

BULLETIN

OF THE

TORREY BOTANICAL CLUB

AUGUST, 1906

North American species of *Peridermium**

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No descriptive account of the species of *Peridermium* found in North America has ever been published. The species have been listed by Farlow and Seymour in their Index issued fifteen years ago, † and again within the year. ‡ The pine-inhabiting forms were the subject of a paper before this association in 1896 by Underwood and Earle, § in which the forms of the eastern United States were described under three species, and three other species, not described, were said to occur in western North America. No other general survey of this part of the North American flora is at present available in any form.

There has been, and still is, great uncertainty regarding the number of valid species. The study and comparison of these species is rendered very difficult owing to the absence of detailed descriptions and figures, the original descriptions especially containing few diagnostic characters. There are also inherent difficulties due to the slight morphological differences between some of the species, and, furthermore, a full understanding of the subject cannot be expected until the microscopic examination is liberally supplemented by cultures. Although there has been no mono-

* Read before the Botanical Section of the American Association for the Advancement of Science, New Orleans meeting, January 1, 1906.

† FARLOW, W. G., & SEYMOUR, A. B. A provisional host index of the fungi of the United States. Part 3. 1891.

‡ FARLOW, W. G. Bibliographical index of North American fungi. Vol. 1, part 1. 1905.

§ UNDERWOOD, L. M., & EARLE, F. S. Notes on the pine-inhabiting species of *Peridermium*. Bull. Torrey Club 23 : 400-405. 1896.

[The BULLETIN for July 1906 (33 : 367-402) was issued 1 Au 1906.]

graphic study of the North American species up to the present time, yet there has been a steadily increasing accumulation of knowledge regarding them, well indicated in Farlow and Seymour's indexes, referred to above, in 1896 seven species being recognized, and in 1905 fifteen species.

The present paper describes twenty-seven species of *Peridermium*, ranging from Mexico to Alaska, and from the Atlantic to the Pacific coasts, and also three species not yet found in America, but which doubtless occur, as the telial forms are abundant. Some important characters are used in the diagnoses not hitherto employed for American forms, such as those derived from the presence and form of pycnia, the structure, especially the cross-section view of the peridium, and the thickness of the wall of the spores. The characters of the peridial cells and of the pycnia have been obtained by making thin vertical sections of the leaf. A piece of the leaf is allowed to soak for a few minutes in boiling hot water, then placed between pith, and sectioned with a sharp razor and steady hand.

Many recent, as well as earlier, mycologists have treated the species of *Peridermium* under *Aecidium*. But that method, it seems to us, more obscures than illuminates the subject. Both names as ordinarily used belong to form-genera. The species are all aecia (aecidia) of species belonging to telial genera, but our knowledge is yet insufficient to properly assign them. The species in the great majority of cases which have been described under the form-genus *Aecidium* are the aecia of pucciniaceous species, while the species described under *Peridermium* with scarcely an exception are the aecia of melampsoraceous species, using these terms in the Dietelian sense. The species of *Peridermium* with rare or possibly no exceptions can be distinguished from other aecial species by both host and structural characters, and there seems no good reason for submerging them under the more general form-genus *Aecidium*.

The genus *Peridermium* as here understood embraces all aecial forms possessing peridia, inhabiting the *Pinaceae* and *Gnetaceae*. By this definition those aecia on gymnospermous hosts having no peridia, usually classed under *Caeoma*, are excluded, for example, *Caeoma Laricis* belonging to the poplar and willow rust, *C.*

Abietis-canadensis Farl. on hemlock, and *C. conigenum* Pat., on pine.

Only three of the twenty-seven species have been definitely associated with telial forms. One of these, the *Peridermium Pini* of American authors, was found by Kellerman* to grow on *Campanula* producing *Coleosporium Campanulae* (Pers.) Lév.; another, *Per. Cerebrum* Peck, has been grown by Shear and the writers on oak, producing a *Cronartium*; while the third, *Per. elatinum*, shows such close morphological identity with the form in Europe proven to belong to *Melampsorella Cerastii* (Pers.) Schröt., that taken in connection with geographical distribution it seems safe to assume that the American form has the same relationship as the European. Other American forms have been somewhat confidently assigned to certain telial species, but in all cases careful study brings out so many

PROBABLE CONNECTION OF NORTH AMERICAN SPECIES OF PERIDERMIIUM WITH KNOWN TELIAL GENERA

Host of Peridermium	Pycnia	Aecia	No. Forms Recognized	No. Actually Connected	No. Forms Required	Telial Genus
<i>Pinus</i> , leaves	subep.	tongue-like	7	1	25	<i>Coleosporium</i>
<i>Pinus</i> , bark	subcort.	hemispherical †	8	1	5	<i>Cronartium</i>
<i>Abies</i>	subcut.	cylindrical	4	0	11	{ <i>Pucciniastrum</i> <i>Calyptospora</i>
<i>Tsuga</i>						
<i>Ephedra</i>	subcut.	tongue-like	2	1	2	{ <i>Melampsorella</i> <i>Melampsoridium</i>
<i>Abies</i>						
<i>Larix</i> ‡	subep.	tongue-like	6	0	8	"Chrysomyxa"
<i>Picea</i>						
<i>Pseudotsuga</i>						
Totals.			27	3	51	

uncertainties and apparent discrepancies that it seems less likely to lead to confusion if for the present such forms are described independently. That cultures are absolutely demanded before the *Peridermium* tangle can be straightened may be shown by the present uncertainty regarding the aecium of *Calyptospora*. There seems to be no reason to doubt the identity of the American and European rust commonly referred to the monotypic genus *Calyp-*

* Jour. Myc. 11: 32. 1905.

† An exception in case of *Per. filamentosum*, which is cylindrical.

‡ No *Peridermium* yet found in North America on *Larix*, but it is assumed to occur.

tospora, so abundant and conspicuous on *Vaccinium*, in this country extending from the Atlantic to the Pacific coasts. Twenty years ago, in 1885-6, Julius Kühn* sowed the spores of this rust upon European spruces in the experimental garden of the University of Halle, and at the same time upon the American species, *Abies balsamea* Mill., *A. nobilis* Lindl., *A. Fraseri* Pursh, *A. concolor* L. & G., and *A. magnifica* Murr., in all cases raising the *Per. columnare*, which Kühn had previously shown belonged to the species; and yet to this day no American collection of *Peridermium* can with certainty be assigned to the species. There is assuredly an attractive field for culture work here, and one which derives importance both from the economic and scientific sides.

Although it is not possible to distribute the American species of *Peridermium* with their respective telial forms, yet some approach toward this end can be made by distributing them among telial genera. So far as we know, no attempt of this kind has heretofore been made, but we believe that our studies warrant us in assigning with some degree of probability the form-species of *Peridermium*, which we are able to distinguish morphologically, to seven prominent telial genera, or to six, if *Calyptospora* be considered a synonym of *Pucciniastrum*, as some would have it. The genus *Melampsoridium* is included in this connection, although no *Peridermium* has yet been found in North America that can be assigned to it. The name "*Chrysomyxa*" is used in the customary sense, but as we believe, not in its true application, this being indicated by the quotation marks, the better generic name being *Melampsoropsis*. The accompanying table exhibits the distribution and the underlying characters.

We have found the most important character for assorting the species into groups to be the position of the pycnia, whether subcuticular or subepidermal. After this comes the shape of the aecia, whether cylindrical, or flattened laterally and tongue-like, the forms on *Pinus* being kept distinct from those on other *Coniferae*. There still remain the bark-inhabiting forms, all on *Pinus* so far as known, which have peridia differing from those of all other aecia in being tissue-like and more than one cell thick. These characters may be arranged in the form of a key, as follows:

* Hedwigia 26: 28. 1887.

Key to the assignment of species of *Peridermium*

Pycnia subcuticular.

Aecia cylindrical.

Aecia tongue-shaped.

Pucciniastrum, *Calyptospora*.*Melampsorella*, *Melampsoridium*.

Pycnia subepidermal.

Aecial peridia one cell thick.

On *Pinus*.*Coleosporium*.

On other Coniferae.

" *Chrysomyxa*."

Pycnia subcorticular.

Aecial peridia more than one cell thick.

Cronartium.

Our guide for selecting the proper telial genus has been the kind of aecia found to belong to certain species of those genera in the culture work accomplished mainly by European botanists, although the characters given as dominant are of our own selection.

After this explanation of the method of deriving the data of the table, we may turn to its statistics to see why in some cases more telial species are known than corresponding aecial forms, and why in two cases the reverse should be true. It must be borne in mind that the whole tabular presentation rests upon a large basis of assumption, in which there is plenty of opportunity for error after every precaution is taken. The rust flora of North America is, moreover, very imperfectly known, and especially the part under discussion. Turning to the table we find that in the first line twenty-five species of *Coleosporium* are recognized and only seven corresponding species of *Peridermium*, which is easily enough accounted for by the fact that the aecia of this genus are remarkably similar. Fischer* in his recent flora of Switzerland describes with much fullness ten species of *Coleosporium*, but gives almost no characters to separate the aecia, saying that these "can not be determined with certainty without infection experiments." It is quite likely that when cultures are made, the seven species as now understood will be segregated into two or three times that number, and in the meantime others may be found. In the second line of the table the situation is quite different; more aecia are known than telial forms. Here the aecia are conspicuous, and the telia comparatively inconspicuous. Probably more species of *Cronartium* are yet to be discovered, or else closely related genera not yet recognized. In the fourth line of the table the two re-

* FISCHER, ED. Die Uredineen der Schweiz. Beitr. Krypt. Schweiz 2: 439-455. 1904.

cognized forms of aecia appear to belong to *Melampsorella*, although only one species of that genus has yet been found within our limits, which may be due to their being inconspicuous. In the remaining lines of the table the discrepancy between aecia and telia is only what would naturally occur by this method of tabulation, and one which may confidently be expected to be removed when more collections are made and studied.

To ascertain the particular species represented by the numbers in this table reference may be made to the following pages for those of *Peridermium*. The species of *Coleosporium* are embraced in a paper presented before the Botanical Society of America one year ago by one of the present writers, but not yet published. The species of this latter genus and of the other telial genera will soon be described in the current *North American Flora*, including a few species that are new.

Thanks are due, and are hereby most heartily accorded, to the curators of many important herbaria for the privilege of examining and studying the collections of *Peridermium*, and to many individual botanists, who have assisted with specimens and various information. The following herbaria proved especially helpful: New York Botanical Garden, New York State Museum, Missouri Botanical Garden, Cryptogamic Herbarium of Harvard University, Cryptogamic Herbarium United States Department of Agriculture, Holway Collection in University of Minnesota, Cornell University, Iowa State College, Mississippi Valley Laboratory at St. Louis. We are particularly indebted to Messrs. W. G. Farlow, W. A. Kellerman, H. Klebahn, P. L. Ricker, P. H. Rolfs, H. von Schrenk, C. L. Shear, C. H. Peck, S. M. Tracy, L. M. Underwood and H. H. Whetzel. The ready coöperation by all botanists to whom our special problems were presented, has enabled us to give a fairly complete account of present available knowledge regarding American forms of *Peridermium*.

Analytical key

Pycnia subcorticular.

Peridium one cell thick.

Peridia very low and fragile.

Spores thin-walled, without smooth spot.

1. *P. delicatulum*.

Peridia medium high (0.5-0.8 mm.).

Spores thin-walled, without smooth spot.

2. *P. montanum*.

- Spores thick-walled, with smooth spot. 3. *P. acicolum*.
 Peridia high and firm (0.7-1.8 mm.).
 Spores thick-walled, without smooth spot.
 Peridial cells very large.
 Walls equally thick.
 Spores coarsely verrucose. 4. *P. carneum*.
 Peridial cells medium large; walls medium.
 Walls equally thick.
 Spores moderately verrucose. 5. *P. intermedium*.
 Spores coarsely verrucose. 6. *P. Rostrupi*.
 Outer wall thinner than inner.
 Spores coarsely verrucose. 7. *P. gracile*.
 Peridium more than one cell thick.
 Peridia cylindrical, with internal filaments.
 Branch not or slightly swollen. 8. *P. filamentosum*.
 Peridia hemispherical, imperfectly filamentose.
 Branch not or slightly swollen.
 Spores moderately verrucose. 9. *P. stalactiforme*.
 Spores coarsely verrucose. 10. *P. pyriforme*.
 Peridia hemispherical or tortuous, without filaments.
 Branch gradually swollen into a gall.
 Spores finely verrucose. 11. *P. Harknessii*.
 Spores coarsely verrucose. 12. *P. fusiforme*.
 Branch abruptly swollen into a gall.
 Gall globoid, lobed and irregular.
 Peridial cells angularly globoid. 13. *P. mexicanum*.
 Gall globoid, its outline regular.
 Peridial cells globoid. 14. *P. Cerebrum*.
 Peridial cells lanceolate. 15. *P. globosum*.
 Pycnia subepidermal.
 Pycnia conspicuous, on leaves.
 Mycelium perennial.
 Aeciospores small.
 Peridial cells scarcely imbricated. 16. *P. boreale*.
 Peridial cells considerably imbricated. 17. *P. coloradense*.
 Mycelium annual.
 Aeciospores medium. 18. *P. consimile*.
 Aeciospores large. 19. *P. decolorans*.
 Pycnia inconspicuous, on leaves.
 Mycelium annual.
 Aeciospores with smooth line.
 Wall thick. 20. *P. abietinum*.
 Aeciospores without smooth line.
 Wall thick. 21. *P. pseudo-balsameum*.
 Wall thin. 22. *P. Holwayi*.
 Pycnia subcuticular.
 Pycnia flat, on cones. 23. *P. conorum-Piceae*.
 Pycnia slightly convex, on leaves.
 Peridia cylindrical. 24. *P. columnare*.
 Peridia flattened laterally. 25. *P. ornamentale*.

Pycnia subepidermal.

Pycnia inconspicuous. { *A. grandis* } 21. *P. pseudo-balsameum*.

Pycnia subcuticular.

Pycnia slightly convex.

Peridia cylindrical. { *A. pectinata* } 24. *P. columnare*.

Peridia flattened

laterally. { *A. lasiocarpa* } 25. *P. ornamentale*.

Pycnia hemispherical.

Peridia cylindrical. { *A. balsamea* } 28. *P. balsameum*.
 { *A. grandis* }

Mycelium perennial, forming
 witches' brooms.

Pycnia subcuticular, hemi- { *A. balsamea* }
 spherical. { *A. lasiocarpa* } 27. *P. elatinum*.
 { *A. religiosa* }

Tsuga:

Foliicolous.

Pycnia subcuticular, inconspicuous.

Mycelium perennial, forming
 witches' brooms.

{ *T. canadensis* } 26. *P. Peckii*.

Larix:

Foliicolous.

Pycnia subcuticular, inconspicuous.

Mycelium annual.

{ *L. decidua* } 29. *P. Laricis*.

Ephedra:

Caulicolous.

Pycnia subcuticular, conspicuous.

Mycelium perennial. { *E. Torreyana* }
 { *E. californica* } 30. *P. Ephedrae*.
 { *E. nevadensis* }
 { *E. trifurca* }
 { *E. pedunculata* }

1. Peridermium delicatulum sp. nov.

O. Pycnia amphigenous, numerous, scattered, conspicuous, brownish, dehiscent by a longitudinal slit, subcortical, large. 0.3–0.4 mm. broad by 0.5–1 mm. long, low-conoidal, 80–100 μ high.

I. Aecia amphigenous, from a limited mycelium, numerous, scattered on discolored spots occupying part of a leaf, erumpent from longitudinal slits, 1–5 mm. long; peridium colorless, delicate, scarcely protruding above the ruptured epidermis, cells isodiametric, slightly or not overlapping, 20–25 μ long, walls transversely striate, inner finely verrucose, 4–5 μ thick, outer walls slightly thinner; aeciospores ovoid or cuboidal, 19–21 by 21–28 μ , con-

tents bright-orange when fresh, wall colorless, finely verrucose, $2.5-3\ \mu$ thick.

On leaves of *Pinus* sp., St. Augustine, Florida, March 27, 1903, *E. W. D. Holway*. Only one collection has been made. It occurred in abundance, but only reached to about four feet above the ground. The host appeared to be the common long-leaved pine (*P. Taeda*); but the microscopic structure of the leaves does not agree well with that of authentic collections of this species. No cones were found. The exact determination of the host must, therefore, remain in doubt for the present. The peridium of this species is so fragile and short that the fungus has the general appearance of a caeoma, and in the field might easily be mistaken for one.

2. *Peridermium montanum* sp. nov.

O. Pycnia chiefly hypophyllous, rather numerous, scattered, noticeable, subcorticular, dehiscent by a longitudinal slit, large, $0.3-0.5$ mm. broad by $0.5-1$ mm. long, low-conoidal, $55-65\ \mu$ high.

I. Aecia from a limited mycelium, chiefly epiphyllous, rather numerous on yellowish spots occupying part or rarely all of the leaf, erumpent from a narrow slit, flattened laterally, $1-1.5$ mm. long by $0.5-0.8$ mm. high, rupturing irregularly; peridium colorless, delicate, cells separating readily, $55-65\ \mu$ long, overlapping, outer and inner walls about same thickness, $3-5\ \mu$, outer minutely verrucose, inner moderately verrucose; aeciospores oblong to linear-oblong, $16-24$ by $32-45\ \mu$, wall colorless, rather thin, $2-3\ \mu$, closely and rather coarsely verrucose.

On leaves of *Pinus scopulorum* (Engelm.) Lemm., Rimini, Montana, June 24, 1889, *F. D. Kelsey* (type, specimen in herbarium of N. Y. Bot. Garden).

On leaves of *Pinus Murrayana* Oreg. Com., Chiquash Mountains, Skamania County, Washington, August 12, 1886, *W. N. Suksdorf* 302; Rocky Mountains (Canada?), July 3, 1885, *J. M. Macoun*; Chiquash Mountains, Skamania County, Washington, July 22, 1901, *W. N. Suksdorf* 645, communicated by *E. W. D. Holway*; Bozeman, Montana, June 26, 1900, *J. W. Blankinship*, communicated by *E. W. D. Holway*.

3. *PERIDERMIIUM ACICOLUM* Underw. & Earle, Bull.

Torrey Club 23: 400. 1896

O. Pycnia amphigenous, numerous, scattered, noticeable, subcorticular, dehiscent by a longitudinal slit, $0.3-0.5$ mm. broad by $0.5-0.8$ mm. long, low-conoidal, $80-100\ \mu$ high.

I. Aecia from a limited mycelium, numerous, scattered, on discolored spots occupying part of a leaf, erumpent from longitudinal slits, flattened laterally, 0.5–1 mm. long by 0.5–0.7 mm. high, rupturing irregularly; peridium colorless, moderately firm, cells overlapping, 35–45 μ long, not much narrower, walls transversely striate, inner coarsely verrucose, thick, 5–6 μ , outer less rough and somewhat thinner; aeciospores ellipsoid, 20–24 by 28–40 μ , wall colorless, closely and coarsely verrucose with deciduous tubercles, which are directed away from a smooth spot extending up one side, thick, 2–3 μ on the smooth spot, increasing to 5–6 μ on the opposite side, including the tubercles.

On leaves of *Pinus rigida* Mill., Egg Harbor, New Jersey, June, 1877, *I. C. Martindale* (specimen in Herb. N. Y. Botanical Garden); Plainville, Connecticut, no date, *J. N. Bishop* (specimen in N. Y. State Herb. at Albany); Sherburne, Massachusetts, June 8, 1888, *Cummings & Seymour* (in Seymour & Earle, Econ. Fungi, no. 223); May's Landing, New Jersey, July 4, 1888, *Pennypacker* (in Ellis & Everh. N. Am. Fungi, no. 2222); Belleplain, New Jersey, May 25, 1903, *C. L. Shear 1457*; Riverhead, Long Island, New York, June 8, 1904, *F. A. Sirrine* (specimen in N. Y. State Herb. at Albany).

This species appears to be unique in having the tubercles on the aeciospores noticeably bent away from the smooth toward the opposite side, so that the longest tubercles directly opposite to the smooth side are the only ones that are truly radial. The species is known from only a small area along the Atlantic coast from near Boston, Mass., to the southern end of New Jersey.

4. PERIDERMIIUM CARNEUM (Bosc) Seym. & Earle,
Econ. Fungi 550. 1899

Tubercularia carnea Bosc, Ges. Nat. Freunde Berlin Mag. 5: 88.
1811.

Peridermium oblongisporium Ravenelii Thüm. Mitth. Forstl. Vers.
Oest. 2: 316 (20). 1880.

Peridermium Ravenelii Kleb. Ber. Deutsch. Bot. Ges. 8²: 69. 1890.

Aecidium Ravenelii Dietel, in Engler & Prantl, Pflanzenfam. 1¹**:
78. 1897.

Aecidium carneum Farl. Bibl. Index 1: 25. 1905.

O. Pycnia amphigenous, numerous, scattered, noticeable, subcortical, dehiscent by a longitudinal slit, large, 0.4–0.7 mm. broad by 1–1.5 mm. long, low-conoidal, 60–80 μ high.

I. *Aecia* amphigenous, from a limited mycelium, numerous, scattered, on discolored spots occupying part of a leaf, erumpent from longitudinal slits, flattened laterally, large, 1–6 mm. long by 0.8–1.5 mm. high, rupturing along the apical line; peridium flesh-colored, especially at apex, when fresh, becoming colorless, rather firm, cells isodiametric, somewhat overlapping, 38–48 μ long, walls transversely striate, inner coarsely verrucose, very thick, 7–13 μ , outer less rough and slightly thinner; aeciospores ellipsoid, 16–24 by 26–38 μ , wall colorless, closely and uniformly verrucose with large, deciduous tubercles, 5–7 μ , or 2–3 μ without tubercles.

On leaves of *Pinus palustris* Mill. (*P. australis* Michx.), Gainesville, Florida, February 12 and February 24, 1906, *P. H. Rolfs*.

On leaves of *Pinus Taeda* L., Darien, Georgia, no date, *H. W. Ravenel* (in Ellis, N. A. F. no. 1026a); Crescent City, Florida, no date, *George Martin* (in Ellis, N. A. F. no. 1026b as on "*Pinus australis*"); Green Cove Springs, Florida, February 23, 1883, *Geo. Martin* (as on "*P. australis*"); Kissimmee, Florida, March, 1885, *E. A. Rau* (in Rabenhorst-Winter, F. Europ., no. 3315b, as on "*P. australis*"); Toccoa, Georgia, April 19, 20 and 21, 1891, *L. M. Underwood*; South Jacksonville, Florida, April, 1891, *L. M. Underwood* (as on "*P. palustris*"); Auburn, Alabama, spring of 1891, *Geo. F. Atkinson* (as on "*P. serotina*"); Lake City, Florida, February 28, 1892, *P. H. Rolfs* (as on "*P. palustris*"); Grassmere, Florida, March, 1893, *W. C. Sturgis* (in Seymour & Earle, Econ. Fungi no. 550, as on "*P. palustris*"); Auburn, Alabama, April 18, 1896, *Underwood & Earle*; Gainesville, Florida, February 12 and 24, 1906, *P. H. Rolfs*.

On leaves of *Pinus Elliottii* Engelm., Ocean Springs, Mississippi, March 31, 1895, *F. S. Earle* (as on "*P. australis*"); Biloxi, Mississippi, March 19, 1898, *S. M. Tracy* 5190 (as on "*P. heterophylla*"); Live Oak, Florida, April 31, 1900, *S. M. Tracy* 7153 (as on "*P. australis*"); Cairo, Georgia, March 26, 1904, *P. J. O'Gara*.

Beside the above collections one in the herbarium of the New York Botanical Garden on *Pinus Taeda*, collected at Ft. Payne, Alabama, in 1896, by L. M. Underwood, may belong here, although both spores and peridial cells are smaller and thinner-walled than usual.

The species is very common along the coast of the south-

eastern states from South Carolina to Mississippi. It is an especially large and conspicuous form, usually passing under the name *Peridermium orientale*. The type as stated by Bosc, was collected in South Carolina on *Pinus palustris*. Although it is probably no longer in existence, his description is so explicit and full, that together with the illustration, *l.c. pl. 6, fig. 13*, no doubt can exist of the application of the name.

5. *Peridermium intermedium* sp. nov.

O. Pycnia amphigenous, scattered, noticeable, dehiscent by a longitudinal slit, subcortical, 0.3–0.4 mm. broad by 0.5–0.75 mm. long, low-conoidal, 65–80 μ high.

I. Aecia amphigenous, from a limited mycelium, scattered, on discolored spots occupying part of a leaf, erumpent from longitudinal slits, flattened laterally, tongue-shaped, of medium size, 1.5–3 mm. long by 0.8–1.5 mm. high, rupturing along the apical line; peridium colorless, rather firm, cells 35–50 μ long, somewhat longer than broad, overlapping, walls transversely striate, inner coarsely verrucose, rather thick, 6–9 μ , outer less rough and of about equal thickness; aeciospores ellipsoid, 16–20 by 23–29 μ , wall colorless, evenly and moderately verrucose, 2.5–3.5 μ thick.

On leaves of *Pinus echinata* Mill. (*P. mitis* Michx.), Perryville, Missouri, May, 1883, *C. H. Demetrio* (in Rabenhorst-Winter, *Fungi Europ. no. 3315a*); Cadet, Washington County, Missouri, May, 1890, *J. G. Barlow 1573* (specimen in herbarium of U. S. Dept. of Agric.); Garrett Park, Maryland, May 29, 1891, *B. T. Galloway*; Eureka Springs, Arkansas, May 23, 1906, *H. von Schrenk*.

This species is intermediate in most of its gross and microscopic characters between *Per. carneum* and *Per. Rostrupi*, and as might be anticipated the determination of collections is likely to be uncertain in some cases. The first collection listed above is taken as the type.

6. *PERIDERMIIUM ROSTRUPI* Ed. Fischer, Bull. Soc.

Bot. France **41**: clxxi. 1894.

O. Pycnia amphigenous, scattered, numerous, dehiscent by a longitudinal slit, noticeable, 0.2–0.4 mm. broad by 1–2 mm. long, low-conoidal, subcortical, 90–110 μ high.

I. Aecia amphigenous, from a limited mycelium, scattered on discolored spots occupying part of a leaf, erumpent from longitudinal slits, flattened laterally, tongue-shaped, 1–3 mm. long by

0.7–1.5 mm. high, rupturing irregularly; peridium yellow fading to white, fragile, cells 35–45 μ long, somewhat longer than broad, overlapping, walls transversely striate, inner moderately verrucose, about 4–6 μ thick, outer less rough and of about equal thickness; aeciospores broadly ellipsoid or globoid, 17–22 by 22–31 μ , wall colorless, densely verrucose with prominent elongate papillae, 2–3.5 μ thick.

On leaves of *Pinus rigida* Mill., Sugar Grove, Ohio, May 17, 1902, May, 1902 (in Kellerman, Ohio Fungi, no. 104), May, 1903, and May 30, 1904, *W. A. Kellerman*; Egg Harbor, New Jersey, June, 1877, *I. C. Martindale* (specimen in herbarium of N. Y. Botanical Garden); Ironton, Ohio, May 27, 1892, *Wm. C. Werner* (specimen in herbarium of U. S. Department of Agriculture).

This rust, as here represented, is the aecial form of *Coleosporium Campanulae* (Pers.) Lév. The demonstration was carried out by Professor Kellerman,* who, in June, 1904, successfully sowed spores from the Sugar Grove station on *Campanula americana*. This is the only culture of *Peridermium* on pine leaves that has yet been successfully made in America. The other two collections that are listed agree closely in microscopic characters with the Sugar Grove collection, and are listed here with much confidence. Still another collection on *Pinus rigida*, collected at Lunenburg, Massachusetts, by F. L. Sargent, on July 1, 1889, possesses considerably larger spores, but is otherwise quite similar. While it may belong with this species, it is more likely to belong to one of several species of *Coleosporium*, whose aecial forms have not yet been identified. Much cultural work has been done in Europe on this and related species, for which the reader is referred to Klebahn's *Die wirtswechselnden Rostpilze*, and Fischer's *Die Uredineen der Schweiz*.

7. *Peridermium gracile* sp. nov.

O. Pycnia amphigenous, numerous, scattered, dehiscent by a longitudinal slit, 190–350 μ broad by 0.5–0.75 mm. long, low-conoidal, subcorticular, 60–75 μ high.

I. Aecia amphigenous, from a limited mycelium, numerous, scattered on discolored spots occupying part of a leaf, erumpent from longitudinal narrow slits 0.3–0.5 mm. wide, flattened laterally,

* Jour. Myc. 11: 32. 1905.

0.5–1.5 mm. long, by 1–1.8 mm. high, rupturing irregularly; peridium colorless, moderately firm, cells somewhat overlapping, 30–40 μ long, walls transversely striate, inner moderately verrucose, thick, 6–9 μ , outer less rough and thinner, 4–6 μ ; aeciospores ellipsoid, 18–24 by 23–39 μ , wall colorless, closely and evenly verrucose with large deciduous tubercles, 3.5 μ thick.

On leaves of *Pinus filifolia* Lindl., mountains above Oaxaca, Mexico, May 28, 1894, C. G. Pringle (type); Topalpa, state of Jalisco, Mexico, June 10, 1892, collector unknown (specimens in herbarium of N. Y. Bot. Garden).

8. PERIDERMIIUM FILAMENTOSUM Peck, Bot. Gaz.

7: 56. 1882

Aecidium filamentosum Farl. Bibl. Index 1: 44. 1905.

O. Pycnia unknown.

I. Aecia caulicolous, not producing noticeable swellings, scattered, cylindrical, 4–7 mm. high by 1–2 mm. wide, pale-yellow or white; peridium rupturing laterally in longitudinal lines, rather firm, scarcely more than 1 cell thick at the sides, becoming thicker above where it extends downward into numerous concolorous, filament-like processes, 70–100 μ in diameter, passing through the spore-mass from apex to base of the aecium, peridial cells linear-oblong, 15–23 by 55–80 μ , pointed at one or both ends, placed longitudinally, walls 4–6 μ thick, inner rather coarsely verrucose, outer somewhat smoother; aeciospores oblong, obovate-oblong or rarely ellipsoid, 13–21 by 27–31 μ , wall colorless, uniformly thick, 2.5–3.5 μ , moderately verrucose, with a smooth area at base often extending up one side.

On *Pinus ponderosa* Dougl., Santa Rita Mountains, Arizona, July 13, 1881, C. G. Pringle. This remarkable and interesting species of *Peridermium* has been collected but once, although an interval of a quarter of a century has passed, and the fungus is a conspicuous one. Mr. C. H. Peck in his account in the Botanical Gazette, gave an excellent characterization, and very properly laid stress on the presence of longitudinal filaments, and on the slitting of the peridium. The filaments are easily seen, even without a hand-lens, and extend from the dome of the aecium to its floor, and are sufficiently numerous to keep the spores from easily falling away, even after the rather fragile peridium has partially disappeared. The apex or dome of the peridium, as in other forms on the branches of pine, is more than one cell thick, but the long

cylindrical sides are for the most part composed of a single layer of cells, and these have their longer axis extending longitudinally, as in foliicolous forms, instead of transversely as in other caulicolous forms. This structure permits of the longitudinal rupture of the peridium, which is especially notable.

9. *Peridermium stalactiforme* sp. nov.

O. Pycnia unknown.

I. Aecia caulicolous, not producing noticeable swellings, scattered, round or irregular, 0.5–1.5 by 1–2 mm., distinct or sometimes confluent, pale-yellow fading to white, low, not much exserted above the bark; peridium hemispherical or tortuous, rupturing irregularly along the sides, about 2 cells thick, often extending numerous concolorous processes from apex and from floor of the aecium a short distance into the spore-mass, peridial cells roundish or occasionally elongate and somewhat pointed, walls thick, striate, lumen small; aeciospores ellipsoid, 16–21 by 27–35 μ , wall colorless, 2.5–3.5 μ thick, moderately verrucose, with a smooth area extending from base up one side, slightly thicker on smooth side.

On branches of *Pinus Murrayana* Oreg. Com., Chiquash Mountains, Skamania County, Washington, July 22, 1901, *W. N. Suksdorf* 645 (type), communicated by E. W. D. Holway.

On branches of *Pinus Jeffreyi* Oreg. Com., Little Valley, Washoe County, Nevada, 2000–2155 m., July 24, 1902, *C. F. Baker* 1351.

This species does not produce noticeable enlargement of the branch, in this respect being similar to *Per. filamentosum*, but the peridium is of the usual character of the caulicolous species. In the short attenuate projections from the floor and dome of the aecium, one is reminded of the connecting filaments of *Per. filamentosum*, with which they are homologous.

10. *PERIDERMIIUM PYRIFORME* Peck, Bull. Torrey Club

6: 13. 1875

Aecidium pyriforme Farl. Bibl. Index 1: 78. 1905.

O. Pycnia unknown.

I. Aecia caulicolous, producing no or only slight swellings, scattered, rounded or irregular, 1–1.5 by 1–2 mm. across, rarely larger by becoming confluent, pale-yellow or white, about 1–1.5 mm. high; peridium bladdery, subhemispherical, rupturing

irregularly along the sides, about 2 cells thick, outer surface infolded and verrucose, inner more coarsely verrucose, numerous, delicate, concolorous processes often projecting from apex and from floor of aecium a short distance into the spore-mass, peridial cells roundish or pyriform, walls thick, striate, lumen small; aeciospores ellipsoid or rarely obovate, 16–23 by 25–31 μ , wall colorless, uniformly thick, 3–4.5 μ , rather coarsely verrucose, with a rather inconspicuous smooth area at base often extending up one side.

On small branches of *Pinus rigida* Mill., Newfield, New Jersey, May, 1890, J. B. Ellis (specimen in herbarium of N. Y. Bot. Garden).

On small branches of *Pinus virginiana* Mill. (*P. inops* Ait.), Newfield, New Jersey, May, 1882, J. B. Ellis (in Ellis, N. A. F. no. 1021).

On small branches of *Pinus sylvestris* L., fruticetum of Missouri Botanical Garden, St. Louis, Missouri, May, 1887, L. H. Pammel (specimen in herbarium of Missouri Bot. Garden).

The authors have examined the type specimen in the herbarium of the N. Y. State Museum at Albany, N. Y. It is a very small fragment, and gave little material for study. So far as we can judge, however, it is identical with the specimen at New York City, the first one cited above, and the host appears to be the same, that is *P. rigida*. The specimen is in the original wrapper, and is labeled "on pine limbs in the spring, Newfield, New Jersey, J. B. Ellis, no. 2040." In the original publication some doubt was expressed regarding the type locality, but there is strong circumstantial evidence that the inscription on the type specimen records the actual facts. In the original description emphasis is laid on the form of the spores, which are said to be "obovate, pyriform, or oblong-pyriform, acuminate below, .0015–.0025 inch long." It is further stated that "the acumination is generally acutely pointed, and sometimes so elongated as to make the spore appear clavate; it is one of the most distinctive features of the species." This description of the spores in both form and size, corresponds to that of the smaller peridial cells, which were doubtless mistaken for spores. A drawing for a spore on the original packet shows a small lumen, which is true for peridial cells, but not for spores; the measurement given is also twice too large for spores.

11. PERIDERMIIUM HARKNESSII Moore, Bull. Calif.

Acad. Sci. 1: 37. 1884

O. Pycnia unknown.

I. Aecia caulicolous, appearing on ellipsoid, oblong or sometimes nearly globoid swellings, scattered or often in groups and confluent; yellow at first fading to white, bladdery, large; peridium rupturing irregularly, soon falling away entirely, about two cells thick, outer surface smooth, inner irregularly verrucose, cells roundish or irregularly compressed, walls very thick, radially striate, lumen small; aeciospores ellipsoid or obovate, 15-21 by 23-31 μ , wall colorless, uniformly thick, 2.5-3.5 μ , finely verrucose, with smooth area at base often extending up one side.

On branches of *Pinus insignis* Dougl., Menlo Park, California, May 6, 1893, W. C. Blasdale (specimen in herbarium of E. W. D. Holway).

On branches of *Pinus Murrayana* Oreg. Com., Yosemite Valley, California, May 29, 1895, W. C. Blasdale (specimen in herbarium of E. W. D. Holway); Dragoon, Washington, no date, H. von Schrenk (specimen at Miss. Valley Lab., St. Louis); Bozeman, Montana, September, 1903, collector unknown (two specimens at Miss. Valley Lab., St. Louis, each about 60 cm. long and 8-10 cm. thick).

On branches of *Pinus ponderosa* Dougl., Colfax, California, no date, H. W. Harkness (specimen in herbarium of N. Y. Bot. Garden); Dragoon, Washington, no date, H. von Schrenk (specimen at Miss. Valley Lab., St. Louis); Long Pine, Nebraska, May 13, 1889, J. M. Bates 370 (specimen in herbarium N. Y. Bot. Garden).

On branches of *Pinus contorta* Dougl., New Metlakahtla, Alaska, June 4, 1899, Wm. Trelease 667 (specimen in herbarium of Missouri Bot. Garden, St. Louis).

This species appears to be very abundant in the Rocky Mt. region, often doing much damage, especially to seedling trees. The galls are usually large, often one to two feet in diameter. The large size is doubtless one reason why the species is so poorly represented in herbaria.

12. *Peridermium fusiforme* sp. nov.

O. Pycnia unknown.

I. Aecia caulicolous, forming fusiform swellings, 2-6 cm. in diameter by 5-25 cm. long, on comparatively small branches,

numerous, scattered, individual sori elongate and sometimes tortuous, 1–2 by 3–9 mm., distinct or rarely confluent, pale-yellow, bladdery, low, scarcely exserted above the bark; peridia circumscissile, soon falling away, about two cells thick, outer surface infolded and verrucose, inner more coarsely verrucose, cells roundish or irregular, walls very thick, radially striate, lumen small; aeciospores obovate or ellipsoid, 15–24 by 24–33 μ , wall colorless, 3–5 μ thick, uniform, coarsely verrucose, usually with smooth area at base, often extending up one side, tubercles about 1 μ long, tardily deciduous.

On branches of *Pinus Taeda* L., Auburn, Alabama, April, 1896, *L. M. Underwood* (type); Auburn, Alabama, no date, *F. S. Earle* (specimen at Miss. Valley Lab., St. Louis); Lake City, Florida, March, 1895, *P. H. Rolfs*; Gainesville, Florida, February, 12, 1906, *P. H. Rolfs*.

On branches of *Pinus palustris* Mill., Cleveland, Texas, no date, *Perley Spaulding* (specimen in herbarium Missouri Bot. Garden, St. Louis); Lake City, Florida, June, 1906, *P. H. Rolfs*.

On branches of *Pinus* sp., Georgia, no date, *H. W. Ravenel* (specimen in herbarium N. Y. Bot. Garden); Cairo, Georgia, March 26, 1904, *P. J. O'Gara* (specimen in herbarium U. S. Dept. Agric.).

The spindle-shaped gall is very characteristic of this species, which rarely shows an abrupt change from the healthy tissue to the hypertrophied area, as in other species.

13. *Peridermium mexicanum* sp. nov.

O. Pycnia unknown.

I. Aecia caulicolous, forming irregular, globoid, gall-like excrescences, 3–7 cm. across, often on small branches, arranged in tortuous lines or cerebroid, pale-yellow fading to white, bladdery, not much exserted above the bark; peridia colorless, circumscissile, soon falling away in flakes or sheets, about 2 cells thick, outer surface somewhat irregularly roughened, inner surface more noticeably roughened, cells roundish or irregularly compressed, walls thick, with radial striations, which may on exposed surfaces separate the wall into tubercle-like processes, lumen moderately small; aeciospores ellipsoid or obovate, 13–22 by 23–33 μ , wall colorless, 2.3 μ thick, very coarsely verrucose, sometimes with a smooth area showing at base and extending up one side, slightly thicker, 3–4 μ , tubercles somewhat deciduous.

On branches of *Pinus patula* Schiede & Deppe, Hovey Station, state of Hidalgo, Mexico, April, 1904, *C. G. Pringle* (type), communicated by E. W. D. Holway.

On branches of *Pinus oocarpa* Schiede, hills near Guadalajara, state of Jalisco, Mexico, June 22, 1893, *C. G. Pringle*.

The type specimen consists of a lobulated, irregularly globose gall, about 4 cm. in diameter, nearly surrounding a slender branch only 8 mm. thick, and attached by a very narrow band of connecting-tissue. The record on the packet says: "forming balls 2-3 inches in diam. on small branches; very common."

14. PERIDERMIIUM CEREBRUM Peck, Bull. Buffalo

Soc. I: 68. 1873

Aecidium deformans Mayr, Waldungen Nordam. 119. 1890.

Aecidium giganteum Mayr, Waldungen Nordam. 120. 1890.

(Bot. Centr. 58: 149. 1894.)

Peridermium giganteum Tubeuf, Pflanzenkr. 429. 1895.

Peridermium deformans Tubeuf, Pflanzenkr. 429. 1895.

Aecidium Cerebrum Dietel, in Engler & Prantl, Pflanzenfam. I^{1**}
79. 1897.

O. Pycnia unknown.

I. Aecia caulicolous, forming globoid swellings, 5-25 cm. across, arranged in tortuous lines or cerebroid, at first orange-yellow, bladdery, large; peridia colorless, circumscissile, soon falling away in flakes or sheets, about 2 cells thick, outer surface smooth, inner verrucose, cells roundish, or irregularly compressed, walls very thick, radially striate, lumen small; aeciopores obovate, 17-23 by 25-32 μ , wall colorless, uniformly thick, 2.5-3.5 μ , coarsely verrucose, with a smooth spot at base usually extending up one side, tubercles somewhat deciduous.

On branches of *Pinus rigida* Mill., Center, New York, May, year?, *J. A. Lintner* (type specimen in herbarium N. Y. State Museum, Albany, N. Y.); Belleplain, New Jersey, March 25, 1903, *C. L. Shear* 1456; Newfield, New Jersey, May, 1882, *J. B. Ellis* (in Ellis, N. A. F. no. 1022).

On branches of *Pinus virginiana* Mill., Washington, D. C., May 11, 1903, and April 24, 1905, *C. L. Shear*; Glen Sligo, Maryland, May 5, 1905, *P. L. Ricker*.

On branches of *Pinus divaricata* (Ait.) Sudw. (*P. Banksiana*

Lamb.), Omer, Arenac County, Michigan, August, 1900, *C. F. Wheeler* (specimen in herbarium U. S. Dept. Agric.).

On branches of *Pinus echinata* Mill. (*P. mitis* Michx.), Eureka Springs, Arkansas, May 29, 1906, *H. von Schrenk*; Alabama, other data wanting (specimen in herbarium of New York Bot. Garden).

On branches of *Pinus Taeda* L., Columbus, Mississippi, April 5, 1896, *S. M. Tracy* (specimen in herbarium of New York Bot. Garden).

On branches of *Pinus ponderosa* Dougl., Colfax, California, no date, *H. W. Harkness* (specimen in herbarium of New York Bot. Garden).

A widespread and characteristic species, more common southward, now known to be the aecial stage of *Cronartium* on the several species of *Quercus*, as demonstrated by Dr. C. L. Shear,* and verified by the writers just as the manuscript goes to press.

The type collection consists of a globoid gall about 2 cm. in diameter, accompanied by a water-color sketch, showing a small lateral branch bearing a sheath with two leaves, now lost from the specimen. This is the only collection reported from the state of New York. The village of Center is now called Karner, and the pine forest is cleared away.

15. *Peridermium globosum* sp. nov.

O. Pycnia unknown.

I. Aecia caulicolous, on globoid swellings, 2-3 cm. across, individual sori scarcely discernible but confluent over almost the entire area giving the whole a crinkled appearance, pale-yellow fading to white; peridia circumscissile, falling away in very large flakes or sheets of uneven thickness, varying from 1 to 2 cells, outer surface verrucose, inner more coarsely verrucose, cells lanceolate, often very slender, placed radially, walls thick, with radial striations, somewhat tuberculate, lumen moderately small; aeciospores ellipsoid, 16-22 by 26-31 μ , wall colorless, rather coarsely verrucose with smooth area extending from base up one side, 2-3 μ thick, about 1 μ thicker on smooth side.

On *Strobilus Strobilus* (L.) Small (*Pinus Strobilus* L.), Lone Rock, Wisconsin, May 21, 1890, *E. S. Goff*. Only one specimen seen,

* Jour. Myc. 12: 89. 1906.

which consists of a regularly globose swelling 3 cm. in diameter, on a branch 1 cm. thick at a point where three smaller branches arise. Its gross appearance is similar to *Per. Cerebrum*, but it is readily distinguished from this and all other known forms on branches, and especially from *Per. Strobi* Kleb., the aecial stage of *Cronartium ribicola*, by the remarkably elongate and attenuate peridial cells, placed radially.

16. *Peridermium boreale* sp. nov.

O. Pycnia amphigenous, numerous, scattered, conspicuous, punctiform, honey-yellow becoming blackish-brown, subepidermal, flask-shaped or globoid, protruding, 95–140 μ broad.

I. Aecia from perennial mycelium, dwarfing the shoot and causing the leaves to adhere somewhat when dried, if not too mature, hypophyllous, in two irregular rows, flattened laterally, erumpent from slits 0.5–2.5 mm. long, often confluent, 0.5–1.2 mm. high, dehiscent along the sides, upper part often falling away intact, leaving an erose margin; peridium colorless, or pinkish at apex, cells very slightly or not overlapping, walls rather thin, outer smooth, 1.5–2.5 μ , inner verrucose, 3–4 μ ; aeciospores broadly ellipsoid or globoid, 16–22 by 23–32 μ , wall colorless, rather thick, 2–4 μ , densely and rather finely verrucose; contents orange-red fading to nearly colorless.

On *Picea Parryana* (André) Parry (*P. pungens* Engelm.), southern Colorado, July, 1897, E. Bethel (in Ellis & Everh. Fungi Columbiani no. 1479), type; Gypsum Creek Cañon, Colorado, August, 1894, C. S. Crandall (in Ellis & Everh. Fungi Columb. no. 876, as on "*P. Engelmanni*"); North Elk Cañon, Rio Blanco County, Colorado, August 20, 1902, W. C. Sturgis; Harvey Peak, South Dakota, July 28, 1904, C. F. Wheeler, communicated by E. W. D. Holway.

On *Picea Engelmanni* (Parry) Engelm., Argentine Pass, Colorado, July 17, 1886 (specimen in herbarium of Missouri Bot. Garden, St. Louis); Camp Creek, Routt County, Colorado, July, 1903, L. N. Goodding 1450 (as on "*P. pungens*"); Edith Pass, Banff, Canada, July 27, 1901, E. W. D. Holway; Vermilion River Valley, British Columbia, Canada, Aug. 16, 1905, E. W. D. Holway; Kittitas County, Washington, July–September, 1904, J. S. Cotton, communicated by P. L. Ricker.

Although the boundaries of this species are not well defined,

yet it appears fairly distinct in most specimens examined. It sometimes forms witches' brooms, as in *Per. coloradense*, and in other characters closely resembles that species. It differs in the leaves usually remaining attached to the branch after drying, in the more prominent pycnia, and in small differences in spores and peridial cells.

17. **Peridermium coloradense** (Dietel) nom. nov.

Aecidium coloradense Dietel, in Engler & Prantl, Pflanzenfam.

I^{1**}: 78. 1897.

O. Pycnia amphigenous, numerous, scattered, conspicuous, honey-yellow becoming blackish-brown, punctiform, subepidermal, globoid or flask-shaped, slightly protruding, 110–150 μ broad.

I. Aecia from perennial mycelium, usually forming witches' brooms often of great size, hypophyllous, forming two irregular lines, flattened laterally, 0.8–1 mm. high, erumpent from a lenticular opening, 1–2 mm. long, dehiscent along the sides, the upper part often falling away in pieces leaving a lacerate margin; peridium colorless, or pinkish at apex, cells slightly overlapping, walls rather thin, outer smooth, thin, inner thicker, verrucose; aeciospores broadly ellipsoid or globoid, 16–25 by 26–35 μ , wall colorless, medium and rather unevenly thick, 2–3 μ , densely and rather coarsely verrucose; contents orange-red fading to nearly colorless.

On *Picea Engelmanni* (Parry) Engelm., Colorado, August, 1877, T. S. Brandegee (specimens in Crypt. Herb. Harvard University); Rocky Mountains, Canada (?), March 8, 1885, J. Macoun (specimen in herbarium N. Y. Bot. Garden); Music Pass, Sangre de Cristo Range, Colorado, July, 1888, Rev. C. H. Demetrio (in Ellis & Everh. N. A. F. no. 2223); Devil's Lake, Athabaska, Canada, March 7, 1891, J. Macoun 372; Lower Basin of the Gallatin River, Montana, July 8, 1898, J. W. Blankinship; Black's Fork, Wyoming, July 16, 1901, Pammel, Johnson, Lummis, & Buchanan 664; Smith's Fork, Wyoming, August 2, 1901, L. H. Pammel 638; Boulder, Colorado, July 1904, E. Bethel; Mariposa Dell, Colorado, August 10, 1905, F. E. & E. S. Clements (in Crypt. Format. Colorado, no. 152); Georgetown, Colorado, no date, Wm. Trelease.

On *Picea Mariana* (Mill.) B.S.P. (*Abies nigra* Desf.), Cacouna, Quebec, Canada, August 10, 1891, D. P. Penhallow (in Seym.

& Earle, Econ. Fungi, no. 221); Isle au Haut, Maine, August 16, 1899, and August 17, 1900, *J. C. Arthur*; North East Harbor, Maine, no date, *H. de Raasloff*.

A very abundant species, especially in the western mountains. It can be distinguished from *Per. decolorans*, with which it is often confused, not only by its common habit of forming witches' brooms, but by its much longer aecium and smaller aeciospores.

18. *Peridermium consimile* sp. nov.

O. Pycnia amphigenous, numerous, scattered, conspicuous, punctiform, honey-yellow becoming blackish-brown, subepidermal, globoid or flask-shaped, almost wholly immersed, 110–150 μ broad.

I. Aecia from a limited mycelium, not changing form of leaf, chiefly hypophyllous, in two irregular rows on yellowish spots occupying part or all of a leaf, flattened laterally, 0.5–1.5 mm. long, 0.5–0.8 mm. high, dehiscent at apex; peridium colorless, rather delicate, margin becoming lacerate, cells slightly overlapping, inner thickened, verrucose, transversely striate, outer thinner, smooth; aeciospores broadly ellipsoid or globoid, 16–23 by 24–35 μ , wall colorless, rather unevenly thick, 1.5–2.5 μ , moderately and densely verrucose.

On *Picea Mariana* (Mill.) B. S. P. (*Abies nigra* Desf.), Junius, New York, July, 1905, *E. J. Durand* (type); Lily Swamp, Oswego County, New York, August 4, 1891, *W. R. Dudley*; Burlington, Vermont, July 30, 1896, *A. J. Grout* (specimen in herbarium N. Y. Bot. Garden); London, Ontario, Canada, no date, *J. Dearness* (specimen in Crypt. Herb. Harvard University); Vermilion Lake, Minnesota, July 20, 1886, *E. W. D. Holway*.

On *Picea rubra* (Lamb.) Link (*Picea rubens* Sarg.), Adirondack Mountains, Aug. 1873, *Chas. H. Peck* (specimen in herbarium of N. Y. State Museum, Albany, N. Y.).

This form has been confused with *Per. decolorans* on the one hand, and *Per. coloradense* on the other. From the former it differs in size of spores and thickening of peridial cells, while agreeing in having an annual mycelium; and from the latter it differs in never forming witches' brooms and in dehiscence of peridia, while agreeing rather closely in size of aecia and spores. It is usually found in swamps.

19. PERIDERMIIUM DECOLORANS Peck, Rep. N. Y.

State Mus. 27: 104. 1875

Peridermium abietinum decolorans Thuem. Mitth. Forstl. Vers.

Oest. 2: 321 (25). 1880.

Aecidium decolorans Farl. Bibl. Index 1: 38. 1905.

O. Pycnia amphigenous, numerous, forming a row on each leaf-face, prominent, punctiform, honey-yellow becoming reddish-brown, subepidermal, flask-shaped, 105–145 μ broad.

I. Aecia from a limited mycelium, not changing form of leaf, hypophyllous, in two rows on yellowish spots occupying a part or all of a leaf, much compressed, erumpent from slits 0.5–3 mm. long, low, 0.5 mm. or less high, dehiscent at apex and readily falling away; peridium colorless, delicate, margin finely lacerate, cells abutted, sometimes slightly overlapping, outer wall and portions in contact strongly thickened, moderately verrucose, appearing transversely striate in section, inner wall smooth and thin; aeciospores broadly ellipsoid or globoid, 22–40 by 27–55 μ , wall colorless, thick, 3–6 μ , densely and finely verrucose, intercalary cells noticeable, about 5 by 7 μ ; contents orange-red, fading to nearly colorless.

On *Picea Mariana* (Mill.) B. S. P. (*Abies nigra* Desf.), Mt. Colvin, Adirondack Mountains, New York, August 1873, Chas. H. Peck (type specimen in Herb. N. Y. State Museum, Albany, N. Y.); King's Ravine, Mt. Adams, New Hampshire, August, 1882, W. G. Farlow (in Ellis, N. A. F. no. 1024); Mt. Washington, New Hampshire, September, 1884, W. G. Farlow (in Rab.-Wint. Fungi Eur. no. 3607); Holly Bay, Newfoundland, August 6, 1894, Robinson & Schrenk; North East Harbor, Maine, August, 1902, Miss T. McV. Hinton (specimen in herbarium U. S. Dept. Agric.); Mt. Adams, New Hampshire, no date, W. G. Farlow; South West Point, Anticosti Island, Quebec, no date (*Macoun?*) (specimen in Crypt. Herb. Harvard University).

On *Picea rubra* (Lamb.) Link (*P. rubens* Sarg.), Nipple Top, Adirondack Mountains, New York, August, 1873, Chas. H. Peck; Sand Lake, New York, August (year?), Chas. H. Peck; Adirondack Mountains, New York, August, 1873, Chas. H. Peck (one or more specimens in N. Y. State Museum, Albany, N. Y.); Prince Edward Island, Sept. 8, 1888 (*Macoun?*) 433; Mt. Washington, New Hampshire, August 16, 1895, E. J. Harper 267.

On *Picea Engelmanni* (Parry) Engelm., Lake Louise, Canada,

Aug. 27, 1904, *E. W. D. Holway*; Laggan, Alberta, Canada, 6,500 feet altitude, September 20, 1905, *E. W. D. Holway*.

On *Picea sitchensis* (Bong.) Carr., Seldovia, Alaska, August 12, 1904, *C. V. Piper*, communicated by P. L. Ricker.

On *Picea canadensis* (Mill.) B. S. P., Kenai, Alaska, August 18-20, 1904, *C. V. Piper*, communicated by P. L. Ricker.

A common species northward, of an essentially alpine character. It occurs on the summits of the Adirondack and White Mountains, islands of the Atlantic coast from Mt. Desert to Newfoundland, and along the mountains of the Pacific coast from Banff, British Columbia, into Alaska. The species is especially marked by its very large spores, being much larger than of any other American *Peridermium*.

In 1882 and 1883 Dr. W. G. Farlow explored the subalpine summits of the White Mountains with the especial object in view of ascertaining the distribution of the species of *Peridermium*, and "their proximity to certain teleutosporic forms on *Ericaceae*." He discussed the results of his observations at considerable length in a paper before the Appalachian Club,* in which he concluded that *Per. colorans* was sufficiently like *Per. abietinum* of Europe to be considered synonymous, especially when taken with the known distribution of the rust on *Ledum*, which had recently been shown by De Bary to be the telial form. This conclusion was accepted by German botanists, as well as American, and a collection made on Mt. Washington, New Hampshire, was issued in Rabenhorst's *Fungi Europaei* under the name "*Chrysomyxa Ledi* (A. & S.)."

In the score of years since these observations were made much knowledge of the distribution of rusts has accumulated, and it is now apparent that there are two species of rusts on *Ledum*, and that it is *Uredo ledicola* Peck, with which the distribution of *Per. decolorans* corresponds, and not with the one common to Europe and America, generally called *Chrysomyxa Ledi*. Moreover, the spores of *Per. decolorans* are very much larger than those of *Per. abietinum*, a difference corresponding with the difference in size of the uredospores of the two forms on *Ledum*. We believe, in fact, that judging both from structural characters and geographical distribution, *Per. decolorans* is the aecial form of what in most herbaria is called *Uredo ledicola*.

* Appalachia 3: 239-243. 1884. See also Proc. Am. Acad. 20: 320. 1885.

20. *PERIDERMIIUM ABIETINUM* (A. & S.) Thuem. Mitth.

Forstl. Vers. Oest. 2: 320. 1880

Aecidium abietinum Alb. & Schw. Consp. Fung. Nisk. 120. 1805.

O. Pycnia amphigenous, numerous, inconspicuous, forming imperfect rows on either leaf-surface, subepidermal, honey-yellow becoming reddish-brown, globose, 100–150 μ broad, 100–130 μ high.

I. Aecia from a limited mycelium, hypophyllous in two rows on yellow spots occupying part or all of a leaf, erumpent from slits 0.3–1.5 mm. long, low, 0.5 mm. or less high, dehiscent at apex; peridium colorless, delicate, lacerate, cells abutted, outer wall and portions in contact much thickened, 5–7 μ , transversely striate, inner wall thin and smooth; aeciospores ellipsoid, 15–22 by 20–35 μ , wall colorless, 2–3 μ thick, strongly and densely verrucose with the exception of a smooth longitudinal stripe.

On *Picea excelsa* (Lam.) Link, in Europe, but not yet found in America. The peridial cells of this species, like those of *Per. decolorans*, are abutted, and not overlapped as in related forms. The cells of the peridium, as well as the spores, are smaller than in *Per. decolorans*, and the spores also have a smooth line, not found in *Per. decolorans* or other American forms. It is the aecial form of *Chrysomyxa Ledi* (A. & S.) DeB. The telial form has been collected in the White Mountains, New Hampshire, northern Wisconsin, and the Yellowstone Park, and consequently the aecial form should eventually be found in America.

21. *Peridermium pseudo-balsameum* (D. & H.) nom. nov.*Aecidium pseudo-balsameum* D. & H. Erythea 7: 98. 1899.

O. Pycnia hypophyllous, rather numerous, inconspicuous, scattered, honey-yellow becoming blackish-brown, subepidermal, globose, large, 160–175 μ broad.

I. Aecia from a limited mycelium, hypophyllous, sparsely arranged in two rows, on yellow spots occupying a part or all of a leaf, deep-seated, cylindrical, 0.4–0.6 mm. in diam. by 0.75–1 mm. high, dehiscent at apex becoming deeply lacerate; peridium colorless, rather delicate, cells overlapping, walls not striate, inner very coarsely verrucose, 5–7 μ thick including tubercles, outer thinner, 3–4 μ ; aeciospores broadly ellipsoid, 18–22 by 23–28 μ , wall colorless, medium thick, 2.5–3.5 μ , closely and rather finely verrucose.

On *Abies grandis* Lindl., Eureka, California, June 4, 1896,

W. C. Blasdale & M. A. Howe. Known only from the type locality, although not an inconspicuous species.

22. *PERIDERMIIUM HOLWAYI* Sydow, Ann. Myc. **1**: 19. 1903

O. Pycnia chiefly hypophyllous, rather numerous, scattered, inconspicuous, scarcely arising above the surface of the epidermis, honey-yellow becoming brown, subepidermal, usually destructive to the epidermal cells above, large, 145–160 μ in diameter.

I. Aecia from a limited mycelium, amphigenous, scattered on yellow areas occupying part or all of a leaf, slightly tongue-like or flattened-cylindrical, 0.2–0.4 mm. across by 0.3–0.6 mm. long, low, 0.4–0.8 mm. high; peridium colorless, delicate, dehiscence irregular, margin becoming lacerate, cells overlapping, walls not striate, outer thin, inner considerably thickened, and strongly tuberculate; aeciospores broadly ellipsoid, 15–18 by 18–24 μ , wall colorless, thin, about 1 μ , evenly and finely verrucose.

On *Pseudotsuga mucronata* (Raf.) Sudw. (*Pseudotsuga Douglasii* Carr., *Abies Douglasii* Lindl.), Glacier, British Columbia, August 11, 1901, *E. W. D. Holway*. Known only from the type locality.

23. *Peridermium conorum-Piceae* (Reess) nom. nov.

Aecidium conorum-Piceae Reess, Abh. Nat. Ges. Halle **11**: (54). 1869.

Peridermium conorum Thuem. Mitth. Forstl. Vers. Oest. **2**: 313 (17). 1880.

Peridermium Engelmanni Thuem. Mitth. Forstl. Vers. Oest. **2**: 314 (18). 1880.

Aecidium Engelmanni Dietel, in Engler & Prantl, Pflanzenfam. **1**¹** : 79. 1897.

O. Pycnia episcumous, numerous, subepidermal, flat, forming continuous layers, 600–900 μ broad, 50–100 μ high, inconspicuous, not noticeably elevating the surface.

I. Aecia chiefly episcumous, subepidermal, forming bullate swellings, irregularly round, large, crowded and often confluent, finally rupturing the epidermis, very pulverulent; peridium irregularly convex, soon dropping away, cells broadly ellipsoid or globose, loosely united, coarsely tuberculate, resembling the spores; aeciospores broadly elliptical or obovoid, large, variable in size, 20–27 by 25–40 μ , wall colorless, thick, 4–5 μ , half formed by the large deciduous tubercles, which are rather crowded, broad, 3–4 μ , and depressed.

On cones of *Picea Mariana* (Mill.) B. S. P. (*Abies nigra* Desf.), Lake Sunapee, New Hampshire, July 30, 1891, and foot of Mt. Lafayette, New Hampshire, July, 1895, *W. G. Farlow* (both specimens in Crypt. Herb. of Harvard Univ.).

On cones of *Picea rubra* (Lamb.) Link (*P. rubens* Sarg.); Fulton Chain, Herkimer County, New York, and North Elba, Essex County, New York, no date, *Chas. H. Peck* (both specimens in the herbarium of N. Y. State Museum, Albany).

On cones of *Picea canadensis* (Mill.) B. S. P. (*Picea alba* Link), Kittery Point, Maine, August 13, 1891, *Roland Thaxter* (in Seym. & Earle, Econ. Fungi no. 220).

On cones of *Picea Engelmanni* (Parry) Engelm., Colorado, no date, *T. S. Brandegee* 477 (specimen in herbarium of N. Y. Bot. Garden).

On cones of *Picea excelsa* L., Newton, Massachusetts, August, 1874, *W. G. Farlow* (specimen in Crypt. Herb. of Harvard Univ.).

The species is probably rather common and widely distributed, but owing to its occurrence high up on trees it is not often or easily collected. It has been suggested by Rostrup that this is the aecial form of *Chrysomyxa Pyrolae* (DC.) Rostr., but this has not yet been fully confirmed. The geographical distribution of the form on *Pyrola* in North America would favor this assumption.

24. PERIDERMIIUM COLUMNARE (A. & S.) Kunze & Schmidt, Deutschl. Schwämme 10. 1815

Aecidium columnare Alb. & Schw. Consp. Fung. Nisk. 121. 1805.

O. Pycnia rarely if ever formed.

I. Aecia from a limited mycelium, hypophyllous, numerous, usually forming rows on either side of the midrib, cylindrical, 0.1–0.15 mm. across, 0.4–0.7 mm. high; peridium colorless, delicate, rupturing at apex, becoming irregularly lacerate, cells slightly overlapping, inner wall finely verrucose, not noticeably striate, 2.5–3.5 μ thick, outer wall of equal thickness, smooth; aeciospores globose or broadly ellipsoid, 13–17 by 16–24 μ , wall colorless, rather thin, 1–1.5 μ , finely and closely verrucose.

On *Abies pectinata* DC. (*A. alba* Mill.) in Europe, but not yet found in America. It has been proven by incontestable cultures to be the aecial stage of *Calyptospora Goeppertiana* Kühn. The *Calyptospora* forms cylindrical swellings on stems of *Vaccinium*,

and is frequently collected in the New England states and along the Pacific coast, which makes it reasonably certain that the aecial form will be found eventually within the same regions.

A peculiarity of this *Peridermium* is the absence of pycnia. So far none have been found in authentic specimens, which makes one think that they may never occur. Very low, inconspicuous pycnia are to be found in a closely related species, which often passes under the same name (see Sydow, Ured. 896 and Vestergren, Micr. rar. sel. 754), a form also undetected in America.

25. PERIDERMIIUM ORNAMENTALE Arth. Bull. Torrey
Club 28: 665. 1901

Aecidium ornamentale Farl. (non Kalchbr. 1875) Bibl. Index 1:
71. 1905.

O. Pycnia amphigenous, numerous, flat, often confluent, inconspicuous, subcuticular, in section broad and low, slightly convex or even a little conical, 130–210 μ broad, 25–35 μ high.

I. Aecia from a limited mycelium, hypophyllous in two rows on yellowish spots occupying part or all of the leaf, large, 1–2 mm. high, somewhat flattened laterally; peridium bladdery, colorless, rupturing irregularly, cells overlapping, rather large, outer wall smooth, rather thin, 2 μ , inner wall thicker, 3–5 μ , moderately verrucose; aeciospores with cylindrical intercalary cells, 3–4 by 5–8 μ , spores broadly ellipsoid, 13–18 by 20–29 μ , wall colorless, thin, 1–1.5 μ , closely and finely verrucose; contents orange-red, fading to pale-yellow.

On *Abies lasiocarpa* (Hook.) Nutt., mountains of Skamania County, Washington, August 11, 1886, *W. N. Suksdorf* 296; Mt. Paddo, Washington, 6000 ft. alt., September 4, 1900, *W. N. Suksdorf* 588 (type collection); Laggan, Alberta, Canada, 6500 ft. alt., September 20, 1905, *E. W. D. Holway*.

26. PERIDERMIIUM PECKII Thuem. Mitth. Forstl. Vers.
Oest. 2: 320 (24). 1880

Aecidium Peckii Dietel, in Engler & Prantl, Pflanzenfam. 1¹** : 78.
1897.

O. Pycnia hypophyllous, numerous, scattered, inconspicuous, subcuticular, extending considerably into the walls of the epidermal cells, in section broad and low, slightly convex or even a little conoidal, small, 65–125 μ broad, 20–26 μ high.

I. Aecia from a limited mycelium, hypophyllous in two rows on yellow spots occupying part or usually all of the leaf, deep-seated, small, 0.2–0.3 mm. in diam., 0.5–1 mm. high, cylindrical; peridium colorless, dehiscence at apex, cells overlapping, only loosely joined, readily falling apart, rather slender, inner wall moderately verrucose, 4–5 μ thick, outer wall smooth and thinner; aeciospores broadly ellipsoid, 15–18 by 18–27 μ , wall colorless, thin, about 1 μ , finely and evenly verrucose.

On *Tsuga canadensis* (L.) Carr. (*Abies canadensis* Michx.), Buffalo, New York, no date, G. W. Clinton (specimen in herbarium of U. S. Dept. Agric.), Shelburne, New Hampshire, September, 1882, W. G. Farlow (in Ellis, N. A. F. no. 1023); Utica, New York, December 9, 1886 and February, 1887, Daniel Batchelor; Wellesley, Massachusetts, June, 1889, Grace E. Cooley (in Seym. & Earle, Econ. Fungi no. 225 a); Manchester, Massachusetts, July, 1890, W. C. Sturgis (in Seym. & Earle, Econ. Fungi no. 225 b); Blacksburg, Virginia, July 14, 1897, W. A. Murrill (specimen in herbarium of the N. Y. Bot. Garden); near Tibb's Run reservoir, West Virginia, June 15, 1904, John L. Sheldon.

27. PERIDERMIIUM ELATINUM (A. & S.) Kunze & Schmidt,
Deutschl. Schwämme 141. 1817

Accidium elatinum Alb. & Schw. Consp. Fung. Nisk. 121. 1805.

O. Pycnia epiphyllous, few, scattered, punctiform, inconspicuous, subcuticular, not extending much into walls of epidermis, in section depressed-hemispherical, small, 100–130 μ broad, 40–50 μ high.

I. Aecia from a perennial mycelium, dwarfing the young shoots and forming witches' brooms, hypophyllous, forming two irregular lines, deep-seated, wholly dropping out of the substratum at maturity, roundish or irregularly oblong, large, 0.5–1 mm. across, bladdery, soon open by falling away of the upper part; peridium colorless, dehiscence irregular, cells with thin inner and outer walls; aeciospores broadly ellipsoid or nearly globoid, 14–18 by 16–28 μ , wall colorless, thin, 1–1.5 μ , closely and rather finely verrucose.

On *Abies balsamea* (L.) Mill., Ripton, Vermont, no date, E. Brainerd (in Ellis, N. A. F. no. 1437); Andover, Massachusetts, no date, Joseph Blake, communicated by P. L. Ricker; Riverhead, Bay of Islands, Newfoundland, September 12, 1885, A. C. Waghorne; La Pointe, Wisconsin, 1896, L. S. Cheney (specimen in

herbarium N. Y. State Museum, Albany); Sailor's Encampment, Michigan, August 5, 1899, *E. T. Harper 316*, communicated by E. W. D. Holway; Isle Royal, Michigan, September 4, 1901, *Stuntz & Allen* (in Ellis & Everh. Fungi Columb. no. 1620); Isle au Haut, Maine, August 20, 1900, *J. C. Arthur*.

On *Abies lasiocarpa* (Hook.) Nutt. (*A. subalpina* Engelm.), Yellowstone Park, Wyoming, August, 1884, *Frank Tweedy*; Black Mountain, Manti, Utah, 8000 ft. alt., August 6, 1895, *Marcus E. Jones*; Battle Lake, Wyoming, August 18, 1897, *Aven Nelson 4244*; Mystic Lake, Bozeman, Montana, 7000 ft. alt., August 1, 1898, *J. W. Blankinship*, communicated by E. W. D. Holway; Brush Creek, Utah, 9000 ft. alt., July 27, 1900, *Pammel & Stanton 642*; Aquarius Plateau, Utah, August 5, 1905, *Rydberg & Carlton 7462*.

On *Abies religiosa* Lindl., Orizaba, Mexico, 1901, *J. N. Rose 5753* (specimen in herbarium of U. S. Dept. Agric.).

A wide-spread and conspicuous species. It appears to be identical in both gross appearance and microscopic structure with the European form of the same name, which through the numerous cultures by Klebahn and Fischer has been proven to be the aecial stage of *Melampsorella Ccrastii* (Pers.) Schröt. The uredinial and telial forms of this species on *Alsine*, *Stellaria* and *Cerastium* are very inconspicuous, but have been collected a few times in the United States.

28. PERIDERMIIUM BALSAMEUM Peck, Rep. N. Y. State

Mus. 27: 104. 1875

Aecidium balsameum Dietel, in Engler & Prantl, Pflanzenfam.

I^{1**}: 78. 1897.

O. Pycnia hypophyllous, few, scattered, punctiform, inconspicuous, honey-yellow, small, subcuticular, extending into the lateral walls of epidermis, in section hemispherical, 100–130 μ broad, 35–50 μ high.

I. Aecia from a limited mycelium not changing form of leaf, hypophyllous in two irregular rows on yellowish spots occupying a part or all of a leaf, white even before spores are discharged, deep-seated, cylindrical, or somewhat flattened laterally, rather small, 0.2–0.5 mm. across, opening at apex; peridium colorless, margin erect, erose or somewhat lacerate, cells overlapping, with medium thick walls, 2–4 μ , the outer smooth, inner somewhat

thicker and rather coarsely verrucose; aeciospores broadly ellipsoid or globoid, 18–22 by 20–30 μ , wall thin, 1–1.5 μ , densely and rather coarsely verrucose; contents colorless.

On *Abies balsamea* (L.) Mill., Kings Ravine, Mt. Adams, New Hampshire, August, 1882, *W. G. Farlow* (in Ellis, N. A. F. no. 1025, and de Thuemen, Mycoth. Universalis, no. 2258); Vermilion Lake, Minnesota, July 24, 1886, *E. W. D. Holway* 208; Mt. Moosilauke, New Hampshire, August 26, 1884, *Miss Clara E. Cummings*; Ellis River, New Hampshire, August, 1889, *L. M. Underwood*; Catskill Mountains, Greene County, New York, August, 1894, *J. F. James* (specimen in herbarium of U. S. Dept. Agric.); Newfoundland, 1894, *Robinson & Schrenk*; Summit of Mt. Washington, New Hampshire, August 16, 1895, *E. T. Harper* 268; Neebish Island, Michigan, August 25, 1899, *E. T. Harper* 333; Adirondack Mountains, New York, no date, *Chas. H. Peck*; Delaware County, Iowa, 1890, collector unknown, communicated by Prof. T. H. Macbride.

On *Abies grandis* Lindl., southern slope of Mt. Paddo, Washington, October 31, 1903, *W. N. Suksdorf* 965.

This species is especially characterized by white spores, which also occur in *Aecidium pseudo-columnare* Kühn. The probable identity of the two forms was pointed out by Farlow,* and our studies confirm this opinion. The only difference we could detect was that the peridial cells were a little more coarsely verrucose in the American specimens. But our European material for the study was scanty, and even this seeming difference may not be constant. Should the two be found to be identical, Kühn's name should be added to the above as a synonym, as it was published about ten years later than the one by Peck.

29. *Peridermium Laricis* (Kleb.) nom. nov.

Aecidium Laricis Kleb. Zeits. Pflanzenkr. 9: 18. 1899.

O. Pycnia amphigenous, rather numerous, scattered, inconspicuous, subcuticular, pale-yellow, flattened-conical, 50–65 μ in diameter by 20–30 μ high; pycniospores oval, 1.5–2 μ long, abundant.

I. Aecia from a limited mycelium, hypophyllous, solitary or in rows on one or both sides of the midrib, flattened laterally, or

* Proc. Am. Acad. 20: 322. 1885.

subcylindrical, 0.1–0.15 mm. wide, 0.3–1 mm. long, by 0.3–0.5 mm. high; peridium light reddish-orange fading to white, rupturing along the apical line, peridial cells rhomboidal in longitudinal section, 25–30 μ long, somewhat overlapping, inner wall finely verrucose, transversely striate, 2–3 μ thick, outer of equal thickness, smooth; aeciospores globoid or broadly ellipsoid, 12–18 by 16–25 μ , wall colorless, rather thin, 1–1.5 μ , closely and evenly verrucose, except a small area on one side which is smooth and slightly thinner.

On *Larix decidua* Mill. in Europe, not yet detected in America. It has been shown by Klebahn and others to be the aecial stage of *Melampsorium betulinum* (Tul.) Kleb. The uredinal and telial stages occur on *Betula*; they have been collected in many localities in this country, both east and west, and the *Peridermium*, which is quite inconspicuous, will doubtless be found also.

30. PERIDERMIIUM EPHEDRAE Cooke, Indian Forester 3: 95.

1877

Peridermium Pini minor B. & C. Grevillea 3: 59. 1874.

Coleosporium Senecionis minus De Toni; Sacc. Syll. Fung. 7: 752. 1888.

Aecidium Ephedrae Dietel, in Engler & Prantl, Pflanzenfam. 1^{1**}: 79. 1897.

O. Pycnia caulicolous, numerous, conspicuous, subcuticular, scattered irregularly over large areas, honey-yellow becoming golden-brown, conical, or often with broad flat top, 75–130 μ broad, 50–70 μ high.

I. Aecia from a perennial mycelium, caulicolous, numerous, scattered over the slightly hypertrophied shoots, cylindrical, slender, 0.3–0.4 mm. in diameter, 1.5–2.5 mm. high, dehiscent at apex; peridium colorless, firm, cells slightly or not overlapping, walls rather thin, outer smooth, inner somewhat thicker and finely verrucose; aeciospores broadly ellipsoid or globoid, 16–20 by 19–26 μ ; wall colorless, thin, 1–1.5 μ , closely and finely verrucose.

On *Ephedra nevadensis* S. Wats. (*E. antisiphilitica* S. Wats.), Arizona, no date, H. H. Rusby.

On *Ephedra pedunculata* Engelm. (as on "*E. antisiphilitica*"), Texas, no date, Chas. Wright (in Ravenel, F. Car. Exsicc. 3: 95, part of type collection); Bradshaw Mountains, Arizona, June 20, 1892, J. W. Toumey (as on "*E. oxycarpa*"); San Luis Potosi,



Arthur, Joseph Charles and Kern, Frank D. 1906. "North American species of Peridermium." *Bulletin of the Torrey Botanical Club* 33, 403–438.

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