnatus (Arth.) J.J.Davis **168**
acuminatus polemonii (Peck) J.J.Davis **168,** 169
acuminatus spartinae (Farl.) Arth. **168,** 169
acuminatus steironematis (Arth.) J.J. Davis **168**
aemulus Arth. **224**
affinis Wint. **278**
agnatus Arth. **310**
albus D.&H. 300
alchemillae Wint. 97
alopecuri Seym. **183**
amoenus Syd. **265**
amphidymus Syd. **184**
andropogonis Tracy **119**
apiosporus Hazsl. **322**
appendiculatus Fries 296
archerianus A.&F. **170**
argophyllae Seym. 244
argutus Kern **169**
arisaemae Cooke 214
aristidae E.&E. **138**
armeriae Lév. 252
asclepiadis (Schw.) Cooke **324**
astragali Sacc. 301
astragalicola P.Henn. 303
aterrimus D.&H. 223
atriplicis Arth. 235
atrofuscus Dudl.&Thomp. 205
aureus D.&H. **224**
beckmanniae Jacks. **170**
betae (Pers.) Lév. **234**
bicolor Ellis **223**
bidenticola (P.Henn.) Arth. **342**
bidentis Lagerh. **342**
brandegei Peck 172
brodiaeae Ellis&Hark. **225**
caladii (Schw.) Farl. **214**
caraganae (Thüm.) Magn. 299
carneus Hariot 302
caryophyllinus (Schr.) Wint. **285**
chenopodii (Duby) Schroet. **234**
chlorogali D.&H. 224
chorizanthis Ellis&Hark. 229
claytoniae C.&P. **284**
coloradensis E.&E. **300**
coloradensis campester Arth. **301**
coloradensis maritimus Arth. **301**
coloradensis montanus Arth. **301**
columbianus Mayor **341**
coluteae Arth. **298**
commelinae (Speg.) Cooke **215**
compactus Peck **266**
coördinatus Arth. **298**
dactylidis Otth 156, **183**
desmodii Cooke 240
dianthi Niessl 286
digitatus Halst. 130
dictyosperma E.&E. 310
dictyosperma [E.&E.] Tranz. **310**
dolicholi Arth. **244**
effusus Arth. 217
effusus De-T. 70
elegans [Berk.] Lagerh. **300**
eleocharidis Arth. **194**
epicampis D.&H. **139**
eragrostidis Tracy **162**
euphorbiae C.&P. 308
euphorbiae-astragali Jordi 301
euphorbiae-corniculati Jordi 299
euphorbiicola Tranz. 308
fabae (Pers.) deBary **242,** 301
fallens Kern 304
flectens Lagerh. 305
fremontii Syd. 249
genistae-tinctoriae (Pers.) Wint. 299
gentianae Arth. **323**
geranii (DC.) Fries **245**
giganteus Speg. 234
glyceriae Arth. 184
glycyrrhizae (Rab.) Magn. **306**
graminicola Burr. **129**
halstedii De-T. **130**
hedysari-obscuri (DC.) Car.&Picc. **303**
hedysari-paniculati (Schw.) Farl. **240**
heterodermus Syd. **278**
holwayi Lagerh. **277**
hordei Tracy 177
hordeinus Arth. **177**
houstoniatus (Schw.) Sheldon **228**
howei Peck 324
hyalinus Peck **306**
hybridi W.H.Davis 304, 305
hyperici (Spreng.) Curt. **247**
hyperici-frondosi Arth. 247
ignobilis (Syd.) Arth. **137**
inaequialtus Lasch 235
indigoferae D.&H. **243**
intricatus Cooke **229**
intrusus Lév. 97
jacksonii A.&F. **185**
jonesii Peck **287**
junci (Desmaz.) L.Tul. 201, **216,** 218, 219
junci-effusi Syd. **217,** 219
junci-tenuis Syd. 218
krameriae Long **240**
laburni (DC.) Fckl. 299
lapponicus Lagerh. **302,** 303
largus Arth.&Cumm. 310
leptodermus Syd. **126**
lespedezae Peck 241
lespedezae-procumbentis (Schw.) Curt. **241**
lilii G.W.Clint. 277
limonii (DC.) Lév. **252**
limonii armeriae (Schl.) Arth. **252**
liniolatus Schroet. 191
loti Blytt 299
lupini B.&C. **243**
lychnidis Lagerh. 285
lychnidis Tr.&Earle 286
lycoctoni (Kalchb.) Trotter **238**
magnatus Arth. 168
major Arth. 137
martinii Farl. **343**
mayorii Tranz. **310**
medicaginis Pass. 299
minimus J.J.Davis **137**
minor Schroet. **305**
minutus Diet. 210, **394**
miurae Syd. **277**
murrillii Ricker 228
myristica B.&C. 308
mysticus Arth. **187**
nerviphilus (Grognot) Hotson **305,** 306
nevadensis Harkn. 322
nothoscordi Syd. 276
oblongisporus E.&E. **344**
oblongus Vize 299, 306
occidentalis Diet. **297,** 298
oenotherae Burr. 249
panici Tracy 129
patzcuarensis Holw. 70

peckianus Farl. **160**
peltandrae Howe 214
perigynius Halst. 199, **200,** 201
pervius Speg. 246
phacae-frigidae (Wahl.) Hariot **303**
phacae-frigidae Lagerh. 303
phaseoli (Pers.) Wint. **296**
phaseoli strophostylis Arth. **296**
phaseoli typica Arth. **296**
phaseoli vignae (Barcl.) Arth. **297**
plumbarius Peck **249,** 274
poae Rabh. 183
poinsettiae Tranz. 308
polygoni (Pers.) Fckl. **230**
pontederiae Ger. **216**
primaverilis Speg. **275**
probus Arth. **228**
proëminens (DC.) Pass. **308,** 310
proëminens euphorbiicola (B.&C.) Arth. **309**
proëminens myristica (B.&C.) Arth. **309**
proëminens poinsettiae (Tranz.) Arth. **309**
proëminens typica Arth. **309,** 310
prunorum Fckl. 72
psoraleae Peck **244,** 245
psoraleae argophyllae (Seym.) Arth. **245**
psoraleae typica Arth. **244,** 245
puccinioides Rob. 245
pulchellus E.&E. 236
pulcherrimus B.&C. 144
punctatus Schroet. 300, **301,** 303
punctato-striatus Cooke&Hark. 70
pyriformis Cooke **215**
rhyncosporae Ellis **196**
rhynchosporicola P.Henn. 196
rickerianus Arth. **282**
rosicola E.&E. 89
rudbeckiae A.&H. 199, **201**
ruelliae Holw. **337**
rugosus Arth. 297
sanguinea Peck 75
scaber E.&E. 139
schroeteri De-T. 285
scillarum (Grev.) Wint. **225**
scirpi (Cast.) Burr. **191,** 321
seditiosus Kern 160
shearianus Arth. **235**
silenes (Schl.) Fckl. **235**
silphii (Burr.) Arth. **218,** 219
simulans Peck 136
solidaginis (Sommerf.) Niessl **201**
sparganii C.&P. **116**
spartinae Farl. 167, 168
speciosus Holw. **323**
spermacoces (Schw.) Curt. **261**
splendens Blytt 302
sporoboli E.&E. **136,** 137
spragueae Hark. **284**
statices B.&C. 252
striatus Schroet. **299,** 300
striatus loti (Blytt) Arth. **300**
striatus medicaginis (Pass.) Arth **299,** 300
suaedae Jacz. 235
substriatus Syd. 297
suksdorfii D.&H. **286**
toxicodendri Berk.&Rav. 69
tranzschelii Syd. **298**
trifolii (Hedw.f.) Lév. **304,** 305
trifolii fallens (Desm.) Arth. **305**
trifolii hybridi (W.H.Davis) Arth. **304**
trifolii-repentis Liro 304
trifolii trifolii-repentis (Liro) Arth. **304,** 305, 306
triquetrus Cooke 247
uniporulus Kern **210**
unitus Peck **284**
valens Kern **210**
valerianae Fckl. 228
veratri (DC.) Schroet. 273
vernalis Speg. 275
versatilis Peck 66
verruculosus Schroet. **285**
vignae Barclay 296
zygadeni Peck **221**
Uropyxis 63, **76**
affinis Arth. **76**
agrimoniae Arth. 295
amorphae (Curt.) Schroet. **77**
holwayi Arth. **77**
mirabilissima Magn. 75
petalostemonis (Farl.) De-T. **76,** 77
sanguinea Arth. 75
texana Arth. 75
wootoniana Arth. 75
Xenodochus 63, **91**
carbonarius Schl. **92**
minor Arth. **91**
tormentillae Magn. 92
Xyloma
euphorbiae Schub. 58
lini Ehrenb. 57
virgaureae DC. 202

Supplement

to

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in

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SUPPLEMENT

In 1956, Cummins and Stevenson (Plant Disease Reporter Supplement **240**: 109–193) published "A Check List of North American Rust Fungi (Uredinales)" in which species of rust fungi, reported subsequently to volume 7 of the North American Flora and Arthur's "Manual of the Rusts in United States and Canada," were listed, together with the correct nomenclature of all of the species. In the preparation of this supplement, free use was made of the "Check List"; many items being used without change. But a rather surprising number of changes and additions have resulted from studies published since 1956.

This supplement provides reference to descriptions of species that are not in the text of Arthur's Manual and to other pertinent literature. It does not list new hosts or extensions of range for species represented in the Manual. Names not listed in the supplement are considered to be correctly presented in the Manual. Recognized binomials are in **bold face** type. If a specific name as used in the Manual has been changed, it will appear as a separate entry with reference made to the recognized name, e.g. *Aecidium anograe* Arth.: see PUCCINIA REDFIELDIAE Tracy. If a species, as *Aecidium anograe*, is treated as a synonym, its binomial is listed under the recognized species. More complicated situations are explained more fully. An asterisk (*) preceding an entry indicates that the binomial is the one used in the Manual but that there has been a change in the author designation. For example, **Aplopsora nyssae** (Ellis & Tr.) Mains (p. 59 of the Manual) is listed in the supplement as ***Aplopsora nyssae** Mains, without explanation. The synonymy in the Manual lists *Uredo nyssae* Ellis & Tr., which is an imperfect state name and hence, according to the International Code, not transferable. Mains, who described the perfect state (telial stage), is the sole author of the binomial. Such situations are obvious if one examines the synonymy in the Manual. There are apparently identical situations that are quite different, however, e.g. **Coleosporium jonesii** (Peck) n. comb. (p. 37 of the Manual) is correct because an examination of the type specimen has revealed the presence of telia, hence the binomial is based on a type that bears the perfect state. A different, but equally misleading, case is that of **Pileolaria toxicodendri** (Berk. & Rav.) Arth. (p. 69 & 70 of the Manual). Here the epithet comes from *Uromyces toxicodendri* Berk. & Rav. but this name is based on uredinoid aecia or uredia, at least not telia, hence it is an imperfect state name. The correct binomial is **Pileolaria brevipes** Berk. & Rav., as listed in the supplement. The above examples will not account for all changes of names but they will explain the majority.

During the preparation of this supplement it has been my privilege to use the facilities of the Southwestern Research Station of the American Museum of Natural History, Dr. Mont A. Cazier, Director. This privilege is gratefully acknowledged. Certain new records taken in 1961 in Arizona, e.g. *Aecidium anthericicola* Arth., *Aecidium talini* Speg., *Puccinia angulata* Diet. & Neger, and *Puccinia bottomleyae* Doidge, as well as suggestions concerning the life cycles of *Puccinia dietelii* Sacc. & Syd. and *Puccinia leptochloae* Arth. & Fromme were made possible by a Grant (G 16418) from the National Science Foundation. And last, but far from least, I acknowledge a debt of gratitude to Mr. John A. Stevenson who, as co-author of the "Check List," made the preparation of this supplement a relatively simple task.

George B. Cummins
September 25, 1961

Achrotelium lucumae Cumm. Mycologia **48:** 601. 1956.
Uredo lucumae Arth. & J. R. Johnston Mem. Torrey Bot. Club **17:** 169. 1918.
On *Lucuma nervosa* A. DC.: Florida.

Aecidium aesculi Ell. & Kell.: see PUCCINIA ANDROPOGONIS Schw.

Aecidium anograe Arth.: see PUCCINIA REDFIELDIAE Tracy.

Aecidium anthericicola Arth. Bull. Torrey Bot. Club **45:** 149. 1918.
On *Anthericum torreyi* Baker: Arizona.

Aecidium apocyni Schw.: see PUCCINIA SMILACIS Schw.

Aecidium arcularium Arth.: see PUCCINIA LIATRIDIS Bethel ex Arth.

Aecidium avocense Cumm. & Greene: see PUCCINIA AVOCENSIS Cumm. & Greene.

Aecidium bouvardiae Diet. & Holw. in Holway Bot. Gaz. **24:** 36. 1897.
On *Bouvardia glaberrima* Engelm.: Arizona.

Aecidium cannonii Griff.: see PUCCINIA VEXANS Farl.

Aecidium conspersum J. J. Davis Paras. Fungi Wis. p. 62. 1942.
Aecidium sparsum J. J. Davis Trans. Wis. Acad. Sci. **24:** 292. 1929. Not Hazl 1874.
On *Houstonia longifolia* Gaertn., *Galium tinctorium* L.: Wisconsin.

Aecidium graebnerianum P. Henn.: see PUCCINIA PRAEGRACILIS Arth.

Aecidium mirabilis Diet. & Holw.: see PUCCINIA ESCLAVENSIS Diet. & Holw.

Aecidium rubromaculans E. West Mycologia **33:** 40. 1941.
On *Viburnum obovatum* Walt.: Florida.

Aecidium smilacis Schw.: see PUCCINIA ARUNDINARIAE Schw.

Aecidium subsimulans Arth. & Mains: see PUCCINIA BIPORULA J. W. Baxter.

Aecidium talini Speg. Rev. Argent. Hist. Nat. **1:** 399. 1891.
On *Talinum paniculatum* (Jacq.) Gaertn.: Arizona.
Unpublished observations by Cummins in 1961 in Arizona indicate this is the aecial stage of *Puccinia leptochloae* Arth. & Fromme.

Aecidium turnerae P. Henn. Hedwigia **43:** 171. 1904.
On *Piriqueta caroliniana* (Walt.) Urb.: Florida.

Aecidium valerianellae Biv. Stirp. Rar. Sic. **4:** 28. 1816.
This is the aecial stage of *Puccinia gladioli* Cast. according to d'Oliveira (Nature **144:** 239–240. 1949). *P. gladioli* does not occur in America.

Aecidium yuccae Arth.: see PUCCINIA SPOROBOLI Arth. var. ROBUSTA Cumm. & Greene.

Angiopsora ampelopsidis (Diet. & P. Syd.) Thirum. & Kern: see PHYSOPELLA AMPELOPSIDIS (Diet. & P. Syd.) Cumm. & Ramachar.

Angiopsora cameliae (Mayor) Mains: see PHYSOPELLA CAMELIAE (Mayor) Cumm. & Ramachar.

Angiopsora compressa Mains: see PHYSOPELLA COMPRESSA (Mains) Cumm. & Ramachar.

***Aplopsora nyssae** Mains Am. J. Bot. **8:** 442. 1921.

Bubakia crotonis (Cke.) Arth.: see PHAKOPSORA CROTONIS (Burr.) Arth.

Caeoma dubium C. A. Ludwig: see MELAMPSORA ABIETI-CAPRAEARUM Tubeuf.

Caeoma faulliana Hunter: see MELAMPSORA ALBERTENSIS Arth.

Caeoma torreyi Bonar Mycologia **43:** 62. 1951.
On *Torreya californica* Torr.: California.

Cerotelium desmium (Berk. & Br.) Arth.: see PHAKOPSORA GOSSYPII (Arth.) Hirat. f.

***Cerotelium dicentrae** Mains & H. W. Anderson in Mains Am. J. Bot. **8:** 445. 1921.

Cerotelium fici (Butl.) Arth. Bull. Torrey Bot. Club **44:** 509. 1917.
Kuehneola fici Butl. Ann. Mycol. **12:** 76. 1914. The first name based on telia.
Physopella fici (Cast.) Arth. Rés. Sci. Congr. Bot. Vienne p. 338. 1906.

Cerotelium tanakae Ito in Ito and Homma Sapporo Nat. Hist. Soc. **15:** 118. 1938.
On *Amphicarpa bracteata* (L.) Fern.: Indiana.

Chrysomyxa arctostaphyli Diet. Bot. Gaz. **19:** 303. 1894.

Peridermium coloradense (Diet.) Arth. & Kern Bull. Torrey Bot. Club **33:** 426. 1906.

Peterson (Science **134:** 468–469. 1961) infected *Arctostaphylos uva-ursi* (L.) Spreng. with aeciospores of *P. coloradense*.

Chrysomyxa cassandrae (Pk. & G. W. Clint.) Tranz.: see CHRYSOMYXA LEDI DBy. var. CASSANDRAE (Pk. & G. W. Clint.) Savile.

Chrysomyxa chiogenis Diet. Bot. Gaz. **19:** 303. 1894.

Aecia occur on *Picea glauca* Moench., *P. mariana* (Mill.) B. S. P. (See Faull in J. Arnold Arb. **17:** 109–114. 1936).

***Chrysomyxa empetri** Schroet. ex Cumm. Mycologia **48:** 602. 1956.

Aecia occur on *Picea glauca* Moench., *P. rubens* Sarg. according to Faull (J. Arnold. Arb. **18:** 141–148. 1937).

***Chrysomyxa ilicina** (Arth.) Arth. Manual Rusts U. S. and Canada p. 31. 1934.

Chrysomyxa ledi DBy. Bot. Zeit. **37:** 809. 1879 var. **ledi.**

Chrysomyxa ledi DBy. var. **cassandrae** (Pk. & G. W. Clint.) Savile Can. J. Res. C. **28:** 324. 1950.

Uredo cassandrae Pk. & G. W. Clint. in Peck Ann. Rept. N. Y. State Mus. **30:** 54. 1878. The type bears telia.

Chrysomyxa cassandrae (Pk. & G. W. Clint.) Tranz. Trav. Soc. Nat. St. Petersb. Sect. Bot. **23:** 28. 1893.

Chrysomyxa ledi DBy. var. **glandulosi** Savile Can. J. Bot. **33:** 489. 1955.

On *Picea engelmannii* (Parry) Engelm.: British Columbia.

Chrysomyxa ledi DBy. var. **groenlandici** Savile Can. J. Bot. **33:** 490. 1955.

On *Ledum groenlandicum* Oeder: Canada, Michigan, New Hampshire.

Chrysomyxa ledi DBy. var. **rhododendri** (DBy.) Savile Can. J. Bot. **33:** 491. 1955.

On *Rhododendron lapponicum* L., *R.* spp.: British Columbia, Manitoba, Newfoundland, Washington.

Chrysomyxa ledi DBy. var. **vaccinii** Ziller in Savile Can. J. Bot. **33:** 492. 1955.

On *Vaccinium parvifolium* Smith: British Columbia.

***Chrysomyxa ledicola** Lagh. Tromsø Mus. Aarsh **16:** 119. 1893.

Chrysomyxa monesis Ziller Can. J. Bot. **32:** 435. 1954.

On *Picea sitchensis* (Bong.) Carr., *Monesis uniflora* (L.) Gray and var. *reticulata* (L.) Gray: Alaska, British Columbia, Washington. This species was segregated from *C. pirolata* Wint. (*C. pyrolae*).

***Chrysomyxa piperiana** Sacc. & Trott. ex Cumm. Mycologia **48:** 602. 1956.

Peridermium parksianum Faull J. Arnold Arb. **15:** 86. 1934.

Inoculations that proved the life cycle were made by Faull (J. Arnold Arb. **17:** 109–114. 1936.

Chrysomyxa pirolata Wint. in Rabh. Krypt.-Fl. Ed. 2. I. **1:** 250. 1882.

Chrysomyxa pyrolae (DC.) Rostr. Bot. Centralbl. **5:** 127. 1877. *Nom. nudum.*

Chrysomyxa pyrolae (DC.) Rostr.: see CHRYSOMYXA PIROLATA Wint.

Chrysomyxa woroninii Tranz. Centralbl. II. **11:** 106. 1903.

On *Ledum groenlandicum* Oeder, *L. palustre* L. var. *decumbens* Ait., *Picea glauca* Moench., *P. mariana* (Mill.) B. S. P.: Alaska, British Columbia, Newfoundland, Nova Scotia, Quebec, Yukon.

Coleosporium adenocaulonis (Jacks.) see UREDO ADENOCAULONIS (Jacks.) Cumm.

Coleosporium aridum Jacks.: see COLEOSPORIUM EUPATORII Arth. ex Cumm.

Coleosporium asterum (Diet.) Syd. Ann. Mycol. **12:** 109. 1914.

Coleosporium solidaginis Thuem. Bull. Torrey Bot. Club **6:** 216. 1878. Based on uredia.

Stichopsora asterum Diet. Bot. Jahrb. **28:** 565. 1899.

***Coleosporium campanulae** Lév. ex Kickx Fl. Flandres **2:** 54. 1867.

Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 8. 1953) consider this a form of *C. tussilaginis* (Pers.) Lév. in Orbigny Dict. Univ. Hist. Nat. **12:** 786. 1849.

Coleosporium crowellii Cumm. Phytopathology **28:** 523. 1938.

On *Pinus edulis* Engelm., *P. flexilis* James: Arizona, Colorado, New Mexico.

***Coleosporium delicatulum** Hedgc. & Kern ex Arth. No. Am. Flora **7:** 657. 1924.

Coleosporium domingensis (Berk.) Arth.: see COLEOSPORIUM PLUMIERAE Pat.

***Coleosporium elephantopodis** Thuem. Mycol. Univ. No. 953. 1878.

Coleosporium eupatoriae Arth. ex Cumm. Mycologia **48:** 603. 1956.

Coleosporium eupatoriae Arth. Bull Torrey Bot. Club **33:** 31. 1906. Based on uredia.

Coleosporium aridum Jacks. in Arthur Bull. Torrey Bot. Club **51:** 52. 1924. Based on uredia.

Uredo arida (Jacks.) Cumm. Mycologia **48:** 607. 1956.

Solheim and Cummins (Univ. Wyo. Publ. **23:** 38. 1959) first treated *C. aridum* as a synonym of *C. eupatorii.*

***Coleosporium inconspicuum** Hedgc. & Long ex Arthur No. Am. Flora **7:** 659. 1924.

***Coleosporium madiae** (Syd.) Arth. No. Am. Flora **7:** 92. 1907.

Stichopsora madiae Syd. Ann. Mycol. **2:** 30. 1904. Telia first described.

Coleosporium plumierae Pat. Bull. Soc. Mycol. Fr. **18:** 178. 1902.

Coleosporium domingensis (Berk.) Arth. Am. J. Bot. **5:** 329. 1918. Based on uredia.

***Coleosporium senecionis** Fr. ex Kickx Fl. Flandres **2:** 53. 1867.

Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 11. 1953) consider this a form of *C. tussilaginis* (Pers.) Lév. in Orbigny Dict. Univer. Hist. Nat. **12:** 786. 1849.

Coleosporium solidaginis Thuem.: see COLEOSPORIUM ASTERUM (Diet.) Syd.

Coleosporium sonchi (Strauss) Lév. ex Tul. Ann. Sci. Nat. Bot. IV. **2:** 190. 1854.

Uredo tremellosa var. *sonchi* Strauss Ann. Wetter. Ges. **2:** 90. 1810. The type contains telia.

Coleosporium sonchi-arvensis Lév. in Berkeley Outline of Brit. Fungi p. 333. 1860. Based on uredia.

Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 11. 1953) consider this a form of *C. tussilaginis* (Pers.) Lév. in Orbigny Dict. Univer. Hist. Nat. **12:** 786. 1849.

Coleosporium sonchi-arvensis (Pers.) Lév.: see COLEOSPORIUM SONCHI.

***Coleosporium terebinthinaceae** Arth. No. Am. Flora **7:** 93. 1907.

Coleosporium viburni Arth. No. Am. Flora **7:** 88. 1907.

Coleosporium viburni Arth. Bull. Iowa Agr. Coll. Dept. Bot. **1884:** 163. 1884. Telia present but not described.

Cronartium appalachianum Hepting Mycologia **49:** 898. 1957 (issued 1958).

Peridermium appalachianum Hepting & Cumm. Phytopathology **42:** 115. 1952.

On *Buckleya distichophylla* (Nutt.) Torr., *Pinus virginiana* Mill.: North Carolina, Tennessee, Virginia.

***Cronartium coleosporioides** Arth. No. Am. Flora **7:** 123. 1907.

There is more than one species involved here but the nomenclature is confused. *C. coleosporioides* Arth., the only validly published name, is based on a telial collection on *Castilleja miniata* Dougl. collected 10 Aug. 1886, Skamania Co., Wash. by Suksdorf. Its aecial stage doubtless is *Peridermium stalactiforme* Arth. & Kern but this cannot be proved as regards the type. *Peridermium filamentosum* Pk., which is distinctive enough in the aecial stage, also infects species of *Castilleja* but no valid telial name is available. *Peridermium harknessii* J. P. Moore is capable of reinfecting pine. In fact there is no very substantial evidence that it does otherwise. *C. filamentosum* Hedgc., *C. harknessii* Meinicke, and *C. stalactiforme* Arth. & Kern were published without descriptions of telia, hence are *nomina nuda.*

Cronartium conigenum Hedgc. & Hunt Phytopathology **12:** 120. 1922.

This was treated as a synonym of *C. quercuum* in the Manual (p. 25) but is distinctive.

Cronartium fusiforme Hedgc. & Hunt ex Cumm. Mycologia **48:** 603. 1956.

Cronartium fusiforme Hedgc. & Hunt Phytopathology **8:** 316. 1918. *Nomen nudum.*

Cronartium quercuum (Berk.) Miyabe ex Shirai Bot. Mag. Tokyo **13:** 74. 1899.

Cronartium asclepiadeum quercium Berk. Grevillea **3:** 59. 1874.

Arthur (p. 25) included *C. cerebrum*, *C. conigenum*, *C. fusiforme*, and *C. strobilinum* in his concept of *C. quercuum*. *C. cerebrum* has not been validly published and is doubtless only a synonym of *C. quercuum*. The other three are generally regarded as distinct species. The type specimen of *C. quercuum* is American, hence the binomial applies to the American fungus should it differ from the Japanese pine-oak rust.

***Cronartium ribicola** J. C. Fischer ex Rabh. Fungi Europ. No. 1595.

Hedwigia **11:** 182. 1872.

Inadvertently, the aecia are described (p. 27) as "on globoid galls" whereas the hypertrophy is none or slightly fusiform.

Cronartium strobilinum Hedgc. & Hahn Phytopathology **12:** 113. 1922.

This was treated as a synonym of *C. quercuum* (p. 25) but is distinctive.

Cumminsiella mirabilissima (Pk.) Nannf. in Lundell & Nannfeldt Fungi Exs. Suec. No. 1507a. 1947.

Uromyces sanguinea Pk. Bot. Gaz. **4:** 128. 1879. Based on uredia.

Puccinia mirabilissima Pk. Bot. Gaz. **6:** 226. 1881.

Cumminsiella sanguinea (Pk.) Arth.: see CUMMINSIELLA MIRABILISSIMA.

***Cumminsiella wootoniana** (Arth.) Arth. Bull. Torrey Bot. Club **60:** 475. 1933.

Endophyllum circumscriptum (Schw.) Whet. & Olive in Olive and Whetzel Am. J. Bot. **4:** 49. 1917.

On *Cissus sicyoides* L.: Florida.

Endophyllum lacus-regis Savile & Parmelee Mycologia **48:** 577. 1956.

On *Claytonia caroliniana* Michx.: Ontario.

Gerwasia epiphylla (Arth.) Cumm. comb. nov.

Spirechina epiphylla Arth. No. Am. Flora **7:** 184. 1912.

Mainsia epiphylla (Arth.) Jacks. Mycologia **23:** 112. 1931.

This transfer is made in accordance with Cummins' treatment (Illustrated Genera Rust Fungi p. 69) of *Mainsia* as a synonym of *Gerwasia*.

Gymnosporangium aurantiacum Chev.: see GYMNOSPORANGIUM CORNUTUM Arth.

***Gymnosporangium bermudianum** Earle in Seymour and Earle Econ. Fungi No. 249. 1892.

***Gymnosporangium clavariiforme** (Pers.) DC. Fl. Fr. **2:** 217. 1805.

***Gymnosporangium clavipes** (Cke. & Pk.) Cke. & Pk. in Peck Ann. Rept. N. Y. State Mus. **25:** 89. 1873.

Gymnosporangium cornutum Arth. ex Kern Bull. N. Y. Bot. Gard. **7:** 444. 1911.

Gymnosporangium cornutum Arth. Mycologia **1:** 240. 1909. Telia not described.

Gymnosporangium aurantiacum Chev. Fl. Paris **1:** 424. 1826.

Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 15. 1953) consider *G. aurantiacum* a *nomen ambiguum*, since it may apply to either *G. cornutum* or *G. tremelloides* Hartig.

Gymnosporangium cupressi Long & Goodding in Long Bot. Gaz. **72:** 39. 1921.

Long and Goodding (Mycologia **32:** 490. 1940) report that the aecia occur on *Amelanchier*.

***Gymnosporangium ellisii** (Berk.) Ell. No. Am. Fungi No. 271. 1879.

Gymnosporangium fraternum Kern Bull. N. Y. Bot. Gard. **7:** 439. 1911.

Gymnosporangium transformans Kern Bull. N. Y. Bot. Gard. **7:** 463. 1911. Based on an imperfect state name.

Gymnosporangium fuscum Hedw. f. in DC. Fl. Fr. **2:** 217. 1805.

On *Juniperus chinensis* L., *Pyrus communis* L.: British Columbia, California. See Ziller (Plant Dis. Reptr. **45:** 90–94. 1961) and McCain (*ibid.* **45:** 151. 1961).

***Gymnosporangium harknessianum** Kern ex Arth. No. Am. Flora **7**: 737. 1926.
Gymnosporangium harknessianum Kern Bull. N. Y. Bot. Gard. **7**: 441. 1911. Telia not described.

***Gymnosporangium hyalinum** Kern ex Cumm. Mycologia **48**: 603. 1956.
Gymnosporangium hyalinum Kern Bull. N. Y. Bot. Gard. **7**: 470. 1911. Based on aecia.
Gymnosporangium hyalinum Kern & West Mycologia **39**: 123. 1947. Latin diagnosis not provided.

Gymnosporangium juniperinum L. ex Mart.: see GYMNOSPORANGIUM TREMELLOIDES Hartig.

Gymnosporangium juvenescens Kern: see GYMNOSPORANGIUM NIDUS-AVIS Thaxt.

Gymnosporangium nidus-avis Thaxt. Conn. Agr. Exp. Sta. Bull. **107**: 3. 1891.
Gymnosporangium juvenescens Kern Bull. N. Y. Bot. Gard. **7**: 448. 1911.
Prince (Farlowia **2**: 481. 1946) has presented evidence that *G. juvenescens* is not distinctive.

***Gymnosporangium nootkatense** Arth. Am. J. Bot. **3**: 44. 1916.
Gymnosporangium sorbi Kern Bull. N. Y. Bot. Gard. **7**: 438. 1911. Telia not described.

Gymnosporangium transformans (Ell.) Kern: see GYMNOSPORANGIUM FRATERNUM Kern.

Gymnosporangium tremelloides Hartig Lehrb. Baum-Krankh. p. 55. 1882.
Gymnosporangium juniperinum Mart. Fl. Crypt. Erlang. p. 333. 1817.
Hylander, Jørstad, and Nannfeldt (Opera Bot. **1**: 15. 1953) consider *G. juniperinum* a *nomen ambiguum* since it may apply to either *G. cornutum* Arth. or *G. tremelloides* Hartig.

***Gymnosporangium tubulatum** Kern ex Arth. No. Am. Flora **7**: 738. 1926.
Gymnosporangium tubulatum Kern Bull. N. Y. Bot. Gard. **7**: 451. 1911. Telia not described.

Gymnosporangium vaquelinae Long & Goodding Mycologia **31**: 671. 1939.
On *Vaquelinia californica* Sarg., *Juniperus monosperma* (Engelm.) Sarg.: Arizona.

***Hyalopsora cheilanthis** Arth. Manual Rusts U. S. and Canada p. 11. 1934.
Hyalopsora cheilanthis Arth. No. Am. Flora **7**: 113. 1907. Telia not described.

Hyalopsora polypodii (Diet.) Magn. Ber. Deutsch. Bot. Ges. **19**: 582. 1901.
Pucciniastrum polypodii Diet. Hedwigia **38** (Beibl.): 260. 1899. The first description of telia.

***Kuehneola malvicola** Arth. No. Am. Flora **7**: 187. 1912.

***Kuehneola uredinis** (Lk.) Arth. Rés. Sci. Congr. Bot. Vienne p. 342. 1906.

Mainsia epiphylla (Arth.) Jacks.: see GERWASIA EPIPHYLLA (Arth.) Cumm.

***Melampsora abietis-canadensis** C. A. Ludwig ex Arth. No. Am. Flora **7**: 664. 1924.
Melampsora abietis-canadensis C. A. Ludwig Phytopathology **5**: 279. 1915. *Nomen nudum*.

Melampsora abieti-capraearum Tub. Centralbl. Bakt. II. **9**: 241. 1902.
Caeoma dubium C. A. Ludwig Phytopathology **5**: 281. 1915.
Ziller (Can. J. Bot. **37**: 109–119. 1959) demonstrated that *C. dubium* belongs here. See also *Melampsora epitea* Thuem.

Melampsora aecidioides (DC.) Schroet.: see MELAMPSORA POPULNEA (Pers.) Karst.

Melampsora albertensis Arth. Bull. Torrey Bot. Club **33**: 517. 1906.
Caeoma faulliana Hunter J. Arnold Arb. **17**: 118. 1936.
Ziller (Can. J. Bot. **38**: 869–870. 1960) found that the host of the type of *C. faulliana* is *Pseudotsuga menziesii* (Mirb.) Franco (*P. mucronata*). In 1955, he reported (*ibid.* **33**: 180–181) that *Caeoma occidentalis* belongs with *Melampsora occidentalis* rather than with *M. albertensis*.

Melampsora bigelowii Thuem.: see MELAMPSORA PARADOXA Diet. & Holw.

Melampsora epitea Thuem. Mitth. Forstl. Versuchw. Oesterr. **2:** 38 et 40. 1879.

According to Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 19. 1953) the following are forms of *M. epitea* and cannot be distinguished morphologically: *M. abieti-capraearum* Tub., *M. arctica* Rostr., *M. ribesii-purpureae* Kleb., and *M. larici-tremulae* Kleb.

Melampsora hypericorum Wint. in Rabh. Krypt.-Fl. 2 Aufl. I. **1:** 241. 1884.

Mesopsora hypericorum Diet. Ann. Mycol. **20:** 30. 1922.

On *Hypericum scouleri* Hook.: Montana.

Melampsora larici-tremulae Kleb. Forstl. Naturw. Zeits. **1897:** 468. 1897.

On *Populus* sp.: Ontario. The record is from Parmelee (Can. Dept. Agr. Res. Branch Publ. **1080:** 13. 1960), but see also *Melampsora epitea* Thuem.

Melampsora occidentalis Jacks. Phytopathology **7:** 354. 1917.

Caeoma occidentalis Arth. Bull. Torrey Bot. Club **34:** 591. 1907.

Ziller (Can. J. Bot. **33:** 180–181. 1955) has pointed out that this aecial name belongs here and not with *M. albertensis.*

Melampsora paradoxa Diet. & Holw. in Dietel Hedwigia **40** (Beibl.): 32. 1901.

Melampsora bigelowii Thuem. Mitth. Forstl. Versuchw. Oesterr. **2:** 37. 1879. Based on uredia.

Melampsora pinitorqua Rostr. De farligste Snyltere Danm. Skove p. 10. 1889.

On *Pinus ponderosa* Lawson: British Columbia.

The record is from Ziller (Plant Dis. Reptr. **45:** 327–329. 1961). Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 25. 1953) consider this a variant of *M. populnea* (Pers.) Karst.

Melampsora piscariae Jacks.: see UREDO PISCARIAE (Jacks.) Cumm.

Melampsora populnea (Pers.) Karst. Bidr. Känned. Finl. Nat. Folk **31:** 53. 1879.

Sclerotium populneum Pers. Syn. Meth. Fung. p. 125. 1801.

Melampsora aecidioides Schroet. in Cohn Krypt.-Fl. Schles. III. **1:** 362. 1887.

Melampsora ribesii-purpureae Kleb. Prings. Jahrb. Wiss. Bot. **35:** 667. 1901.

See also *Melampsora epitea* Thuem.

Melamsorella caryophyllacearum Schroet. Hedwigia **13:** 85. 1874.

Peterson (Science **134:** 468–469. 1961) has proved that *Peridermium coloradense* (Diet.) Arth. is the aecial stage of *Chrysomyxa arctostaphyli.*

Melampsorella cerastii (Pers.) Schroet.: see MELAMPSORELLA CARYOPHYLLACEARUM.

Melampsoridium alni Auth. not Diet.: see MELAMPSORIDIUM HIRATSUKANUM Ito.

***Melampsoridium betulinum** (Fr.) Kleb. Zeitschr. Pflanzenkr. **9:** 21. 1899.

Sclerotium (*Xyloma*) *betulinum* Fr. Syst. Mycol. **2:** 262. 1822. Telia present?

Melampsoridium carpini** (Fckl.) Diet. in Engler and Prantl Nat. Pfl. I. **1*: 551. 1900.

Melampsoridium hiratsukanum Ito ex Hirat. f. J. Fac. Arg. Hokkaido Imp. Univ. **21:** 10. 1927.

Melampsoridium alni Auth. not Diet.

American material should be referred here rather than to the European *M. alni* Diet.

Milesia acuta Faull J. Arnold Arb. **37:** 314. 1956.

On *Woodwardia fimbriata* Sm.: California. Based on uredia.

Milesia laeviuscula (Diet. & Holw.) Faull Contr. Arnold Arb. **2:** 95. 1932.

Ziller (Can. J. Bot. **35:** 885–894. 1957) has described the aecial stage on *Abies grandis* Lindl.

Milesia polypodophila (Bell) Faull: see MILESIA PYCNOGRANDIS Arth.

***Milesia polystichi** Wineland ex Faull Contr. Arnold Arb. **2:** 108. 1932.

Milesia polystichi Wineland in Jacks. Mem. Brooklyn Bot. Gard. **1:** 214. 1918. Telia not described.

Milesia pycnograndis Arth. No. Am. Flora **7:** 685. 1925.

Uredinopsis polypodophila Bell Bot. Gaz. **77:** 25. 1924. Telia not described.

***Milesia vogesiaca** Faull Contr. Arnold Arb. **2:** 103–104. 1932.
Milesia vogesiaca Syd. Ann. Mycol. **8:** 491. 1910. Only uredia described.

Peridermium appalachianum Hepting & Cumm.: see CRONARTIUM APPALACHIANUM Hepting.

Peridermium coloradense (Diet.) Arth. see CHRYSOMYXA ARCTOSTAPHYLI Diet.

Phakopsora cherimoliae Cumm. Mycologia **48:** 604. 1956.
Uredo cherimoliae Lagh. Bull. Soc. Mycol. Fr. **11:** 215. 1895.

Phakopsora crotonis (Cke.) Arth. Bull. Torrey Bot. Club **44:** 508. 1917.
Bubakia crotonis (Cke.) Arth. Rés. Sci. Congr. Bot. Vienne p. 339. 1906.
Cummins (Illustrated Genera Rust Fungi p. 39) did not recognize the genus *Bubakia*, hence the treatment here.

Phakopsora desmium (Berk. & Br.) Cumm.: see PHAKOPSORA GOSSYPII (Arth.) Hirat. f.

Phakopsora gossypii (Arth.) Hirat. f. Ured. Studies. p. 266. Oct. 1955.
Kuehneola gossypii Arth. No. Am. Flora **7:** 187. 1912.
Phakopsora gossypii Dale Commonw. Mycol. Inst. Mycol. Paper **60:** 4. Dec. 1955.

Phakopsora zizyphi-vulgaris Diet. Ann. Mycol. **8:** 469. 1910.
On *Zizyphus jujuba* Mill., *Z. mauritana* Lam.: Florida.

Phragmidium arcticum Lagh. ex Liro Bidr. Finl. Nat. Folk **65:** 419. 1908.
On *Rubus acaulis* Michx.: Quebec.

Phragmidium disciflorum (Tode) James: see PHRAGMIDIUM MUCRONATUM (Pers.) Schlecht.

Phragmidium fusiforme Schroet. Abh. Schles. Ges. Vaterl. Cult. Nat. Abt. **1869–72:** 24. 1870.
Phragmidium rosae-acicularis Liro Bidr. Finl. Nat. Folk **65:** 428. 1908.

Phragmidium mucronatum (Pers.) Schlecht. Fl. Berol. **2:** 156. 1824.
Puccinia mucronata rosae Pers. Syn. Meth. Fung. p. 230. 1801.
Phragmidium disciflorum (Tode) James Contr. U. S. Nat. Herb. **3:** 276. 1895.

Phragmidium rosae-acicularis Liro: see PHRAGMIDIUM FUSIFORME Schroet.

Phragmidium rosae-pimpinellifoliae Diet. Hedwigia **44:** 339. 1905.
Phragmidium subcorticium Wint. in Rabh. Krypt.-Fl. Ed. 2. I. **1:** 228. 1882 (in part). Material under this name belongs partly to the above species and partly to *P. mucronatum* (Pers.) Schlecht.

Phragmidium subcorticium Wint.: see PHRAGMIDIUM ROSAE-PIMPINELLIFOLIAE Diet.

Phragmidium tuberculatum J. Muell. Ber. Deutsch. Bot. Ges. **3:** 391. 1885.
On *Rosa* sp.: Alaska, Connecticut.

Phragmidium violaceum (C. F. Schultz) Wint. Hedwigia **19:** 54. 1880.
On *Rubus* sp.: Mississippi. The record is based on a specimen submitted by the late L. E. Miles. The method of introduction and the possible persistence of the fungus are unknown.

Phragmopyxis deglubens (Berk. & Curt.) Diet. in Engler and Prantl Nat. Pfl. I. **1**:** 70. 1897.
On *Cracca edwardsii* Gray (*Benthamantha edwardsii* Kuntze): Arizona.

Physopella ampelopsidis (Diet. & P. Syd.) Cumm. & Ramachar Mycologia **50:** 742. 1958.
Phakopsora ampelopsidis Diet. & P. Syd. in Dietel Hedwigia **37:** 217. 1898.
Physopella vitis Arth. Rés. Sci. Congr. Bot. Vienne p. 338. 1906.
Angiopsora ampelopsidis (Diet. & P. Syd.) Thirum. & Kern Mycologia **41:** 288. 1949.

Physopella cameliae (Mayor) Cumm. & Ramachar Mycologia **50:** 742. 1958.
Uredo cameliae Mayor Mem. Soc. Neuchat. Sci. **5:** 578. 1913. Telia present.
Puccinia cameliae (Mayor) Arth. Mycologia **7:** 227. 1915.
Angiopsora cameliae (Mayor) Mains Mich. Acad. Sci. Arts, Letters **22:** 154. 1937.

Physopella compressa (Mains) Cumm. & Ramachar Mycologia **50:** 743. 1958.

Puccinia compressa Arth. & Holw. in Arthur Proc. Am. Phil. Soc. **64:** 157. 1925, not Dietel 1907.

Puccinia paspalicola (P. Henn.) Arth. Manual Rusts U. S. and Canada p. 127. 1934, in part.

Angiopsora compressa Mains Mycologia **26:** 129. 1934.

On *Axonopus compressus* (Swartz) Beauv., *Paspalum conjugatum* Bergius, *P.* sp.: Florida, Louisiana, Texas.

Physopella fici (Cast.) Arth.: see CEROTELIUM FICI (Butl.) Arth.

Pileolaria brevipes Berk. & Rav. in Berk. Grevillea **3:** 58. 1874.

Uromyces toxicodendri Berk. & Rav. *ibid.* **3:** 56. 1874. Based on uredia.

Pileolaria toxicodendri (Berk. & Rav.) Arth. No. Am. Flora **7:** 147. 1907.

Pileolaria cotini-coggygriae Tai & Cheo Bull. Chinese Bot. Soc. **3:** 59. 1937.

On *Cotinus coggygriae* Scop.: Georgia. See Thompson in Mycologia **52:** 321–325. 1960 (issued 1961).

Pileolaria mexicana Arth.: see UREDO MEXICANA (Arth.) Cumm.

Pileolaria toxicodendri (Berk. & Rav.) Arth.: see PILEOLARIA BREVIPES Berk. & Rav.

Prospodium appendiculatum (Wint.) Arth. J. Mycol. **13:** 31. 1907.

On *Tecoma stans* (L.) H. B. K.: Florida, Texas.

Prospodium lippiae (Speg.) Arth. No. Am. Flora **7:** 161. 1918.

On *Aloysia* (*Lippia*) *lycioides* Cham., *A. wrightii* (Gray) Heller: Arizona, Texas.

Prospodium plagiopus (Mont.) Arth. No. Am. Flora **7:** 162. 1912.

On *Tabebuia guayacan* (Seem.) Hemsl.: Florida.

Prospodium transformans (Ell. & Ev.) Cummins Lloydia **3:** 66. 1940.

On *Tecoma stans* (L.) H. B. K.: Florida.

Puccinia abnormis P. Henn. Hedwigia **35:** 243. 1896.

Puccinia flaccida Auth. not Berk. & Br.

In unpublished studies, Ramachar and Cummins found that the rust fungus on *Echinochloa* is morphologically unlike *Puccinia flaccida.*

Puccinia absinthii (Hedw. f.) DC.: see PUCCINIA TANACETI DC.

***Puccinia acetosae** Koern. Hedwigia **15:** 184. 1876.

Puccinia agrimoniae (Arth.) Arth.: see PUCCINIA LATERIPES Berk. & Rav.

Puccinia airae Mayor & Cruch.: see PUCCINIA DESCHAMPSIAE Arth.

Puccinia allii Rud. Linnaea **4:** 392. 1829.

Puccinia porri Wint. in Rabh. Krypt.-Fl. Ed. 2. I. **1:** 200. 1882.

Puccinia ammophilina Mains ex Cumm. Mycologia **48:** 604. 1956.

Puccinia ammophilina Mains Bull. Torrey Bot. Club **66:** 617. 1939. Latin diagnosis not provided.

On *Ammophila arenaria* (L.) Link, *A. breviligulata* Fern.: Michigan, Oregon.

This may be synonymous with *Puccinia pygmaea* Eriks., as treated by Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 67. 1953).

Puccinia amphigena Diet. Hedwigia **34:** 291. 1895.

Cummins and Greene (Brittonia **13:** 276. 1961) report that the aecia occur only on *Smilax* spp., that the telia occur only on *Calamovilfa longifolia*, and that the teliospores in Fig. 159 of the Manual are those of *Puccinia sporoboli* Arth. var. *robusta* Cumm. & Greene.

Puccinia andropogonis Schw. Trans. Am. Phil. Soc. II. **4:** 295. 1832.

Aecidium aesculi Ell. & Kell. Bull. Torrey Bot. Club **11:** 114. 1884.

Inoculations by Baxter (Plant Dis. Reptr. **39:** 658. 1955) established the relationship of *A. aesculi.*

Puccinia angulata Diet. & Neger Bot. Jahrb. **24:** 156. 1897.

On *Sisyrinchium longipes* (Bicknell) Kearney & Peebles: Arizona.

Puccinia anisacanthi Diet. & Holw. in Holway Bot. Gaz. **31:** 329. 1901.

Puccinia bouvardiae Griff. Bull. Torrey Bot. Club **20:** 297. 1902.

Cummins and Baxter (Madroño, in press) report the host of *P. bouvardiae* is *Anisacanthus thurberi* Gray, not *Bouvardia glaberrima* Englem. (*B. ternifolia*).

Puccinia anomala Rostr.: see PUCCINIA HORDEI Otth.

Puccinia areolata Diet. & Holw. in Dietel Bot. Gaz. **19:** 304. 1894.

Puccinia nephrophyllidii Mains Bull. Torrey Bot. Club **66:** 620. 1939.

Anderson (Iowa State Coll. J. Sci. **26:** 514. 1952) reports the host of Mains' fungus is *Caltha biflora* DC., not *Nephrophyllidium crista-galli.*

Puccinia artemisiae-norvegicae Tranz. & Woron. Publ. Riabouchinsky Exped. Bot. **2:** 563. 1914.

On *Artemisia arctica* Less.: Alaska.

Puccinia arundinariae Schw. Schr. Nat. Ges. Leipzig **1:** 72. 1822.

Aecidium smilacis Schw. *ibid.* **1:** 69. 1822.

The *Aecidium* is assigned here on the basis of unpublished inoculations by Cummins.

Puccinia atra Diet. & Holw.: see PUCCINIA ESCLAVENSIS Diet. & Holw.

Puccinia avocensis Cumm. & Greene in Greene Trans. Wis. Acad. Sci., Arts. Letters **43:** 177. 1954.

Aecidium avocensis Cumm. & Greene in Greene *ibid.* **43:** 177. 1954.

On *Callirhoe triangulata* (Leavenw.) Gray, *Stipa spartea* Trin.: Wisconsin.

Greene and Cummins (Mycologia **50:** 28. 1958) placed the aecial name in synonymy.

Puccinia barbanae (Wallr.) Cda. Icones Fung. **4:** 17. 1840.

See also *Puccinia calcitrapae* DC.

Puccinia bartholomaei Diet.: see PUCCINIA CHLORIDIS Speg.

Puccinia biocellata Vest. ex Cumm. Mycologia **48:** 606. 1956.

Puccinia biocellata Vest. Micromy. Rar. Sel. Nos. 1267, 1368. 1908. Teliospores present but not described.

Puccinia plucheae Arth. Bull. Torrey Bot. Club **49:** 194. 1922. Based on uredia.

Puccinia biporula J. W. Baxter Lloydia **14:** 218. 1951.

Aecidium subsimulans Arth. & Mains in Arthur Bull. Torrey Bot. Club **47:** 475. 1920.

On *Salvia lemmonii* Gray, *S. lycioides* Gray: Arizona, New Mexico, Texas. Solheim and Cummins (Univ. Wyo. Publ. **23:** 44. 1959) reduced the *Aecidium* to synonymy.

Puccinia blyttiana Lagh. Bot. Notiser **1892:** 169. 1892.

Puccinia ranunculi Blytt Forh. Vid.-Selsk. Christ. **1882(5):** 12. 1882 (*nomen provisorium*).

Puccinia bottomleyae Doidge Bothalia **3(4):** 498. 1939.

On *Aristida orcuttiana* Vasey: Arizona. This fungus has abundant capitate paraphyses and is best referred to *P. bottomleyae* for the present, although the teliospores tend to be longer and the walls of the urediospores thicker.

Puccinia boutelouae (Jenning) Holw. Ann. Mycol. **3:** 20. 1905.

See also *Puccinia exasperans* Holw.

Puccinia bouvardiae Griff.: see PUCCINIA ANISACANTHI Diet. & Holw.

Puccinia bromicola (Mains) Guyot: see PUCCINIA RECONDITA Rob. ex Desm.

Puccinia bromi-maximi Guyot: see PUCCINIA RECONDITA Rob. ex Desm.

Puccinia buchnerae Cumm. Mycologia **33:** 385. 1941.

Buchnera elongata Sw.: Florida.

Puccinia cacabata Arth. & Holw. in Arthur Proc. Am. Phil. Soc. **64:** 179. 1925.

Aecidium gossypii Ell. & Ev. Erythea **5:** 6. 1897.

Puccinia stakmanii Presley in Presley and King Phytopathology **33:** 385. 1943.

On *Bouteloua aristidoides* H. B. K., *B. barbata* Lag., *B. eriopoda* (Torr.) Torr., *B. hirsuta* Lag., *B. parryi* (Fourn.) Griff., *B. rothrockii* Vasey, *Chloris ciliata* Sw.: Arizona, Florida, New Mexico, Texas. Presley and King (l. c.) demonstrated that

Aecidium gossypii belongs here rather than with *Puccinia schedonnardi* Kell. & Swing. Hennen and Cummins (Mycologia **48:** 132. 1956) reduced *P. stakmanii* to synonymy.

Puccinia calcitrapae DC. Fl. Fr. **2:** 221. 1805.

Puccinia bardanae Cda. Icon. Fung. **4:** 17. 1840.

Puccinia cirsii Lasch in Rabh. Fungi Europ. No. 89. 1859.

The above synonymy is proposed by Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 40. 1953).

***Puccinia calthae** Link in Willd. Sp. Plant. Ed. 4. **6(2):** 79. 1825.

Puccinia cameliae (Mayor) Mains: see PHYSOPELLA CAMELIAE (Mayor) Cumm. & Ramachar.

Puccinia campanulae novae-zembliae (Jørst.) Arth.: see PUCCINIA NOVAE-ZEMBLIAE Jørst.

Puccinia cannae (Wint.) P. Henn.: see PUCCINIA THALIAE Diet.

Puccinia caricina DC. Fl. Fr. **5:** 60. 1815.

Uredo caricis Schum. Enum. Pl. Saell. **2:** 231. 1803. Not *Uredo caricis* Pers., 1801 = *Cintractia caricis* (Pers.) P. Magn.

Puccinia caricis (Schum.) Schroet. in Cohn Krypt.-Fl. Schles. III. **1:** 327. 1887. Not *Puccinia caricis* Rebent. 1804.

Puccinia caricina DC. var. **limosae** (P. Magn.) Jørst. Kgl. N. Vidensk. Selsk. Skr. **38:** 17. 1936.

Puccinia limosae P. Magn. Tagebl. Naturf. Vers. München **50:** 199. 1877.

Puccinia karelica Tranz. Trav. Mus. Bot. Acad. Sci. St. Petersb. **2:** 16. 1905.

Puccinia caricina DC. var. **uliginosa** (Juel) Jørst. Skr. Vidensk. Oslo I. 1951, **2:** 30. 1952.

Puccinia uliginosa Juel Oefv. Sv. Vet.-Aksd. Foerh. **51:** 409. 1894.

Puccinia caricis (Schum.) Schroet.: see PUCCINIA CARICINA DC.

***Puccinia castillejae** Arth. in Blasdale Univ. Calif. Publ. Bot. **7:** 133. 1919.

Puccinia cesatii Schroet. in Cohn Beitr. Biol. Pfl. **3:** 70. 1879.

On *Bothriochloa ischaemum* (L.) Keng: Texas.

Puccinia chloridis Speg. Rev. Argent. Hist. Nat. **1:** 172. 1891.

Puccinia bartholomaei Diet. Hedwigia **31:** 290. 1892.

This treatment follows Hennen and Cummins (Mycologia **48:** 146. 1956).

Puccinia cirsii Lasch in Rabh. Fungi Europ. No. 89. 1859.

See also *Puccinia calcitrapae* DC.

Puccinia claytoniicola Cumm. Bull. Torrey Bot. Club **79:** 218. 1952.

On *Claytonia lanceolata* Pursh: British Columbia, Wyoming.

Puccinia cockerelliana Bethel: see PUCCINIA RECONDITA Rob. ex Desm.

***Puccinia collinsiae** P. Henn. Hedwigia **37:** 269. 1898.

Puccinia columbiensis Ell. & Ev. Proc. Acad. Nat. Sci. Phil. **1893:** 153. 1893.

Puccinia maculosa Schw. Trans. Am. Phil. Soc. II. **4:** 295. 1832. Not Roehling 1813.

***Puccinia conglomerata** (Strauss) Roehling Deutsch. Fl. Ed. 2. **3(3):** 130. 1813.

Uredo conglomerata Strauss Ann. Wetter. Ges. **2:** 100. 1810. Telia present.

Puccinia conglomerata Schmidt & Kunze Deutsch. Schwämme **8:** 4. 1818.

Puccinia connersii Savile: see PUCCINIA PRAEGRACILIS Arth. var. CONNERSII.

***Puccinia conspicua** Mains Mycologia **25:** 408. 1933.

***Puccinia convolvuli** Cast. Obs. **1:** 16. 1842.

***Puccinia crepidis-montanae** Magn. ex E. Fischer Beitr. Krypt. Schweiz **2(2):** 212. 1904.

Puccinia cressae Lagh.: see PUCCINIA TUYUTENSIS Speg.

Puccinia cryptandri Ell. & Barth. Erythea **5:** 47. 1897 var. *cryptandri*.

Uromyces simulans Pk. Bot. Gaz. **4:** 127. 1897. Based on uredia.

Puccinia simulans (Pk.) Barth. No. Am. Ured. No. 32. 1922.

Puccinia cryptandri Ell. & Barth. var. **luxurians** (Arth.) Cumm. & Greene Brittonia **13:** 274. 1961.

Puccinia tosta luxurians Arth. Bull. Torrey Bot. Club **29:** 229. 1902.

Puccinia luxuriosa Syd. Monogr. Ured. **1:** 812. 1904.

***Puccinia cyani** Pass. in Rabh. Fungi Europ. No. 1767. 1874.

***Puccinia cyperi-tagetiformis** Kern Mycologia **11:** 138. 1919.

Puccinia dactylidis Gäum.: see PUCCINIA GRAMINIS Pers.

Puccinia deschampsiae Arth. Bull. Torrey Bot. Club **37:** 570. 1910.

Puccinia airae Mayor & Cruch. in Cruchet Bull. Soc. Vaud. Sci. **51:** 628. 1917.

Puccinia poae-sudeticae var. *airae* Arth. Manual Rusts U. S. and Canada p. 151. 1934.

Puccinia dietelii Sacc. & Syd. in Saccardo Syll. Fung. **14:** 358. 1899.

Puccinia chloridis Diet. Hedwigia **31:** 290. 1892. Not Speg. 1891.

The treatment here follows Hennen and Cummins (Mycologia **48:** 137–138. 1956). Unpublished observations made in 1961 by Cummins in Arizona indicate that the aecial stage occurs on *Acalypha ostryaefolia* Riddell and that the aeciospores have uniformly thin walls.

Puccinia dioicae P. Magn. Amt. Ber. 50 Versammt. D. Naturf. Ärzte München p. 199. 1877.

Puccinia extensicola Plowr. Brit. Ured. Ustil. p. 181. 1889.

This treatment follows Hylander, Jørstad, and Nannfeldt (Opera. Bot. **1:** 48. 1953).

Puccinia dolosa Arth. & Fromme Torreya **15:** 262. 1915.

On *Paspalum plicatulum* Michx.: Texas.

Puccinia dondiae Arth.: see PUCCINIA GLOBOSIPES Pk.

Puccinia dracunculi Fahrendorf Ann. Mycol. **39:** 181. 1941.

On *Artemisia dracunculoides* Pursh. Segregated from *Puccinia tanaceti* DC. (*P. absinthii* DC.).

Puccinia echeveriae Linder Mycologia **30:** 667. 1938.

On *Echeveria caespitosa* (Haw.) DC., *E. farinosa* Lindl.: California.

Puccinia elymi West. Bull. Acad. Roy. Belge **18(2):** 409. 1851.

Cummins and Caldwell (Phytopathology **46:** 81–82. 1956) believe this is distinct from the *Puccinia recondita* complex because of its multicellular teliospores.

Puccinia epicampis Arth.: see PUCCINIA SCHEDONNARDI Kell. & Swing.

Puccinia esclavensis Diet. & Holw. in Holway Bot. Gaz. **24:** 29. 1897.

Puccinia atra Diet. & Holw. *ibid.* **24:** 29. 1897. Not Spreng. 1827.

Aecidium mirabilis Diet. & Holw. in Holway Bot. Gaz. **24:** 37. 1897.

The relationship of *A. mirabilis* has been demonstrated by inoculation (see Cummins and Baxter, Madroño, in press).

Puccinia eumacrospora Cumm. in Cummins and Baxter, Madroño, in press.

Puccinia macrospora Arth. Mycologia **1:** 244. 1909. Not Spreng. 1827.

Puccinia exasperans Holw. Ann. Mycol. **3:** 21. 1905.

Reinstatement of this species follows Hennen and Cummins (Mycologia **48:** 140. 1956).

Puccinia extensicola Plowr.: see PUCCINIA DIOICAE P. Magn.

Puccinia farinacea Long Bull. Torrey Bot. Club **29:** 115. 1902 var. **farinacea.**

Puccinia farinacea Long var. **azurea** J. W. Baxter Lloydia **14:** 221. 1951.

***Puccinia festucae** Plowr. Grevillea **21:** 109. 1893.

Puccinia fischeri Cruch. & Mayor Bull. Soc. Vaud. Nat. **44:** 471. 1909.

Puccinia lyngei Jørst. Rept. Sci. Res. Norw. Exped. Novaya Zemlya 1921, No. 18, 1923.

On *Saxifraga oppositifolia* L.: Yukon.

Puccinia flaccida Auth. not Berk. & Br.: see PUCCINIA ABNORMIS P. Henn.

Puccinia gaillardiae (Diet. & Holw.) Arth.: see UREDO GAILLARDIAE Diet. & Holw.

Puccinia gentianae (Strauss) Roehling Deutsch. Fl. Ed. 2. **3(2):** 131. 1813.
Puccinia probabilis Arth. & Cumm. Ann. Mycol. **31:** 42. 1933. The host is *Gentiana*.
Puccinia globosipes Pk. Bull. Torrey Bot. Club **12:** 34. 1885.
Puccinia dondiae Arth. Bull. Torrey Bot. Club **42:** 592. 1915.
Puccinia grayiae (Arth.) Arth. Manual Rusts U. S. and Canada p. 282. 1934.
The hosts of *P. dondiae* and *P. grayiae* are species of *Lycium*.
Puccinia glumarum (Schmidt) Eriks. & E. Henn.: see PUCCINIA STRIIFORMIS West.
Puccinia gnaphalii (Speg.) P. Henn.: see PUCCINIA GNAPHALIICOLA P. Henn.
Puccinia gnaphaliicola P. Henn. Hedwigia **38** (Beibl.): 68. 1899.
Puccinia gnaphalii P. Henn. Hedwigia **41** (Beibl.): 66. 1902.
***Puccinia graminella** Diet. & Holw. in Dietel Erythea **3:** 80. 1895.
Puccinia graminis Pers. Syn. Meth. Fung. p. 228. 1801.
Puccinia dactylidis Gäum. Ber. Schweiz Bot. Ges. **55:** 79. 1945.
Puccinia grayiae (Arth.) Arth.: see PUCCINIA GLOBOSIPES Pk.
Puccinia grindeliae Pk. Bot. Gaz. **4:** 127. 1879.
Puccinia wentii Gäum. Ber. Schweiz Bot. Ges. **57:** 246. 1947.
Puccinia gymnandrae Tranz. Scripta Bot. Hort. Univ. Imp. Petrop. **3:** 137. 1891.
On *Lagotis glauca* Gaertn.: Alaska.
***Puccinia helianthellae** Arth. Bull. Torrey Bot. Club **31:** 4. 1904.
Puccinia helianthi Schw. Schr. Nat. Ges. Leipzig **1:** 73. 1822.
Puccinia xanthiifoliae Ell. & Ev. J. Mycol. **6:** 120. 1891.
Baxter (see Baxter and Cummins, Madroño, in press) has proved that *P. xanthiifoliae* is not distinctive.
Puccinia helicalis Savile Can. J. Bot. **37:** 981. 1959.
On *Pedicularis capitata* Adams.: Alaska, northern Canada.
Puccinia heucherae (Schw.) Diet. Ber. Deutsch. Bot. Ges. **9:** 42. 1891 var. **heucherae.**
Puccinia heucherae (Schw.) Diet. var. **austroberingiana** Savile Can. J. Bot. **32:** 407. 1954.
Puccinia heucherae (Schw.) Diet. var. **lithophragmae** (Holw.) Savile Can. J. Bot. **32:** 409. 1954.
Puccinia lithophragmae Holw. No. Am. Ured. **1:** 51. 1906.
Puccinia heucherae (Schw.) Diet. var. **saxifragae** (Schlecht.) Savile Can. J. Bot. **32:** 408. 1954.
Puccinia saxifragae Schlecht. Fl. Berol. **2:** 134. 1824.
***Puccinia hieracii** (Roehling) Mart. Prod. Fl. Mosq. Ed. 2. p. 227. 1817.
Puccinia flosculorum var. *hieracii* Roehling Deutsch. Fl. Ed. 2. III. **3:** 131. 1813.
Puccinia holboellii (Hornem.) Rostr.: see PUCCINIA THLASPEOS Schub.
Puccinia hordei Fckl.: see PUCCINIA RECONDITA Rob. ex Desm.
Puccinia hordei Otth Mitth. Nat. Ges. Bern **1870:** 114. 1871.
Puccinia anomala Rostr. in Thuemen Flora **61:** 92. 1878.
For a discussion of the nomenclature see Plant Dis. Reptr. **30:** 373. 1946.
***Puccinia hydrocotyles** Cke. Grevillea **9:** 14. 1880.
***Puccinia hyptidis** (Lagh.) Tracy & Earle Bull. Miss. Agr. Exp. Sta. **34:** 86. 1895.
Gymnoconia hyptidis Lagh. Tromsø Mus. Aarsh. **17:** 83. 1895.
Puccinia hyptidis-mutabilis Mayor Mem. Soc. Neuchat. Sci. Nat. **5:** 496. 1913.
On *Hyptis mutabilis* (A. Rich.) Briq.: Florida.
Puccinia inanipes Diet. & Holw. in Holway Bot. Gaz. **31:** 332. 1901.
On *Eupatorium solidaginifolium* Gray: Arizona.
Puccinia infuscans Arth. & Holw. in Arthur Am. J. Bot. **5:** 463. 1918.
On *Bothriochloa wrightii* (Hack.) Henr.: Texas.
***Puccinia interveniens** Bethel in Blasdale Univ. Calif. Publ. Bot. **7:** 119. 1919.
Puccinia iridis Rab. Deutsch. Krypt.-Fl. **1:** 23. 1844.
Puccinia clavuligera iridis Wallr. Fl. Crypt. Germ. **2:** 223. 1883. Based on uredia.

Jørstad and Roll-Hansen (Nytt. Mag. Nat. **87**: 61–75. 1949) proved that the aecia occur on *Urtica dioica* L.

Puccinia kaernbachii (P. Henn.) Arth.: see PUCCINIA POSADENSIS Sacc. & Trott.

Puccinia karelica Tranz.: see PUCCINIA CARICINA DC. var. LIMOSAE (P. Magn.) Jørst.

Puccinia koeleriae Arth.: see PUCCINIA PYGMAEA Eriks.

Puccinia lapathicola Hylander, Jørst., & Nannf. Opera Bot. **1**: 66. 1953.

Puccinia punctiformis Diet. & Holw. in Dietel Erythea **2**: 128. 1894. Not Roehling, 1813.

***Puccinia lapsanae** Fckl. Jahr. Nass. Ver. Nat. **15**: 13. 1860.

Puccinia lateripes Berk. & Rav. in Berkeley Grevillea **3**: 52. 1874.

Puccinia ruelliae Lag. Tromsø Mus. Aarsh. **17**: 71. 1895.

Puccinia agrimoniae (Arth.) Arth. Manual Rusts U. S. and Canada p. 295. 1934.

Cummins and Baxter (Madroño, in press) report that *P. agrimoniae* was based on loose spores, probably from a dirty plant press.

Puccinia leonotidicola P. Henn. in H. Baum Kun-Samb. Exped. p. 2. 1903.

On *Leonotis nepetaefolia* (L.) R. Br.: Florida.

Puccinia leptochloae Arth. & Fromme Torreya **15**: 263. 1915.

See note under *Aecidium talini* Speg.

Puccinia liatridis (Arth. & Fromme) Bethel ex Arthur Manual Rusts U. S. and Canada p. 146. 1934.

Dicaeoma liatridis Arth. & Fromme No. Am. Flora **7**: 326. 1920. The first valid description of telia.

Aecidium arcularium Arth. Bull. Torrey Bot. Club **47**: 478. 1920.

Solheim and Cummins (Univ. Wyo. Publ. **23**: 27. 1959) have presented evidence of the relationship of *A. arcularium*,

Puccinia limosae P. Magn.: see PUCCINIA CARICINA DC. var. LIMOSAE (P. Magn.) Jørst.

Puccinia longiana Syd. Hedwigia **40**(Beibl.): 126. 1901.

On *Ruellia tuberosa* L.: Texas. Considered to be distinct from *Puccinia lateripes* Berk. & Rav.

Puccinia ludoviciana Fahrendorf Ann. Mycol. **39**: 181. 1941.

On *Artemisia ludoviciana* Nutt. Segregated from *Puccinia tanaceti* DC. (*P. absinthii* DC.)

Puccinia lupinicola Gäum.: see PUCCINIA THELYPODII Cumm.

Puccinia luxuriosa Syd.: see PUCCINIA CRYPTANDRI Ell. & Barth. var. LUXURIANS (Arth.) Cumm. & Greene.

Puccinia macrospora Arth.: see PUCCINIA EUMACROSPORA Cumm.

Puccinia maculosa Schw.: see PUCCINIA COLUMBIENSIS Ell. & Ev.

Puccinia mariae-wilsoni G. W. Clint. in Peck Bull. Buffalo Soc. Nat. Sci. **1**: 66. 1873 var. **mariae-wilsoni.**

Puccinia mariae-wilsoni G. W. Clint. var. **montiae** Savile Mycologia **48**: 574. 1956.

Puccinia melanocephala Syd.: see PUCCINIA PHYLLOSTACHYDIS Kusano.

Puccinia menthae Pers. Syn. Meth. Fung. p. 227. 1801 var. **menthae.**

Puccinia menthae Pers. var. **cordillerensis** J. W. Baxter Lloydia **22**: 244. 1959.

Puccinia monardellae Dudl. & Thomps. J. Mycol. **10**: 53. 1904.

Puccinia microspora Diet. Bot. Jahrb. **27**: 101. 1905.

On *Imperata hookeri* Rupr.: Arizona. Referred to *Puccinia kaernbachii* (= *P. posadensis* Sacc. & Trott.) in the Manual.

Puccinia mirifica Diet. & Holw. in Dietel Erythea **3**: 79. 1895.

Uromyces triannulatus Berk. & Curt. Grevillea **3**: 56. 1874. Based on uredia.

Puccinia triannulata Jacks. Mycologia **14**: 111. 1922.

Puccinia monardae J. W. Baxter Mycologia **51**: 600. 1959 (issued 1960).

On *Monarda didyma* L.: Pennsylvania, West Virginia.

Puccinia neocoronata Greene & Cumm. Mycologia **50**: 25. 1958.

On *Piptochaetium fimbriatum* (H. B. K.) Hitchc., *Stipa pringlei* Scribn.: Arizona.

Puccinia nephrophyllidii Mains: see PUCCINIA AREOLATA Diet. & Holw.

Puccinia novae-zembliae Jørst. Rept. Sci. Res. Norw. Exped. Nov. Zemlya **18:** 6. 1923.

Puccinia campanulae novae-zembliae (Jørst.) Arth. Manual Rusts U. S. and Canada p. 262. 1934.

Puccinia obtegens (Lk.) Tul.: see PUCCINIA PUNCTIFORMIS (Strauss) Roehling.

***Puccinia oxalidis** Diet. & Ell. in Dietel Hedwigia **34:** 291. 1895.

Puccinia pagana Arth. Bull. Torrey Bot. Club **38:** 372. 1911.

The host is *Lloydia serotina* (L.) Reichb., not *Allium*. See Cummins and Baxter (Madroño, in press).

Puccinia pallidissima Speg. An. Soc. Cien. Argent. **12:** 69. 1881.

On *Stachys coccinea* Jacq.: Arizona, Texas.

Puccinia paroselae Cumm. Bull. Torrey Bot. Club **68:** 44. 1941.

On *Parosela mollis* (Benth.) Heller: California.

Puccinia parthenii Arth. Bull. Torrey Bot. Club **37:** 570. 1910.

Not known north of Mexico.

Puccinia partheniicola Jacks. Mycologia **24:** 166. 1932.

On *Parthenium incanum* H. B. K.: Texas. Segregated from *P. parthenii* Arth.

Puccinia paspalicola (P. Henn.) Arth.: see PUCCINIA SUBSTRIATA Ell. & Barth. and PHYSOPELLA COMPRESSA (Mains) Cumm. & Ramachar.

Puccinia pazschkei Diet. var. **heterisiae** (Jacks.) Savile Can. J. Bot. **32:** 410. 1954.

Puccinia heterisiae Jacks. in Arthur Bull. Torrey Bot. Club **47:** 471. 1920.

Puccinia pazschkei Diet. var. **jueliana** (Diet.) Savile Can. J. Bot. **32:** 411. 1954.

Puccinia jueliana Diet. Hedwigia **36:** 298. 1897.

Puccinia pazschkei Diet. var. **oppositifoliae** Savile Can. J. Bot. **32:** 413. 1954.

On *Saxifraga oppositifolia* L.: Quebec.

Puccinia pazschkei Diet. var. **tricuspidatae** Savile Can. J. Bot. **32:** 413. 1954.

Puccinia turrita Arth. & Jacks. in Arthur Bull. Torrey Bot. Club **29:** 230. 1902.

Puccinia penniseti Zimm.

On *Pennisetum glaucum* (L.) R. Br.: Georgia. This fungus, reported in Plant Dis. Reptr. **38:** 511. 1954, is considered to be *Puccinia chaetochloae* Arth.

Puccinia peridermiospora (Ell. & Tracy) Arth.: see PUCCINIA SPARGANIOIDES Ell. & Barth.

Puccinia phyllostachydis Kusano Bull. Agr. Coll. Tokyo **8:** 38. 1908.

Puccinia melanocephala Auth. not Sydow.

***Puccinia pimpinellae** (Strauss) Roehling Deutsch. Fl. Ed. 2. III. **3:** 131. 1913.

Puccinia plucheae (Syd.) Arth.: PUCCINIA BIOCELLATA Vest.

Puccinia poae-nemoralis Otth Mitth. Naturf. Bern **1870:** 113. 1871.

Puccinia poae-sudeticae (West). Jørst.: see PUCCINIA POAE-NEMORALIS Otth.

Puccinia poae-sudeticae Jørst. var. *airae* (Lagh.) Arth.: see PUCCINIA DESCHAMPSIAE Arth.

Puccinia porri (Sow.) Wint.: see PUCCINIA ALLII Rud.

Puccinia posadensis Sacc. & Trott. in Sacc. Syll. Fung. **21:** 691. 1912.

Puccinia kaernbachii Arth. Bull. Torrey Bot. Club **46:** 110. 1919.

See also *Puccinia microspora*.

Puccinia praegracilis Arth. Bull. Torrey Bot. Club **34:** 585. 1907 var. **praegracilis**.

Aecidium graebnerianum P. Henn. Hedwigia **37:** 273. 1898.

This fungus was removed from the synonymy of *Puccinia coronata* Cda. The host of the type is *Agrostis thurberiana* Hitchc.

Puccinia praegracilis Arth. var. **connersii** (Savile) Savile Mycologia **43:** 458. 1951.

Puccinia connersii Savile Mycologia **42:** 665. 1950.

On *Habenaria dilatata* A. Gray, *Deschampsia atropurpurea* (Wahl.) Scheel.: British Columbia.

Puccinia praegracilis Arth. var. **cabotiana** Savile Can. J. Bot. **35:** 199. 1957.
On *Hierochloa odorata* (L.) Beauv.: Nova Scotia.

Puccinia probabilis Arth. & Cumm.: see PUCCINIA GENTIANAE (Strauss) Roehling.

Puccinia procera Diet. & Holw.: see PUCCINIA RECONDITA Rob. ex Desm.

***Puccinia proserpinacae** Farl. Proc. Am. Acad. **18:** 80. 1883.

Puccinia prosopidis Bieberdorf, Meffer, & Blackmon: see RAVENELIA HOLWAYI Diet.

Puccinia ptarmicae Karst. Bidr. Känned. Finl. Nat. Folk. **31:** 41. 1879.
On *Achillea ptarmica* L.: Quebec.

Puccinia pulverulenta Grev. Fl. Edinb. p. 432. 1824.
Puccinia vagans Arth. Manual Rusts U. S. and Canada p. 313. 1934.

Puccinia punctiformis (Strauss) Roehling Deutsch. Fl. Ed. 2. III. **3:** 132. 1813.
Uredo punctiformis Strauss Ann. Wett. Ges. **2:** 103. 1810. Telia present.
Puccinia obtegens Tul. Ann. Sci. Nat. IV. **2:** 87. 1854.

Puccinia punctiformis Diet. & Holw.: see PUCCINIA LAPATHICOLA Hylander, Jørst., & Nannfeldt.

Puccinia puritanica Cumm. Bull. Torrey Bot. Club **68:** 45. 1941.
On *Carex pennsylvanica* Lam.: Massachusetts, Wisconsin.

Puccinia pygmaea Eriks. Fungi Paras. Scand. No. 449. 1895.
Puccinia koeleriae Arth. Mycologia **1:** 247. 1909.
See also *Puccinia ammophilinae* Mains.

Puccinia ranunculi Blytt: see PUCCINIA BLYTTIANA Lagh.

Puccinia recondita Rob. ex Desm. Bull. Soc. Bot. Fr. **4:** 798. 1857.
Puccinia hordei Fckl. Jahrb. Nass. Ver. Nat. **27–28:** 16. 1873. Not Otth, 1871.
Puccinia rubigo-vera Wint. Rabh. Krypt.-Fl. **1:** 217. 1881.
Puccinia procera Diet. & Holw. in Dietel Erythea **1:** 249. 1893.
Puccinia cockerelliana Bethel ex Arthur Bull. Torrey Bot. Club **46:** 113. 1919.
Puccinia hordei-murini Buchw. Ann. Mycol. **41:** 308. 1943.
Puccinia bromi-maximi Guyot Uredineana **2:** 50. 1946.
Puccinia bromicola Guyot Uredineana **2:** 52. 1946.
See Cummins & Caldwell (Phytopathology **46:** 81–82. 1956) for a discussion of the nomenclature of this species. See also *Puccina elymi* West. and *Puccinia tomipara* Trel. It is doubtful if the varieties set up by Arthur in the Manual are tenable on morphological grounds.

Puccinia redfieldiae Tracy J. Mycol. **7:** 281. 1893.
Aecidium anograe Arth. Bull. Torrey Bot. Club **28:** 664. 1901.
Solheim & Cummins (Univ. Wyo. Publ. **23:** 35. 1959) proved the relationship of the aecial stage.

Puccinia ripulae Mains Bull. Torrey Bot. Club **66:** 620. 1939.
On *Baccharis glutinosa* Pers.: Texas.

Puccinia rubigo-vera (Wint.) DC.: see PUCCINIA RECONDITA Rob. ex Desm.

Puccinia ruelliae (Berk. & Rav.) Lagh.: see PUCCINIA LATERIPES Berk. & Rav.

Puccinia scaber (Ell. & Ev.) Barth. see PUCCINIA SUBSTERILIS Ell. & Ev.

Puccinia seriphidii Fahrendorf Ann. Mycol. **39:** 182. 1941.
On *Artemisia tridentata* Nutt. Segregated from *Puccinia tanaceti* DC. (*P. absinthii* DC.).

Puccinia simulans (Pk.) Arth.: see PUCCINIA CRYPTANDRI Ell. & Barth. var. CRYPTANDRI.

Puccinia smilacis Schw. Schr. Nat. Ges. Leipzig **1:** 72. 1822.
Aecidium apocyni Schw. *ibid.* **1:** 68. 1822.
The relationship of the aecial stage was proved by Cummins (Mycologia **27:** 320. 1935).

Puccinia solheimii Cumm. Ann. Mycol. **38:** 338. 1940.
On *Dodecatheon pauciflorum* (Durand) Greene: Wyoming.

Puccinia sparganioides Ell. & Barth. Erythea **4:** 2. 1896.
Puccinia peridermiospora Arth. Science II. **10:** 565. 1899.
Puccinia sphaeralceae Gäum.: see PUCCINIA SPHAERALCEOIDES Cumm.
Puccinia sphaeralceoides Cumm. Bull. Torrey Bot. Club **79:** 224. 1952.
Puccinia sphaeralceae Gäum. Ber. Schweiz Bot. Ges. **57:** 249. 1947.
On *Iliamna rivularis* (Dougl.) Wiggins, *Sphaeralcea ambigua* Gray, *S. orcuttii* Rose: California, Idaho.
Puccinia sphaeromeriae Fahrendorf Ann. Mycol. **39:** 182. 1941.
On *Sphaeromeria capitata* Nutt. Segregated from *Puccinia tanaceti* DC. (*P. absinthii* DC.).
Puccinia sporoboli Arth. Bull. Iowa Agr. Coll. Dept. Bot. **1884:** 159. 1884. var. **sporoboli.**
Puccinia sporoboli Arth. var. **robusta** Cumm. & Greene Brittonia **13:** 272. 1961.
Aecidium yuccae Arth. Bull. Torrey Bot. Club **49:** 194. 1922.
On *Leucocrinum montanum* Nutt., *Smilacina stellata* Desf., *Yucca glauca* Nutt., *Calamovilfa gigantea* Nutt., *C. longifolia* (Hook.) Scribn., *Sporobolus asper* (Michx.) Kunth. For further detail see Cummins and Greene (l. c.); see also *Puccinia amphigena.*
Puccinia stakmanii Presley: see PUCCINIA CACABATA Arth. & Holw.
Puccinia stenotaphri Cumm. Bull. Torrey Bot. Club **87:** 40. 1960.
On *Stenotaphrum secundatum* (Walt.) Kuntze: Florida.
Puccinia stipae Arth. Bull. Iowa Agr. Coll. Dept. Bot. **1884:** 160. 1884 var. **stipae.**
Greene and Cummins (Mycologia **50:** 18. 1958) set up this variety as required by the International Code.
Puccinia striiformis West. Bull. Soc. Roy. Acad. Belge **21(2):** 235. 1854.
Puccinia glumarum Eriks. & E. Henn. K. Landtbr.-Akad. Handl. o Tidskr. **33:** 169. 1894. Zeit. Pflanzenkr. **4:** 197. 1894.
This treatment follows Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 75. 1953).
Puccinia substerilis Ell. & Ev. Bull. Torrey Bot. Club **22:** 58. 1895. var. **substerilis.**
Uromyces scaber Ell. & Ev. J. Mycol. **6:** 119. 1891. Based on uredia.
Puccinia scaber (Ell. & Ev.) Barth. No. Am. Ured. No. 2560. 1922.
Puccinia substerilis Ell. & Ev. var. **scribneri** Greene & Cumm. Mycologia **50:** 16. 1958.
On *Stipa scribneri* Vasey: Colorado, New Mexico.
Puccinia substerilis Ell. & Ev. var. **oryzopsidis** Greene & Cumm. Mycologia **50:** 16. 1958.
On *Oryzopsis hymenoides* (Roem. & Schult.) Ricker, *Stipa arida* Jones: Wyoming to Oregon, south to New Mexico and California.
Puccinia substriata Ell. & Barth. Erythea **5:** 47. 1897.
Puccinia paspalicola Arth. Manual Rusts U. S. and Canada p. 127. 1934 (in part).
See also *Physopella compressa* (Mains) Cumm. & Ramachar; for a discussion of the species see Mycologia **34:** 683–686. 1942.
Puccinia tanaceti DC. Fl. Fr. **2:** 222. 1805.
Puccinia absinthii DC. Fl. Fr. **5:** 56. 1815.
This is the treatment proposed by Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 75. 1953). See also *Puccinia dracunculi* Fahrendorf, *P. seriphydii* Fahrendorf, and *P. sphaeromeriae* Fahrendorf.
***Puccinia tenuis** Burr. Bot. Gaz. **9:** 188. 1884.
Puccinia thaliae Diet. Hedwigia **38:** 250. 1899.
Puccinia cannae P. Henn. Hedwigia **41:** 105. 1902.
On *Canna indica* L., *Thalia geniculata* L.: Florida, Texas.

Puccinia thelypodii Cumm. Mycologia **31:** 170. 1939.

Puccinia lupinicola Gäum. Ber. Schweiz Bot. Ges. **57:** 247. 1947.

On *Thelypodium lasiophyllum* (H. & A.) Greene: California. The host of *P. lupinicola* appears to be *T. lasiophyllum* rather than *Lupinus*.

Puccinia thlaspeos Schub. in Fic. Fl. Dresd. **2:** 254. 1823.

Puccinia holboellii (Hornem.) Rostr. Medd. Groen. **3:** 534. 1888.

This treatment follows Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 76. 1953).

Puccinia tomipara Trel. Wis. Acad. Sci. **6:** 127. 1885.

Segregated from the synonymy of *Puccinia recondita* Rob. ex Desm. (*P. rubigo-vera*) because of its muriformly multicellular teliospores.

Puccinia triannulata (Berk. & Curt.) Jacks.: see PUCCINIA MIRIFICA Diet. & Holw.

Puccinia turrita Arth.: see PUCCINIA PAZSCHKEI Diet. var. TRICUSPIDATAE Savile.

Puccinia tuyutensis Speg. An. Soc. Cien. Argent. **12:** 70. 1881.

Puccinia cressae Lagh. Bol. Soc. Brot. **7:** 131. 1889.

Lindquist (Bol. Soc. Argent. Bot. **5:** 35–36. 1953) states that the host of *P. tuyutensis* is *Cressa*, not *Convolvulus*.

Puccinia uliginosa Juel: see PUCCINIA CARICINA DC. var. ULIGINOSA (Juel) Jørst.

Puccinia vagans (DC.) Arth.: see PUCCINIA PULVERULENTA Grev.

***Puccinia veratri** Duby Bot. Gall. **2:** 890. 1830.

Puccinia versicolor Diet. & Holw. in Holway Bot. Gaz. **24:** 28. 1897.

On *Heteropogon contortus* (L.) Beauv.: Texas.

Puccinia vesciculosa Schlecht. ex Ehr. in Nees v. Essenbeck Horae Phys. Berolin. p. 97. 1820.

On *Anemone narcissiflora* L. var. *villosissima* DC.: Unalaska.

Puccinia vexans Farl. Proc. Am. Acad. Sci. **18:** 82. 1883.

Aecidium cannonii Griff. Bull. Torrey Bot. Club **34:** 210. 1907.

Solheim and Cummins (Univ. Wyo. Publ. **23:** 37. 1959) proved the relationship of *A. cannonii* to *P. vexans*.

***Puccinia vincae** Berk. in Smith Engl. Fl. V. **2:** 364. 1836.

Puccinia virgae-aureae (DC.) Lib. Pl. Crypt. Arduenn. IV. No. 393. 1837.

The specific name is often erroneously spelled *virgaureae*.

Puccinia wentii Gäum.: see PUCCINIA GRINDELIAE Pk.

Puccinia xanthiifoliae Ell. & Ev.: see PUCCINIA HELIANTHI Schw.

Puccinia zexmeniae Diet. & Holw. in Holway Bot. Gaz. **24:** 26. 1897.

On *Zexmenia podocephala* Gray.: Arizona.

Pucciniastrum agrimoniae (Diet.) Tranz. Scripta Bot. Hort. Univ. Imp. Petrop. **4:** 301. 1895.

Thekopsora agrimoniae Diet. Hedwigia **29:** 153. 1890. Telia first described.

Pucciniastrum alaskanum Mains: see UREDO ALASKANA (Mains) Cumm.

***Pucciniastrum arcticum** Tranz. Scripta Bot. Hort. Univ. Imp. Petrop. **4:** 300. 1895.

Pucciniastrum epilobii Otth Mitth. Naturf. Ges. Bern **1861:** 72 & 74. 1861.

Pucciniastrum pustulatum Diet. in Engler and Prantl Nat. Pfl. **1**:** 47. 1897.

Pucciniastrum ericae (Naumann) Cumm. see UREDO ERICAE Naumann.

Pucciniastrum galii (Lk.) E. Fisch.: see PUCCINIASTRUM GUTTATUM (Schroet.) Hylander, Jørst., & Nannfeldt.

Pucciniastrum goodyerae (Tranz.) Arth.: see UREDO GOODYERAE Tranz.

Pucciniastrum guttatum (Schroet.) Hylander, Jørst. & Nannfeldt. Opera Bot. **1:** 81. 1953.

Melampsora guttata Schroet. Abh. Schles. Ges. Vaterl. Cult. Nat. Abth. **1869–1872:** 26. 1870.

Pucciniastrum galii E. Fischer Beitr. Krypt.-Fl. Schweiz **2(2):** 471. 1904.

***Pucciniastrum hydrangeae** (Magn.) Arth. Rés. Sci. Congr. Bot. Vienne p. 337. 1906.

Pucciniastrum myrtilli (Schum.) Arth.: see PUCCINIASTRUM VACCINII (Wint.) Jørst.

Pucciniastrum pustulatum (Pers.) Diet.: see PUCCINIASTRUM EPILOBII Otth.

***Pucciniastrum pyrolae** Diet. ex Arthur No. Am. Flora **7:** 108. 1907.
Earlier names were based on uredia.

Pucciniastrum vaccinii (Wint.) Jørst. Skr. Vidensk.-Akad. Oslo I. **1951(2):** 55. 1952.
Melampsora vaccinii Wint. Hedwigia **19:** 56. 1880 (telia not described); Rabh. Krypt.-Fl. Ed. 2. I. **1:** 224. 1882.
Pucciniastrum myrtilli Arth. Rés. Sci. Congr. Bot. Vienne p. 337. 1906. (Telia not described); No. Am. Flora **7:** 109. 1907.

Ravenelia dysocarpi Long & Goodding Mycologia **31:** 670. 1939.
On *Mimosa dysocarpa* Benth.: Arizona.

Ravenelia hoffmanseggiae Long: see UREDO HOFFMANSEGGIAE (Long) Cumm.

Ravenelia holwayi Diet. Hedwigia **33:** 61. 1894.
Puccinia prosopodis Bierberdorf, Meffer, & Blackmon Bull. Torrey Bot. Club **82:** 131. 1955.

Ravenelia humphreyana P. Henn. Hedwigia **37:** 278. 1898.
On *Poinciana pulcherrima* L.: Florida, Texas.

Ravenelia siliquae Long: see RAVENELIA SPEGAZZINIANA Lindq.

Ravenelia spegazziniana Lindq. Bol. Soc. Argent. Bot. **1:** 300. 1946.
Ravenelia siliquae Long Bot. Gaz. **35:** 118. 1903. Based on uredia.

***Ravenelia versatilis** Diet. Hedwigia **33:** 64. 1894.
Uromyces versatilis Pk. Bot. Gaz. **7:** 56. 1882. Based on uredia.

Scopella sapotae Mains ex Cumm. Mycologia **48:** 607. 1956.
Scopella sapotae Mains Ann. Mycol. **37:** 59. 1939. Latin diagnosis not provided.
On *Achras sapota* L.: Florida.

Sphenospora kevorkianii Linder Mycologia **36:** 464. 1944.
On *Epidendron tampense* Lindl.: Florida.

Sphenospora mera Cumm. Bull. Torrey Bot. Club. **72:** 214. 1945.
On *Catasetum* sp., *Bletia verecunda* Ait., *B. hyacinthina* Ait.: Florida.

Sphenospora saphena Cumm. Bull. Torrey Bot. Club **87:** 40. 1960.
On *Oncidium tetrapetalum* Willd.: Florida.

Trachyspora intrusa (Grev.) Arth. Manual Rusts U. S. and Canada p. 97. 1934.
Uredo intrusa Grev. Fl. Edinb. p. 436. 1824. Telia described.

Tranzschelia anemones (Pers.) Nannf. in Lundell and Nannfeldt Fungi Exs. Suec. No. 839a. 1939.
Puccinia anemones Pers. Syn. Meth. Fung. p. 226. 1801.
Tranzschelia fusca Diet. Ann. Mycol. **20:** 31. 1922.
Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 84. 1953) place *T. suffusca* (Holw.) Arth. and *T. thalictri* (Chev.) Diet. in synonymy with *T. anemones.*

Tranzschelia arthuri Tranz. & Litv. J. de Bot. **24:** 250. 1939.
On *Prunus serotina* (Ehrh.) Ag.: North America. Segregated from *T. pruni-spinosae* (Pers.) Diet.

Tranzschelia discolor (Fckl.) Tranz. & Litv. J. de Bot. **24:** 248. 1939.
Tranzschelia pruni-spinosae (Pers.) Diet. var. *discolor* Dunegan Phytopathology **28:** 424. 1938.
On *Prunus* spp. (cultivated): throughout the world. Segregated from *T. pruni-spinosae.*

Tranzschelia pruni-spinosae (Pers.) Diet. var. **pruni-spinosae.**
Tranzschelia pruni-spinosae (Pers.) Diet. var. *typica* (E. Fisch.) Dunegan.
This varietal designation is required by the Code.

Tranzschelia suffusca (Holw.) Arth. Manual Rusts U. S. and Canada p. 73. 1934.
See also *T. anemones* (Pers.) Nannf. above.

Tranzschelia thalictri (Chev.) Diet. Ann. Mycol. **20:** 31. 1922.
See also *T. anemones* (Pers.) Nannf. above.

***Triphragmium ulmariae** (Hedw. f. ex DC.) Lk. in Willd. Sp. Plant. **6(2):** 84. 1825.

Puccinia ulmariae Hedw. f. ex DC. in Poir. in Lam. Encyc. Meth. Bot. **8:** 245. 1808.

Uraecium lucumae (Arth. & J. R. Johnston) Arth.: see ACHROTELIUM LUCUMAE Cumm.

Uredinopsis.

This genus was completely reworked by Faull (Contr. Arnold Arb. No. 11. 120 pp. 1938). For details not given below, see Faull's monograph.

Uredinopsis americana Syd. Ann. Mycol. **1:** 325. 1903.

Septoria mirabilis Pk. Ann. Rept. N. Y. State Mus. **25:** 87. 1873. Based on uredia.

Uredinopsis mirabilis Magn. Hedwigia **43:** 121. 1904.

Segregated from *U. mirabilis* of the Manual.

Uredinopsis arthuri Faull Contr. Arnold Arb. **11:** 101–102. 1938 var. **arthuri.**

On *Woodwardia virginica* (L.) Sm. Segregated from *U. struthiopteridis* of the Manual.

Uredinopsis arthuri Faull var. **maculata** Faull Contr. Arnold Arb. **11:** 103–104. 1938.

On *Woodwardia areolata* (L.) Moore. Segregated from *U. mirabilis* of the Manual.

Uredinopsis aspera Faull: see UREDINOPSIS HASHIOKAE Hirat. f.

Uredinopsis atkinsonii Magn. Hedwigia **43:** 123. 1904.

On *Abies balsamea* (L.) Mill., *Dryopteris thelypteris* (L.) Gray var. *pubescens* (Lawson) A. R. Prince: Reinstated from *U. struthiopteridis* of the Manual.

Uredinopsis ceratophora Faull Contr. Arnold Arb. **11:** 52–53. 1938.

On *Abies balsamea* (L.) Mill., *Cystopteris bulbifera* (L.) Bernh.: Indiana, New York, Wisconsin, Ontario. Segregated from *U. struthiopteridis* of the Manual.

Uredinopsis copelandii Syd. Ann. Mycol. **2:** 30. 1904.

On *Athyrium cyclosorum* Rupr.: California. Reinstated from *U. struthiopteridis* of the Manual.

Uredinopsis glabra Faull Contr. Arnold Arb. **11:** 55–56. 1938.

On *Cheilanthes pyramidalis* Fée, *Cystopteris fragilis* (L.) Bernh., *Pellaea cordata* (Cav.) J. Sm.: Arizona, New Mexico.

Uredinopsis hashiokai Hirat. f. Mem. Tottori Agr. Coll. **4:** 82. 1936.

Uredinopsis aspera Faull Contr. Arnold Arb. **11:** 79. 1938.

On *Abies grandis* (Dougl.) Lindl., *Pteridium aquilinum* (L.) Kuehn var. *lanuginosum* (Bong.) Fern.: British Columbia. The aecia are morphologically like *Peridermium pseudobalsameum* (Diet. & Holw.) Arth. & Kern, but see also *U. pteridis*. For additional detail see Ziller (Can. J. Bot. **37:** 93–107. 1959).

Uredinopsis investita Faull: see UREDO INVESTITA (Faull) Cumm.

Uredinopsis longimucronata Faull Contr. Arnold Arb. **11:** 44. 1938 var. **longimucronata.**

This varietal designation is required by the Code. The species is a segregate from *U. struthiopteridis* of the Manual.

Uredinopsis longimucronata Faull var. **acrostichoides** Faull Contr. Arnold Arb. **11:** 50. 1938.

On *Athyrium thelypteroides* (Michx.) Desv.: New Hampshire, New York, Wisconsin.

Uredinopsis macrosperma (Cke.) Magn.: see UREDINOPSIS PTERIDIS Diet. & Holw.

Uredinopsis mirabilis (Pk.) Magn.: see UREDINOPSIS AMERICANA Syd.

Uredinopsis pteridis Diet. & Holw. in Dietel Ber. Deutsch. Bot. Ges. **13:** 331. 1895.

Uredinopsis macrosperma Magn. Hedwigia **43:** 122. 1904.

Ziller (Can. J. Bot. **37:** 93–107. 1959) reports the aecia are morphologically like *Peridermium pseudobalsameum* (Diet. & Holw.) Arth. & Kern and also those of *U. hashiokai*. See also *U. virginiana*.

Uredinopsis struthiopteridis Stoermer ex Diet. Ber. Deutsch. Bot. Ges. **13:** 331. 1895.
Uredinopsis struthiopteridis Stoermer Bot. Notiser **1895:** 81. 1895. Telia not described.
See also *U. arthuri, U. atkinsonii, U. ceratophora, U. longimucronata.*

Uredinopsis virginiana Faull Contr. Arnold Arb. **11:** 92. 1938.
On *Pteridium aquilinum* (L.) Kuehn var. *pseudocaudatum* Clute: Eastern and Central U. S. Segregated from *U. macrosperma* (Cke.) Magn. (*U. pteridis*) of the Manual.

Uredo adenocaulonis (Jacks.) Cumm. Mycologia **48:** 607. 1956.
Coleosporium adenocaulonis Jacks. Brooklyn Bot. Gard. Mem. **1:** 202. 1918. Based on uredia.

Uredo alaskanum (Mains) Cumm. Mycologia **48:** 607. 1956.
Pucciniastrum alaskanum Mains Bull. Torrey Bot. Club **66:** 620. 1939. Based on uredia.
On *Gentiana glauca* Pall.: Alaska.

Uredo arida (Jacks. in Arth.) Cumm. see COLEOSPORIUM EUPATORII Arth. ex Cumm.

Uredo cherimoliae Lagh.: see PHAKOPSORA CHERIMOLIAE Cumm.

Uredo egenula Arth. Bull. Torrey Bot. Club **45:** 155. 1918.
On *Sporobolus argutus* (Nees) Kunth.: Texas.

Uredo epidendri P. Henn. Hedwigia **35:** 254. 1896.
On *Oncidium lieboldii* Reichb.: Florida.

Uredo ericae Naumann Jahresb. Vereinig. Angew. Bot. **9:** 207. 1912.
On *Erica hyemalis* Nichols: California.

Uredo ficina Juel Bih. Sv. Vet. Akad. Handl. **23(3):** 25. 1897.
Segregated from *Cerotelium fici* (Butl.) Arth. as distinct.

Uredo gaillardiae Diet. & Holw. in Dietel Erythea **7:** 98. 1899.
Puccinia gaillardiae (Diet. & Holw.) Barth. Handbook No. Am. Ured. Ed. 1. p. 115. 1928. Based on uredia; telia still unknown.

Uredo goodyerae Tranz. Trudi St. Petersb. Obschch. Est. Otd. Bot. **23:** 28. 1893.
Pucciniastrum goodyerae (Tranz.) Arth. No. Am. Flora **7:** 105. 1907. Based on uredia; telia still unknown.

Uredo guacae Mayor Mem. Soc. Neuchat. Sci. Nat. **5:** 583. 1913.
On *Epidendrum nocturum* Jacq., *E. tampense* Lindl.: Florida.

Uredo guaynabensis Kern & Whet. Mycologia **18:** 41. 1926.
On *Jussiaea peruviana* L.: Florida.

Uredo hoffmanseggiae (Long) Cumm. Mycologia **48:** 608. 1956.
Ravenelia hoffmanseggiae Long Bot. Gaz. **64:** 57. 1917. Based on uredia; telia still unknown.

Uredo hypoxidis P. Henn. Hedwigia **40** (Beibl.): 173. 1901.
Segregated from *Uromyces affinis* Wint. of the Manual.

Uredo investita (Faull) Cumm. Mycologia **48:** 608. 1956.
Uredinopsis investita Faull Contr. Arnold Arb. **11:** 35. 1938. Based on uredia; telia still unknown.

Uredo laeticolor Arth. Bull. Torrey Bot. Club **47:** 473. 1920.
On *Ipomoea dissecta* Jacq.: Florida.

Uredo lucumae Arth. & J. R. Johnston: see ACHROTELIUM LUCUMAE Cumm.

Uredo mckinleyensis Cumm. Bull. Torrey Bot. Club **79:** 231. 1952.
On *Salix reticulata* L. var. *gigantifolia* Ball: Alaska.

Uredo mexicana (Arth.) Cumm. Mycologia **48:** 608. 1956.
Pileolaria mexicana Arth. No. Am. Flora **7:** 149. 1907. Based on uredia; telia still unknown.

Uredo nigropuncta P. Henn. Hedwigia **35:** 254. 1896.

On *Cyrtopodium punctatum* Lindl., *Polystachya minuta* Britt.: California, Florida.

Uredo nociviola Jacks. & Holw. in Jackson Mycologia **18:** 144. 1926.

On *Cyperus ferax* Rich.: Florida.

Uredo oncidii P. Henn. Hedwigia **41:** 15. 1902.

On *Oncidium cavendishianum* Batem.: California.

Uredo paspalicola P. Henn.: see PHYSOPELLA COMPRESSA (Mains) Cumm. & Ramachar.

Uredo piscariae (Jacks.) Cumm. Mycologia **48:** 608. 1956.

Melampsora piscariae Jacks. Brooklyn Bot. Gard. Mem. **1:** 212. 1918. Based on uredia; telia still unknown.

Uromyces affinis Wint. Hedwigia **24:** 259. 1885.

On *Hypoxis erecta* L.: Missouri. See also *Uromyces necopinus* Cumm. and *Uredo hypoxidis* P. Henn.

Uromyces alopecuri Seym.: see UROMYCES DACTYLIDIS Otth.

Uromyces americanus Speg. An. Mus. Nac. Buenos Aires **19:** 310. 1909.

On *Scirpus americanus* Pers., *S. californicus* (Mey.) Britt., *S. validus* Vahl.: Canada, U. S. A. Segregated from *U. scirpi* Burr.

Uromyces ari-triphylli (Schw.) Seeler Rhodora **44:** 174. 1942.

Puccinia ari-triphylli Schw. Trans. Am. Phil. Soc. II. **4:** 297. 1832.

Uromyces caladii Farl. in Ellis No. Am. Fungi No. 232. 1879.

Uromyces armeriae Lév. ex Kickx Fl. Flandres **2:** 73. 1867.

See also *U. limonii* (DC.) Lév. and *U. limonii-caroliniani* Savile & Conners.

Uromyces armeriae Lév. subsp. **hudsonicus** Savile & Conners Mycologia **43:** 190 1951.

On *Armeria maritima* Willd. var. *labradorica* (Wallr.) Lawrence: Canada.

Uromyces armeriae Lév. subsp. **pacificus** Savile & Conners Mycologia **43:** 191. 1951.

On *Armeria maritima* Willd.: British Columbia, California, Oregon.

***Uromyces asclepiadis** Cke. Grevillea **5:** 152. 1877.

Uromyces betae (Pers.) Tul. Ann. Sci. Nat. III. **8:** 375. 1847.

Uredo betae Pers. Syn. Meth. Fung. p. 220. 1801. Telia present.

***Uromyces bidenticola** Arth. Mycologia **9:** 71. 1917.

Uromyces caladii (Schw.) Farl.: see UROMYCES ARI-TRIPHYLLI (Schw.) Seeler.

Uromyces caryophyllinus (Schrank) Wint.: see UROMYCES DIANTHI (Pers.) Niessl.

Uromyces cestri Mont. in Gay Hist. Fis. Polit. Chile **8:** 49. 1852.

Uromyces cestri Lév. Ann. Sci. Nat. III. **8:** 371. 1847. *Nomen nudum.*

On *Cestrum diurnum* L.: Florida.

Uromyces chenopodii (Duby) Schroet.: see UROMYCES GIGANTEUS Speg.

***Uromyces claytoniae** Cke. & Pk. in Peck Ann. Rept. N. Y. State Mus. **29:** 50. 1878.

Has been cited in error as *U. claytoniae* G. W. Clint. & Pk.

Uromyces coluteae Arth. Bull. Torrey Bot. Club **37:** 574. 1910.

Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 93. 1953) treat this as part of the collective species *U. pisi* (DC.) Otth.

***Uromyces commelinae** Cke. Trans. Roy. Soc. Edinb. **31:** 342. 1888.

Uromyces dactylidis Otth. Mitth. Nat. Ges. Bern **1861:** 85. 1861.

Uromyces alopecuri Seym. Proc. Boston Soc. Nat. Hist. **24:** 186. 1889.

Uromyces dianthi (Pers.) Niessl Verh. Naturf. Ver. Brünn **10:** 162. 1872.

Uredo dianthi Pers. Syn. Meth. Fung. p. 222. 1801. Contains telia.

Uromyces caryophyllinus Wint. in Rabh. Krypt.-Fl. **1:** 149. 1881.

Uromyces dictyosperma Ell. & Ev. ex Tranzschel Ann. Mycol. **8:** 12. 1910.

Uromyces dictyosperma Ell. & Ev. No. Am. Fungi No. 2882. 1893. *Nomen nudum.*

***Uromyces elegans** Lagh. Tromsø Mus. Aarsh. **17:** 34. 1895.

Uromyces ervi West. Bull. Acad. Roy. Belg. **21(2):** 234. 1854.

On *Vicia hirsuta* (L.) S. F. Gray: Nova Scotia.

Uromyces eugentianae Cumm. Mycologia **48:** 608. 1956.
Uromyces gentianae Arth. Bot. Gaz. **16:** 227. 1891. Not Lév. 1847.
Uromyces euphorbiae Cke. & Pk. in Peck Ann. Rept. N. Y. State Mus. **25:** 90. 1873.
Uromyces proëminens Pass. in Rabh. Fungi Europ. Exsic. (Ed. nov.) No. 1795. 1874. Telia not described.
Uromyces fabae (Pers.) DBy.: see UROMYCES VICIAE-FABAE (Pers.) Schroet.
Uromyces fragilipes Tranz. Ann. Mycol. **5:** 549–550. 1907.
Uromyces jacksonii Arth. & Fromme Torreya **15:** 260. 1915.
Uromyces mysticus Arth. Bull. Torrey Bot. Club **38:** 377. 1911.
Uromyces galii-californici Linder Mycologia **30:** 668. 1938.
On *Galium californicum* Hook. & Arn.: California.
Uromyces gentianae Arth.: see UROMYCES EUGENTIANAE Cumm.
***Uromyces geranii** (DC.) Lév. Ann. Sci. Nat. Bot. III. **8:** 371. 1847.
Uredo geranii DC. in Lam. & DC. Syn. Pl. Gall. p. 247. 1806. Telia present.
Uromyces giganteus Speg. Dec. Mycol. Ital. No. 30. 1879.
Uromyces chenopodii Schroet. in Kunze Fungi Sel. No. 214. 1880.
***Uromyces glycyrrhizae** Magn. Ber. Deutsch. Bot. Ges. **8:** 383. 1890.
***Uromyces hedysari-obscuri** (DC.) Lév. in Orbigny Dict. Univ. Hist. Nat. **12:** 786. 1849.
Uromyces hellerianus Arth. Bull. Torrey Bot. Club **31:** 2. 1904.
On *Melothria pendula* L.: Florida.
***Uromyces hordeinus** (Arth.) Barth. Handbook No. Am. Ured. Ed. 1. p. 63. 1928.
***Uromyces houstoniatus** Sheldon Torreya **9:** 55. 1909.
Uromyces hyperici (Spreng.) Curt.: see UROMYCES TRIQUETRUS Cke.
Uromyces ignobilis Arth. = *U. tenuicutis* McAlp.
U. tenuicutis is not known in the area but see *Uromyces major* Arth.
Uromyces inaequialtus Lasch ex Rabh. Fungi Europ. No. 94. 1859.
Uromyces silenes Fckl. Jahr. Nass. Ver. Nat. **23–24:** 61. 1870.
Uromyces jacksonii Arth. & Fromme: see UROMYCES FRAGILIPES Tranz.
Uromyces limonii (DC.) Lév. in Orbigny Dict. Univ. Hist. Nat. **12:** 786. 1849.
See also *Uromyces armeriae* Lév. and *U. limonii-caroliniani* Savile and Conners.
Uromyces limonii-caroliniani Savile & Conners Mycologia **43:** 193. 1951.
On *Limonium carolinianum* Walt.: Canada, Mississippi. Segregated from *Uromyces limonii* (DC.) Lév.
Uromyces lineolatus (Desm.) Schroet. in Rabh. Fungi Europ. No. 2077. 1876.
Puccinia lineolata Desm. Ann. Sci. Nat. Bot. III. **11:** 273. 1849.
Uromyces scirpi Burr. Bot. Gaz. **9:** 188. 1884.
Uromyces major Arth. Bull. Torrey Bot. Club **38:** 377. 1911.
Uromyces ignobilis Arth. of the Manual.
On *Muhlenbergia reverchonii* Vasey: Texas.
Uromyces mexicanus Diet. & Holw. in Holway Bot. Gaz. **24:** 24. 1897.
On *Desmodium procumbens* (Mill.) A. S. Hitchc., *D.* sp.: Arizona, New Mexico.
Uromyces muscari (Duby) Lév. Ann. Sci. Nat. Bot. III. **8:** 371. 1847.
Uredo muscari Duby Bot. Gall. p. 1830. Based on telia.
Uredo scillarum Grev. ex Berk. in Smith Engl. Flora **5:** 376. 1836.
Uromyces scillarum (Grev. ex Berk.) Wint. in Rabh. Krypt.-Fl. **1:** 142. 1881.
This treatment follows Jørstad and Nannfeldt (Bot. Notiser **111:** 306–318. 1958).
Uromyces mysticus Arth.: see UROMYCES FRAGILIPES Tranz.
Uromyces necopinus Cumm. Bull. Torrey Bot. Club **68:** 46. 1941.
On *Hypoxis hirsuta* (L.) Cov.: Connecticut, New York. Segregated from *Uromyces affinis* Wint.
Uromyces oaxacanus Diet. & Holw. in Holway Bot. Gaz. **31:** 327. 1901.
On *Jatropha angustidens* (Torr.) Muell.-Arg.: Arizona.
Uromyces pisi (DC.) Otth Mitth. Naturf. Ges. Bern **1863:** 87. 1863.

Hylander, Jørstad, and Nannfeldt (Opera Bot. **1:** 93–95. 1953) consider *Uromyces punctatus* Schroet. and *U. striatus* Schroet. are only forms of this species.

Uromyces polygoni (Pers.) Fckl.: see UROMYCES POLYGONI-AVICULARIS (Pers.) Karst.

Uromyces polygoni-avicularis (Pers.) Karst. Bidr. Känned. Finl. Nat. Folk **4:** 12. 1879.

Puccinia polygoni-avicularis Pers. Syn. Meth. Fung. p. 227. 1801.

Uromyces polygoni-avicularis Otth Mitth. Naturf. Ges. Bern **1861:** 73. 1861. *Nomen nudum.*

Uromyces polygoni Fckl. Jahrb. Nass. Ver. Nat. **23–24:** 64. 1870. A rejected name; Art. 65(2) of the Code.

Uromyces proëminens (DC.) Pass.: see UROMYCES EUPHORBIAE Cke. & Pk.

Uromyces punctatus Schroet. Abh. Schles. Ges. Vaterl. Cult. Nat. Abth. **1869–72:** 10. 1870.

See also *Uromyces pisi* (DC.) Otth.

Uromyces pyriformis Cke.: see UROMYCES SPARGANII Cke. & Pk.

Uromyces scillarum (Grev.) Wint.: see UROMYCES MUSCARI (Duby) Lév.

Uromyces scirpi (Cast.) Burr.: see UROMYCES LINEOLATUS (Desm.) Schroet.

Uromyces silenes (Schlecht.) Fckl.: see UROMYCES INAEQUIALTUS Lasch.

***Uromyces silphii** Arth. J. Mycology **13:** 202. 1907.

Uromyces solidaginis (Sommerf.) Niessl: see UROMYCES SOMMERFELTII Hylander, Jørst., & Nannfeldt.

Uromyces sommerfeltii Hylander, Jørst., & Nannfeldt Opera Bot. **1:** 96. 1953.

Uromyces solidaginis (Sommerf.) Niessl. Verh. Naturf. Ver. Brünn **10:** 163. 1872. Not Fckl. 1860.

Uromyces sparganii Cke. & Pk. in Peck Ann. Rept. N. Y. State Mus. **26:** 77. 1874.

Uromyces pyriformis Cke. in Peck Ann. Rept. N. Y. State Mus. **29:** 69. 1878.

According to Parmelee and Savile (Mycologia **46:** 823–836. 1954) the aecia occur on *Hypericum* spp.

Uromyces spragueae Hark.: see UROMYCES UNITUS Pk. subsp. SPRAGUEAE (Hark.) Savile.

Uromyces striatus Schroet. Abh. Schles. Ges. Vaterl. Cult. Nat. Abth. **1867–72:** 11. 1870.

See also *Uromyces pisi* (DC.) Otth.

Uromyces triquetrus Cke. Proc. Portland Soc. Nat. Hist. **1:** 184. 1862.

Uromyces hyperici Curt. Cat. Pl. No. Car. p. 123. 1867.

Uromyces unitus Pk. Bull. Torrey Bot. Club **10:** 74. 1883. subsp. **unitus.**

Uromyces unitus Pk. subsp. **montanensis** Savile Mycologia **48:** 582. 1956.

On *Lewisia rediviva* Pursh: Montana.

Uromyces unitus Pk. subsp. **pacificus** Savile Mycologia **48:** 583. 1956.

On *Spraguea umbellata* Torr.: California.

Uromyces unitus Pk. subsp. **spragueae** (Hark.) Savile Mycologia **48:** 582. 1956.

Uromyces spragueae Hark. Bull. Calif. Acad. Sci. **1:** 36. 1884.

Uromyces viciae-fabae (Pers.) Schroet. Hedwigia **14:** 161. 1875.

Uredo viciae-fabae Pers. Syn. Meth. Fung. p. 221. 1801. Telia present.

Puccinia fabae Grev. Scott. Crypt. Fl. **1:** Tab. 29. 1823.

Uromyces fabae DBy. Ann. Sci. Nat. Bot. IV. **20:** 80. 1863. *Nomen nudum.*

Uropyxis affinis Arth.: see UROPYXIS PETALOSTEMONIS (Farl.) DeT.

Uropyxis daleae (Diet. & Holw.) Magn. Ber. Deutsch. Bot. Ges. **17:** 115. 1899. var. **eysenhardtiae** (Diet. & Holw.) J. W. Baxter Mycologia **51:** 216. 1959.

On *Dalea albiflora* Gray, *D. formosa* Torr., *D. frutescens* Gray, *Eysenhardtia orthocarpa* (Gray) Walt.: Arizona, Texas.

Uropyxis petalostemonis (Farl.) DeT. in Saccardo Syll. Fung. **7:** 735. 1888.

Uropyxis affinis Arth. Manual Rusts U. S. and Canada p. 76. 1934.

Baxter (Mycologia **51:** 222. 1959) treats *Uropyxis affinis* as a synonym of *U. petalostemonis* because of evidence that it is not microcyclic.

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