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A PRELIMINARY LIST
OF THE
RUSTS OF BOONE COUNTY

by

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INTRODUCTION

A complete list of the rusts of Boone County has not been published. In the year 1889 Dr. B. T. Galloway of the U. S. Department of Agriculture, published a preliminary list of the parasitic fungi of Missouri. The specimens which Dr. Galloway collected were destroyed at the time of the fire which demolished the main building of the University in February, 1892. This list included one hundred and two rusts, only three of which are mentioned specifically as having been collected in Boone County. Twenty-six of the list are mentioned as common forms, and were probably found in this immediate vicinity. The larger number of the remainder of the forms were collected in Perry County, located on the Mississippi river in the southeastern part of the state.

Since that date a considerable number of specimens has been collected, largely from this region, and placed in the herbarium of the University. The collection contains a

total of four hundred and forty-three specimens. Most of these were collected on general field trips taken by different members of the Department of Botany, in the years 1910, 1911 and 1912, but no systematic collection of Rusts has been undertaken.

The localities in which the collections were made were Columbia and vicinity; Rock Bridge vicinity, seven miles south of Columbia; McBaine and eastward two miles; Perche Creek vicinity, three miles west of Columbia on the Rocheport road, south of the bridge; and the Pinnacles vicinity, twelve miles north of Columbia.

In most cases the host plant for each specimen was identified at the time of collection, and a provisional identification made of the rust. No further work has been done on the collection until the present time. The present work has consisted in establishing the identity of the host plant, wherever this was in doubt, by reference to written descriptions and by comparison with the herbarium specimens of the F. P. Daniels collection of the flora of Columbia and vicinity; and a careful macroscopic and microscopic examination of the rust, including comparisons with written descriptions and with specimens in the general collection in the herbarium.

It has been the purpose of the present work to identify the rusts occurring in the collection and arrange them in order according to the classification accepted at the present time. This collection and arrangement may then serve as a basis for further work. The present list doubtless includes but a small portion of the Rusts to be found in this region, and the addition

to the collection of other forms from this locality, as well as from the remainder of the state, is very desirable. It is quite probable that the rust flora of Missouri is as abundant and diversified as that of any other state.

Authorities

All identifications of host plants were made to conform to Gray's New Manual of Botany, seventh edition, 1908. For the Rusts, Sydow's Monographia Uredinearum, Vols. I (1904), II (1910), III (fascicle 1, 1912), covering the genera Puccinia, Uromyces, Gymnoconia, Gymnosporangium and Phragmidium, is followed. The other genera represented in the collection, Bubakia, Coleosporium and Melampsora are not treated in the published volumes of Sydow's monograph. For these, Arthur's Classification of North American Uredinales in North American Flora, Vol. 7, Parts 2 and 3, is used. The genera Gymnoconia, Gymnosporangium, Phragmidium, Uromyces, and a portion of the genus Puccinia are described in the same work of Arthur. Sydow's work is followed for these, and Arthur's work used for comparison, especially as to the hosts for specific forms. Some modification of Sydow's description is accepted for a few forms of the genus Puccinia on the ground of cultural experiments, the results of which have been published since the appearance of Sydow's Monograph. Preference is given to Sydow's classification because of its international character, and because it represents the arrangement most generally accepted at the present time.

General Description of Rusts

As far as is known, every rust species is an obligate parasite upon seed plants or ferns. All attempts to grow them upon artificial media have resulted in failure beyond the stages of germination.

The growth of the fungus upon the host plant is internal, sometimes causing considerable deformity of the latter. The vegetative portion of the fungus is a septate mycelium, generally local in extent, which penetrates the intercellular spaces of the host tissue and absorbs nourishment from the living protoplasm of the host cells by means of minute haustoria which penetrate the cell walls and contents.

The development of a considerable mycelium is succeeded by the development of fruiting bodies termed spores, consisting of from one to several cells. The spore forms which may occur are of five general types. These are, in the order of their production from the mycelium, as follows: (1) Pycnospores (*) (spermatia), borne in pycnidia (spermogonia); (2) aecidiospores, borne in cup-like structures, aecidia; (3) uredospores, borne in pustules or sori; (4) teleutospores, borne in sori similar to the uredo sori; (5) sporidia. The last are not developed from the vegetative mycelium directly, but upon a four-celled structure, the promycelium, developed from the germinating teleutospore. The first four of the above spore forms or the corresponding stages of development of the rust, are represented in the order given

(*) The terminology is that used by Sydow.

above, respectively by 0, I, II, III. A rust species may include from one to five of these forms. All the forms present in a particular rust species may be produced upon the same host giving a condition known as autoecism; or upon two (rarely three) different hosts in regular order, usually with 0 or I or both on one host and II and III, or III upon the other, giving a condition called heteroecism. Aecidial stages are especially abundant in the spring, followed by the uredo stage, if present, and finally by the teleuto stage, which is most abundant in the late summer and autumn. The spore forms may appear in close succession or be scattered through several months. In some forms the mycelium is perennial but in most cases dies after its final production of spores or with the host plant.

According to the number and type of spore forms present in a particular species, a classification into types has been devised. These are as follows:

Eu forms with all stages; or 0, I, II, III present.

Brachy forms with aecidia omitted; or 0, II, III present.

Opsis forms with uredo omitted; or 0, I, III present.

Hemi forms with pycnidia and aecidia omitted; or II, III present.

Micro forms with teleutospores only; or III present, germinating only after a resting period.

Lepto forms with teleutospores only; or III present, germinating immediately.

Dr. Duggar¹ has proposed a combination of the above terms, together with the terms auto and hetero expressing autoecism and

¹Fungous Diseases of Plants, p. 388.

heteroecism respectively, where this is necessary, with a root word *uredo*, into single terms applicable to all genera having similar spore forms present. According to the scheme suggested, the rusts are divisible into the following groups: *Euautouredo*, *Euheterouredo*, *Brachyautouredo*, *Opsiautouredo*, *Opsiheterouredo*, *Hemiuredo*, *Microuredo*, and *Leptouredo* forms. *Brachyheterouredo* forms do not occur because II and III are found on the same host and the pycnospores are functionless. No term is given applying to forms with only 0 III, 0 II, or II present.

Sexuality

The rusts are believed to have a definite though modified form of sexuality. Cytological studies by Blackman¹, Christman², and Olive³ have shown that a fusion takes place between two cells of the mycelium resulting in a binucleated cell from which binucleated spores are produced. For a *Eu* form this fusion takes place just before the formation of aecidiospores. Two cells of adjacent hyphae lying in the base of the developing aecidium fuse at their outer ends forming a binucleated cell. This cell then acts as a basal cell from which a row of aecidiospores is produced. The paired nuclei of the basal cell divide simultaneously, producing four nuclei, two of which, one from each division, pass toward the outer end of the cell, which is then cut off by a cross wall. The binucleated cell thus formed then undergoes a nuclear division similar to the one described, with the production of two binucleated cells. The inner of these

¹Annals of Botany, Vol. 18 (1904) pp. 323-375.

²Botanical Gazette, Vol. 44 (1904) pp. 81-101.

³Annals of Botany, Vol. 22, pp. 331-360.

becomes a small, flattened, apparently functionless cell known as an intercalary cell; the outer cell develops into a binucleated aecidiospore.

The aecidiospore on germination gives rise to a mycelium, composed of binucleated cells, which produces binucleated uredospores by a process similar to the production of aecidiospores, but without fusion of cells, and later and similarly to young teleutospores with binucleated cells. The uredospores on germination give rise to a mycelium, similar to the one which produced them and which in turn produces uredospores and later teleutospores. An apparently indefinitely large number of generations of this stage of a rust may be produced by means of successive series of uredospores.

The young teleutospore contains in each cell two nuclei which fuse as the spore matures. On germination of the teleutospore, this nucleus divides twice to form four daughter nuclei each of which becomes the nucleus of a cell of the short, thread-like, four-celled promycelium. By a budding process each cell of the promycelium produces a small sporidium into which the nucleus passes. The sporidia on germination give rise to the aecidial stage.

In other than *Eu* forms this process is somewhat modified in details and stages, but is essentially the same, as far as known, in the production of a binucleated condition with ultimate fusion of the nuclei, which is later followed by a reduction division. Thus a regular alternation of cytological conditions occurs, which, from its similarity to that present in the higher plants, has led to the belief by many investigators that this is a modification of the sexual process.

Classification

The rusts include the fungi occurring in the order Uredinales of the class Basidiomycetes. The order is divided by different writers into families which differ in terminology, but agree generally in the forms included by each, with the exception of Dietel's Melampsoraceae, which includes two of Arthur's families and three of Fischer's. Table I shows the names and the limits of the families given in four of the principal classifications now in use.

Table I

Arthur	Sydow	Fischer	Dietel
I Coleosporiaceae	?	Coleosporiaceae	Melampsoriaceae
II Uredinaceae	?	Gronartiaceae	Endophyllaceae
		melampsoriaceae	Schinzosporaceae
III Aecidiaceae	Pucciniaceae	Pucciniaceae	Pucciniaceae

Arthur's arrangement is based upon a consideration of (1) the time of the occurrence of the sexual process or its equivalent, and (2) the number of spore forms present in the life cycle, assuming that the primitive forms of rusts possessed the complete cycle of pycnospores, aecidiospores, uredospores, and teleutospores, now present in only a portion of the known forms. The other classifications are based primarily upon the form of the teleutospores and their type of germination. The result of the two methods of classification is that the limits of the family groupings and the number of species are practically the same in the

Table No. II.

Family	Genus	Genera			Species			Total Specimens coll. in Boone Co.
		Coll. in Boone Co.	Total Syd. world	Total Arth. No. Am.	Coll. in Boone Co.	Total Syd. world	Total Arth. No. Am.	
Coleosporiaceae	Coleosporium	1	?	7	4	?	24	28
Uredinaceae	Melampsora**							
	(Uredo)	2	?	22	2	?	7	10
	Bubakia				1	?	2	5
Pucciniaceae (Aecidiaceae)	Gymnosporangium				4	43	32	42
	Gymnoconia				1	3	2	3
	Phragmidium				2	63	16	2
	Uromyces				11	421	(126)	42
	Puccinia	5	26	46	37	940	?	300
	Summary	8	(26)	75	62	(1370)	(209)	432

Coll. = Collected Syd. = Sydow Arth. = J.C. Arthur

? = unknown Figures in parentheses are incomplete.

two systems, while Arthur's method results in splitting up and rearranging the old generic groups into a considerably larger number of, and for the most part, smaller genera.

In this paper Sydow's arrangement is used as far as available. This includes only the Pucciniaceae corresponding to the Aecidiaceae of Arthur. For the forms not included in this family, Arthur's division into Coleosporiaceae and Uredinaceae is followed.

The order Uredinales includes about two thousand species which are distributed by Arthur among seventy-five genera. Sydow's distribution is known only for the Pucciniaceae in which twenty-six genera are listed. The Boone County collection contains eight genera and sixty-two species. The distribution of these according to the arrangement adopted for this work is shown in Table II.

This table shows the smallness and incompleteness of the Boone County collection in comparison with the known genera and species of North America and of the world. This is to be expected of any collection made in a locality of such limited extent, and made in such a fragmentary manner. The collection is, however, seen to be fairly representative of the Uredinales. All of the families are represented. The six chief genera of

Reference to Table II. ** The name *Melampsora* is used for this genus in preference to Arthur's term *Uredo* because the former term is the most widely used and its use serves to prevent confusion with the numerous older forms known under the latter term.

the order, Coleosporium, Melampsora, Gymnosporangium, Phragmidium, Uromyces, and Puccinia, are represented about in proportion to their numerical importance.

In the following pages is given a complete list of the Boone County collection arranged alphabetically according to genera and species. Under each form is given the hosts on which it is present in the collection with, as far as possible, the date and locality of collection, and the collector.

The forms which were represented in Dr. Galloway's collection are indicated by the letters B. T. G. followed by the number under which it appeared in his published list, in parenthesis.

The collectors whose initials appear in the list are as follows: Dr. G. M. Reed, Dr. E. J. Durand, Dr. B. T. Galloway, Dr. B. M. Duggar, H. S. Reed, Charles Brooks, J. P. Bennett, E. H. Favor, and L. E. Cline.

List of Boone County Rusts.

COLEOSPORIACEAE.

1. Coleosporium Elephantopodis (Schw.) Thüm.

Elephantopus Carolinianus Willd. II.

Columbia, 9-28-08, G. M. R.; Pinnacles, 10-26-12.

2. Coleosporium Solidaginis (Schw.) Thüm.

Aster sagittifolius Wede. II.

Columbia, 6-13-03, 7-14-03; McBaine, 10-30-08, G. M. R.;

Rock Bridge, 10-19-12; Perche Creek, 10-22-12.

Aster Tradescanti L. II.

Perche Creek, 10-22-12.

Solidago Caesia L. II.

McBaine, 10-12-12.

Solidago Canadensis L. II.

Columbia, 9-25-03; McBaine, 10-12-12.

Solidago latifolia L. II.

Columbia, 10-10-12; Rock Bridge, 10-19-12.

Solidago nemoralis Ait. II.

Columbia, 10-14-10, G. M. R.

Solidago radula Nutt. II.

Perche Creek, 10-22-12.

Solidago serotina Ait. II.

Rock Bridge, 10-19-12; Pinnacles, 10-26-12.

Solidago (sp. indet.) II.

Columbia, 10-7-08, G. M. R.

3. *Coleosporium Terebinthinaceae* (Schw.) Arth.

Silphium integrifolium Michx. III.

Columbia, 10-27-12, G. M. R.

Silphium perfoliatum L. III.

Rock Bridge, 10-19-12; Perche Creek, 10-22-12;

Pinnacles, 10-26-12.

4. *Coleosporium Vernoniae* B. & C. (B. T. G. 44)

Vernonia Baldwini Torr. II, III.

Columbia, 10-15-07, 10-13-10, G. M. R., 10-15-12,

J. P. B.; Rock Bridge, 10-19-12.

Vernonia glauca (L.) Willd. III.

Columbia, 7-7-12.

UREDINACEAE.

5. *Bubakia Crotonis* (Cke.) Arth. (B. T. G. 46)

Croton Capitatus Michx. II, III.

Columbia, 9-28-10, G. M. R.

Croton Monanthogynus Michx. II, III.

Columbia, 9-23-06, B. M. D.; 10-7-10, 9-30-12, G. M. R.;

Rock Bridge, 10-19-12.

6. *Melampsora Bigelowii* Thüm. (B. T. G. 47)

Salix longifolia Muhl. II.

Columbia, 9-5-03, B. M. D.; 10-5-12, G. M. R.; Rock

Bridge, 10-19-12; Pinnacles, 10-26-12.

7. Melampsora Medusae Thüm.

Populus deltoides Marsh. II, III.

Huntsdale, 9-5-03, H. S. R.; Columbia, 1904, C. B.;

McBaine, 10-30-08; Columbia, 10-5-12, G. M. R.;

10-10-12, J. P. B.; Pinnacles, 10-26-12, J. P. B.

PUCCINIACEAE.

8. Gymnoconia reckiana (Howe) Trot. (B. T. G. 42, 73)

Rubus Allegheniensis Porter I.

Columbia, 5-25-07, B. M. D.; 5-12-11, 5-25-11, 5-21-12,

G. M. R.; McBaine, 5-12-10.

9. Gymnosporangium clavipes Cke. & Pk.

Crataegus punctata Jacq. O, I.

Columbia, ?, B. M. D.

10. Gymnosporangium globosum Farl. (B. T. G. 87?)

Crataegus Crus-galli L. O, I.

Columbia, 6-13-03; 6-?-08, G. M. R.; 5-29-10; 5-30-10;

7-1-11, G. M. R.

Crataegus mollis (T. & G.) Scheele. O, I.

Columbia, 7-1-02; 6-13-03, B. M. D.; 6-19-03, L. E. C.;

Summer '04; 6-17-07.

Crataegus rotundifolia Moench. O, I.

Columbia, 6-20-03, L. E. C.; 6-?-03; 5-29-10; 6-21-10.

Juniperus virginiana L. III.

Columbia, 3-29-11; 4-15-13, J. P. B.; 4-26-13, J. P. B.;

5-2-13, J. P. B.

11. Gymnosporangium Juniperi-virginianae Schw. (B. T. G. 88)

Pyrus angustifolia Ait. O.

Columbia, 6-13-03, B. M. D.

Pyrus ioensis (Wood) Bailey. O, I.

Columbia, 7-31-02; 7-8-08; 7-4-10; 7-1-11, G. M. R.;
9-30-12, G. M. R.; 10-10-12, J. P. B.; (-----?).

Pyrus malus L. O, I. (B. T. G. 88)

Columbia, 7-29-08, G. M. R.; 6-7-10, G. M. R.;
9-30-12, G. M. R.; McBaine, 7-4-11, G. M. R.

Juniperus virginiana L. III. (B. T. G. 45)

Columbia, 4-5-09, G. M. R.; 3-29-11; 4-16-12, G. M. R.;
4-26-13, J. P. B.; 4-30-13, J. P. B.; 5-2-12, J. P. B.

12. *Gymnosporangium nidus-avis* Thaxter.

Juniperus virginianae L. III.

Columbia, 3-29-11; 4-24-12, G. M. R.; 4-26-13, J. P. B.;
4-30-13, J. P. B.; 5-2-13, J. P. B.

13. *Phragmidium americanum* Diet.

Rosa (sp. indet.) III.

Rock Bridge, 10-19-12, J. P. B.

14. *Phragmidium potentillae* (Pers.) Karst.

Potentilla canadensis L. I.

Columbia, 5-7-12.

15. Puccinia Agropyrii Ell. & Ev.
 Clematis virginiana L.
 Boone County, 6-7-86, B. T. G.
16. Puccinia albiperidia Arth.
 Ribes gracile Michx. I.
 Columbia, 5-10-08, G. M. R.
17. Puccinia Asparagi DC.
 Asparagus officinalis L. III.
 Columbia, 10-15-07, G. M. R.; 11-15-12, E. J. D.
18. Puccinia Bolleyana Sacc.
 Sambucus canadensis L. I. (B. T. G. 34)
 McBaine, 6-7-10, 5-20-11, G. M. R.
19. Puccinia Caricis (Schum.) Reb. (B. T. G. 15)
 Carex (sp. indet.) II, III.
 Columbia, 10-11-91, 6-13-03, 4-4-09; Pinnacles,
 9-26-12; Rock Bridge, 9-19-12.
20. Puccinia Caricis-Asteris Arth.
 Aster cordifolius L. I.
 Columbia, 5-10-08, G. M. R.; 5-25-11, G. M. R.
 Aster sagittifolius Wedd. I. (B. T. G. 5)
 Columbia, 5-3-10, G. M. R.; McBaine, 5-12-10;
 5-20-11, G. M. R.
21. Puccinia Caricis-Erigerontis Arth.
 Erigeron annuus (L.) Pers. I. (B. T. G. 10)
 Columbia, 5-9-08; 5-3-10; 5-18-11, G. M. R.;
 Rock Bridge, 5-28-12.

Erigeron canadensis L. I.

Columbia, 5-18-11, G. M. R.; 6-13-03.

Erigeron pulchellus Michx. I.

Columbia, 5-9-08, G. M. R.

Erigeron ramosus (Walt.) B. S. P. I.

Columbia, 5-25-11.

22. *Puccinia caricis-solidaginis* Arth.

Solidago latifolia L. I.

McBaine, 5-12-10, 5-20-11, G. M. R.

Solidago speciosa Nutt. I.

Columbia, 5-10-10, G. M. R.

Solidago ulmifolia Muhl. I.

Columbia, 5-18-11.

23. *Puccinia coronata* Cda.

Avena sativa L. II, III.

var. American Banner,

Columbia, 7-4-12.

var. Great Dakota,

Columbia, 7-4-12.

var. Kherson,

Columbia, 7-4-12.

var. Lincoln,

Columbia, 7-4-12.

var. Red Rust Proof,

Columbia, 7-4-12.

var. Swedish Select,

Columbia, 7-4-12.

var. White Tartar,

Columbia, 7-4-12.

24. Puccinia Cyperi Arth.

Cyperus Hallii Brit. II, III.

Pinnacles, 7-8-11, G. M. R.

25. Puccinia Eatoniae Arth.

Ranunculus abortivus L. O, I.

Columbia, 4-1-10; 4-20-11; McBaine, 4-27-12, G. M. R.

26. Puccinia Ellisiana Thueum.

Andropogon scoparius Michx. III.

Columbia, 11-10-12, G. M. R.

27. Puccinia graminis Pers. (B. T. G. 65)

Avena sativa L. II, III.

Columbia, 6-14-08, G. M. R.

var. *trisperma* Schübl.

Columbia, 7-19-11.

var. *mutica* Alef.

Columbia, 7-19-11.

var. *montana* Alef.

Columbia, 7-19-11.

Avena sativa L. II.

Columbia, 6-25-11, G. M. R.

Dactylis glomerata L. II.

Columbia, 10-4-10.

Hordeum distichon L. II, III.

var. *abysinicum* Ser.

Columbia, 7-4-12.

var. *decipiens* Stend.

Columbia, 6-25-11, 7-4-12.

var. nigrescens Kcke.

Columbia, 6-25-11, 7-4-12, G. M. R.

var. nutans Schübl.

Columbia, 6-25-11, 7-4-12, G. M. R.

Hordeum hexastichon L. II, III.

var. parvillum Kcke.

Columbia, 6-21-11, 7-11-12, G. M. R.

var. pyramidatum Kcke.

Columbia, 6-25-11, 7-11-12, G. M. R.

Hordeum nigrescens L. x *Hordeum trifurcatum* Kcke. II, III.

Columbia, 7-11-12.

Hordeum stendellii x *Hordeum trifurcatum* II, III.

Columbia, 7-11-12.

Hordeum stendellii x *Hordeum trifurcatum* II, III.

Columbia, 6-25-11, G. M. R.

Hordeum tetrastichon L. II.

var. Coeruleascens Kcke.

Columbia, 6-25-11, G. M. R.

var. Ciorrhynchum Kcke. I, III

Columbia, 6-25-11, G. M. R.

var. nigrum Willd.

Columbia, 6-25-11, G. M. R.

Hordeum vulgare L. II.

var. Beardless.

Columbia, 6-29-12, G. M. R.

var. Black Canada.

Columbia, 6-29-12.

var. Black Hulless.

Columbia, 6-29-12.

var. Blue Ribbon.

Columbia, 6-29-12.

var. Champion.

Columbia, 6-29-12.

var. Champion Beardless.

Columbia, 6-29-12.

var. Manchuria.

Columbia, 6-29-12.

var. Oderbrucker.

Columbia, 6-29-12.

var. Reed's Triumph.

Columbia, 6-29-12.

var. Six-Rowed.

Columbia, 6-29-12.

var. Success Barley.

Columbia, 6-29-12.

var. Success Beardless.

Columbia, 6-29-12.

var. tetrastichon.

Columbia, 6-25-12.

Phleum pratense L. II.

Columbia, 7-17-11.

Poa (sp. indet.) II.

Columbia, 6-20-03, L. E. C.

Triticum compactum Host. II, III.

var. *Creticum* Mass.

Columbia, 6-29-12.

Triticum compactum Host. II, III.

var. *Rubidum* Kcke.

Columbia, 7-7-11, G. M. R.

Triticum dicoccum Schrk. II, III.

var. (not given)

Columbia, 7-10-12, 7-12-12.

var. *africanum* Kcke.

Columbia, 7-12-12, 7-10-12.

var. *Bruneum* Alef.

Columbia, 7-12-12.

var. *Cladurum* Alef.

Columbia, 7-12-12.

var. *Ferrum* Baylle.

Columbia, 7-12-12.

var. *Fuchsii* Kcke.

Columbia, 7-30-11, G. M. R.; 7-12-12.

var. *Common Emmer*.

Columbia, 6-28-11, 6-29-11, 7-5-11, G. M. R.

var. *Russian Emmer*.

Columbia, 7-12-12.

var. *Spring Emmer*.

Columbia, 7-12-12.

var. *White Emmer*.

Columbia, 6-29-11, 6-30-11, G. M. R.

Triticum durum Desf. II, III.

var. (not given)

Columbia, 7-5-12.

var. affine Kcke.

Columbia, 7-10-12, 7-12-12.

var. africanum Kcke.

Columbia, 7-3-11, G. M. R.; 6-29-12.

var. Arnantka

Columbia, 7-13-12.

var. Black Don.

Columbia, 7-13-12.

var. Fastuosum Fag.

Columbia, 7-7-11, G. M. R.

var. Hordeiforme Hort.

Columbia, 7-10-12, 7-12-12.

var. Kubanka.

Columbia, 6-29-11, 7-5-11, 7-6-11, G. M. R.;

7-5-12, 7-13-12.

var. Obscurum Rönn.

Columbia, 7-10-09.

var. Roumanian.

Columbia, 6-29-11, G. M. R.; 7-3-11.

var. Red Indian.

Columbia, 6-29-11, G. M. R.; 7-5-12.

var. Reichenbachii Kcke.

Columbia, 7-10-12.

var. Soretina Spring Wheat.

Columbia, 6-30-11, 7-5-11, G. M. R.

Triticum freycenetii Host.

Columbia, 7-8-11, G. M. R.; 7-5-12.

Triticum Polonicum L.var. *oblongum*.

Columbia, 7-10-11, G. M. R.

var. *Velutinum*.

Columbia, 7-13-11, G. M. R.; 7-5-11, G. M. R.

Triticum spelta L.

Columbia, 7-5-11, G. M. R.

var. *album* Alef.

Columbia, 7-8-11, G. M. R.; 7-5-12.

var. *coeruleum* Alef.

Columbia, 7-9-11, G. M. R.

Triticum thaoudar Boiss.

Columbia, 7-19-10, G. M. R.; 7-8-11, 7-13-11, G. M. R.

7-5-12.

Triticum tumonia L.

Columbia, 7-13-11, G. M. R.

Triticum turgidum L.

Columbia, 6-28-11, G. M. R.

var. *dinura*.

Columbia, 7-7-11, G. M. R.

Triticum vulgare Vill. II, III.var. *albidum* Alef.

Columbia, 7-7-11, G. M. R.; 7-5-12.

var. *alborubrum* Kcke.

Columbia, 7-19-11, G. M. R.

var. *aristatum* Schübl.

Columbia, 7-1-11, G. M. R.

var. erythospermum Keke.

Columbia, 6-28-11, G. M. R.; 6-25-11, G. M. R.

var. erythospermum aristatum.

Columbia, 7-5-12.

var. ferrugineum Alef.

Columbia, 6-12-11, G. M. R.; 7-5-12.

var. graecum Keke.

Columbia, 7-9-11, G. M. R.; 7-20-11.

var. Haines pedigree.

Columbia, 7-5-12.

var. leucospermum Keke.

Columbia, 7-7-11, G. M. R.

Triticum Vulgare Will. II, III.

var. Milturum Alef.

Columbia, 7-3-11, G. M. R.

var. Muticum Bayle.

Columbia, 7-1-11, G. M. R.

var. Nuticum Bayle.

Columbia, 7-3-11, G. M. R.

var. Muticum Alef.

Columbia, 6-27-11, 6-28-11, G. M. R.

var. Pyrothrix Alef.

Columbia, 7-19-11, G. M. R.

var. Tibetan.

Columbia, 7-5-12.

Triticum Vulgare x *Triticum durum* II, III.

Columbia, 7-7-11, G. M. R.

Triticum durum Desf. x *Triticum dicoccum* Schrk. II, III.

Columbia, 6-29-11, 7-3-11, 7-8-11, G. M. R.

Triticum dicoccum Schrk. x *Triticum Vulgare* Vill. II, III.

Columbia, 7-3-11, 7-7-11, G. M. R.

Triticum dicoccum Schrk. x *Triticum Vulgare* Vill. II, III.

Columbia, 7-4-12.

Triticum durum Desf. x *Triticum diococcum* Schrk. II, III.

Columbia, 7-4-12.

28. *Puccinia granulispora* Ell. & Gall.

Allium canadense L. O, I.

Rock Bridge, 5-28-12, G. M. R.

29. *Puccinia Helianthi* Schw. (B. T. G. 81?)

Helianthus annuus L. III. (B. T. G. 81?)

Columbia, 10-15-07.

Helianthus hirsutus Raf. II, III.

McBaine, 10-8-10, G. M. R.

Helianthus Strumosus L. O, I, II, III.

Columbia, 7-2-03, D. E. C.; 10-15-07, J. P. B.; 5-9-08;

5-10-10; McBaine, 10-8-10, G. M, R.; Pinnacles, 10-26-12;

5-20-11, G. M. R.

Helianthus tuberosus L. II, III.

Columbia, 9-28-08.

Helianthus (sp. indet.)

Columbia, 7-2-03.

30. *Puccinia Impatientis* (Schw.) Arth.

Impatiens pallida Nutt. I. (B. T. G. 19)

Columbia, 6-?-08, G. M. R.; 4-?-10, G. M. R.;

5-15-10, G. M. R.

31. Puccinia Krigiae Syd. (B. T. G. 55?)
Krigia amplexicaulis Nutt. III.
 Columbia, 5-25-11, G. M. R.
32. Puccinia Lobeliae Ger. (B. T. G. 68)
Lobelia syphilitica L. III.
 McBaine, 10-12-12, J. P. B.
33. Puccinia marylandica Lindr.
Sanicula marylandica canadensis (L.) Torr. O, I.
 McBaine, 4-27-12.
34. Puccinia maydis Bereng. (B. T. G. 71)
Zea mays L. II, III.
 Columbia, 10-16-10.
35. Puccinia Menthae Pers.
Blephilia hirsuta (L.) Raf. I.
 Columbia, 6-1-10, G. M. R.
36. Puccinia menthae Pers.
 var. *Americana* Burr.
Monarda fistulosa L. II, III. (B. T. G. 72)
 Rock Bridge, 10-19-12, J. P. B.; Columbia, 11-10-12;
 Pinnacles, 9-26-12.
Monarda fistulosa mollis L. I.
 Columbia, 7-14-03.
37. Puccinia myrrhis Schw.
Chaerophyllum procumbens (L.) Crantz. II.
 McBaine, 4-27-12.
38. Puccinia obtecta Peck.
Scirpus americanus Pers. II, III.
 Columbia, 7-12-11, G. M. R.

39. Puccinia Osmorrhizae (Peck) Cke. & Peck.
Osmorrhiza Claytoni (Michx) Clarke III.
 Columbia, 5-18-11, G. M. R.; 4-16-12.
Osmorrhiza longistylis (Torr) DC. I. (B. T. G. 74?)
 Columbia, 5-4-09, G. M. R.
40. Puccinia Peckii (DeToni) Kellerm.
Oenothera biennis L. I. (B. T. G. 23)
 Columbia, 6-13-03; N, Jf.; 8-22-11, G. M. R.
41. Puccinia peridermiospora (Ell. & Tracy) Arth. (B. T. G. 14)
Fraxinus pennsylvanica Marsh. I.
 var. *lanceolata* (Borkh.) Sarg.
 Rock Bridge, 5-28-12.
42. Puccinia phlei-pratensis (Eriks. & Henn.)
Phleum pratense L. II.
 Columbia, 6-30-10, G. M. R.; 10-5-12, G. M. R.
43. Puccinia podophylli Schw.
Podophyllum peltatum L. O, I, III. (B. T. G. 75)
 Columbia, 5-7-03; 6-13-03, B. M. D.; 6-16-07; 6-6-08,
 G. M. R.; 4-30-10; McBaine, 6-7-10, G. M. R.;
 Columbia, 6-7-10, G. M. R.; 5-25-11, G. M. R.; 5-14-12.
44. Puccinia Polygoni-amphibii Pers. (B. T. G. 76)
Geranium maculatum L. O, I.
 McBaine, 5-12-10; 5-20-11, G. M. R.; 4-26-13, J. P. B.
 Columbia, 5-7-13, J. P. B.
Polygonum scandens L. II.
 Columbia, 7-1-11, G. M. R.
Polygonum virginianum L. II, III.
 Columbia, 10-10-12, J. P. B.

Polygonum Acre H. B. K. II.

Columbia, 9-14-03; 10-10-10, G. M. R.; 10-16-10, G. M. R.

Polygonum virginianum L. II, III.

McBaine, 10-8-10, G. M. R.; Columbia, 10-5-12, G. M. R.;

McBaine, 10-12-12.

45. *Puccinia rubigo-vera* (DC.) Wint.

Secale cereale L. II, III.

McBaine, 6-7-10.

Triticum compactum, Host. II, III.

var. *Creticum* Mass.

McBaine, 7-4-12.

var. *rufulum* Kcke.

Columbia, 7-4-12; 7-5-12.

Triticum dicoccum Schrk. II, III.

var. *Red Emmer*.

Columbia, 7-4-12.

var. *Russian Emmer*.

Columbia, 7-10-12.

Triticum durum Desf. II, III.

var. *Africanum* Kcke.

Columbia, 7-12-12.

var. *Black Don*,

Columbia, 7-10-12.

var. *Cherson*,

Columbia, 7-10-12.

var. (not given).

Columbia, 7-5-12.

Triticum monococcum L., II, III

Columbia, 7-5-12.

Triticum spelta L. II, III.

Columbia, 7-5-12.

Triticum vulgare Vill. II, III.

var. *Caesium* Alef.

Columbia, 7-5-12.

var. *Early Java*.

Columbia, 7-5-12.

var. *leucospermum* Kcke.

Columbia, 7-5-12.

var. (not given).

Columbia, 6-23-03.

46. *Puccinia Ruelliae* (B. & Br.) Lagh. (B. T. G. 67?)

Ruellia strepens L. II, III.

Columbia, 9-25-03; 10-16-10, G. M. R.; 10-10-12, J. P. B.;

10-5-12, G. M. R.; Perche Creek, 10-22-12, J. P. B.;

10-22-12, G. M. R.; Rock Bridge, 10-19-12.

47. *Puccinia Silphii* Schw.

Silphium perfoliatum L. III. (B. T. G. 79)

Rock Bridge, 5-28-12.

Silphium integrifolium Michx. III. (B. T. G. 79)

Columbia, 10-27-12, G. M. R.

48. *Puccinia Taraxaci* (Reb.) Plowr.

Taraxacum officinale Weber III.

Columbia, 6-23-08, G. M. R.; 7-1-11, G. M. R.;

McBaine, 10-12-12, J. P. B.; Pinnacles, 10-26-12,

G. M. R.

49. Puccinia Thompsonii Hume.*Carex Frankii* Kunth. III.

Columbia, 10-17-12, G. M. R.; Perche Creek, 10-22-12,

G. M. R.; 10-22-12, J. P. B.

50. Puccinia Violae (Schum.) DC.*Viola cucullata* Ait. I.

McBaine, 4-27-12, G. M. R.; Pinnacles, 10-26-12,

J. P. B.

Viola Missouriensis Greene I.

Columbia, 4-16-09, G. M. R.

Viola papilionacea Pursh.

McBaine, 4-5-11, G. M. R.

Viola pubescens Ait, I, II, III.

McBaine, 5-12-10, G. M. R.; Columbia, 4-20-11, G. M. R.;

McBaine, 4-15-11, G. M. R.; Columbia, 5-25-11, G. M. R.;

McBaine, 10-15-12, J. P. B.

Viola scabriuscula Schwein I. II, III.

McBaine, 5-12-10, G. M. R.; Columbia, 5-25-11, G. M. R.;

Columbia, 5-7-12, G. M. R.

Viola striata Ait. I. (B. T. G. 84)

Columbia, 4-16-09, G. M. R.; McBaine, 6-7-10, G. M. R.

51. Puccinia Windsoriae Schw.*Pteleae trifoliata* L. I. (B. T. G. 31)

Columbia, 5-?-1888; 5-13-03; 5-30-08; 6-?-08, G. M. R.;

6-12-10; 6-21-10; 6-16-11; G. M. R.; 7-8-11, G. M. R.;

5-21-12; 5-25-12; 5-28-12, J. P. B.

Tridens flavus (L.) Hitchc. II, III.

Columbia, 9-28-08, G. M. R.; 10-14-10;

10-5-12, G. M. R.; 10-10-12; Rock Bridge, 10-19-12;

Pinnacles, 10-26-12.

52. *Puccinia Xanthii* (Schw.)

Ambrosia trifida L. III. (B. T. G. 85)

Columbia, 8-10-02, E. H. F.

Xanthium canadense Mill. III.

Columbia, 8-1-03; 7-13-11, G. M. R.;

10-5-12, J. P. B.

Xanthium strumarium L. (B. T. G. 85)

McBaine, 10-8-10.

53. *Uromyces appendiculatus* (Pers.) Lk.

Phaseolus vulgaris (B. T. G. 93)

Columbia, 10-?-04.

Strophostyles helvola (L.) Brit.

Rock Bridge, 10-19-12, G. M. R.; 10-19-12, J. P. B.

Vigna sinensis (L.) Endl.

Columbia, 9-23-06, B. M. D.

54. *Uromyces Arisaemae* Cke.

Arisaema dracontium (L.) Schott. (B. T. G. 94)

Columbia, 5-4-09; 4-24-10, G. M. R.; 5-10-10;

5-2-10, G. M. R.; McBaine, 5-20-11, G. M. R.;

4-26-13, G. M. R.; Rock Bridge, 5-28-12, G. M. R.

Arisaema triphyllum (L.) Schott. (B. T. G. 94)

Columbia, 6-6-08; 3-31-10, G. M. R.; Rock Bridge,

5-28-12, G. M. R.; McBaine, 4-26-13, J. P. B.

55. Uromyces Hedysari-paniculata (Schw.) Farl.

Desmodium canescens (L.) DC. III.

Columbia, 9-23-03, B. M. D.; McBaine, 10-8-10, G. M. R.;

Perche Creek, 10-22-12, J. P. B.

Desmodium pauciflorum (Nutt.) DC. III.

Perche Creek, 10-22-12, J. P. B.

Desmodium paniculatum (L.) DC. III. (B. T. G. 96.)

McBaine, 10-12-12.

Desmodium rigidum (Ell.) DC. III.

McBaine, 10-12-12, J. P. B.

Desmodium (sp. indet.) III.

McBaine, 10-12-12, J. P. B.

56. Uromyces Howei Pk.

Asclepias purpurascens L. II, III.

North Jefferson, 8-22-11.

Asclepias syriaca L. II, III. (B. T. G. 98)

Columbia, -?-03, B. M. D.; 10-17-12; 11-1-12.

57. Uromyces Junci-tenuis Syd.

Juncus tenuis Willd. III.

Columbia, 9-19-03.

Silphium perfoliatum L. O, I. (B. T. G. 10)

Columbia, 5-15-10.

58. Uromyces Lespedezae-procumbentis (Schw.) Lagh. (B. T. G. 99)

Lespedeza frutescens (L.) Brit. III.

Columbia, 9-27-04.

Lespedeza repens (L.) Bart. III.

(?) (?-?-?)

Lespedeza Virginica (L.) Brit. III.

Columbia, 11-10-12.

59. Uromyces Poinsettiae Tranzsch.
 Euphorbia dentata Michx. II, III.
 Columbia, 9-?-02, B. M. D.; North Jefferson,
 8-22-11, G. M. R.
60. Uromyces Polygoni (Pers.) Fuckel (B. T. G. 100)
 Polygonum erectum L. II, III.
 Columbia, 10-10-12.
61. Uromyces proeminens (DC.) Lev. (B. T. G.)
 Euphorbia Preslii Guss. III. (B. T. G. 11)
 Columbia, 9-11-02, 9-23-06, B. M. D.; McBaine,
 7-4-11, 10-12-12, J. P. B.
62. Uromyces Toxicodendri Berk. & Rav.
 Rhus Toxicodendron L. III. (B. T. G. 102)
 Columbia, 9-25-03, B. M. D.; Rock Bridge, 10-19-12,
 J. P. B.; 10-19-12, G. M. R.; (?), (?-?-?)
63. Uromyces Trifolii (Hedw.) Lev.
 Trifolium pratense L. II.
 Columbia, 6-25-03; 10-5-12, G. M. R.

Aecidial Forms

Below is given a list of forms showing only the aecidial stage of development. They probably are the aecidial stages of forms belonging to the genera found in the local collection.

64. Aecidium abundans Peck.

Symphoricarpus orbiculatus Moench I.

Columbia, 5-31-11, G. M. R.

65. Aecidium compositarum Mart.

Ambrosia trifida L. I.

McBaine, 6-7-10; 5-18-11; 5-25-11, G. M. R.

66. Aecidium compositarum Mart.

Helianthus strumosus L. I. (B. T. G. 10)

Columbia, 5-19-08; 5-10-10; McBaine, 5-20-11, G. M. R.

Rudbeckia laciniata L. I.

McBaine, 5-12-10; 5-20-11, G. M. R.

67. Aecidium Xanthoxylii Peck. (B. T. G. 40)

Xanthoxylum americanum Mills.

Columbia, 6-13-03; 6-11-11.

Discussion and Notes on Specific Forms

Coleosporium Solidaginis (Schw.) Thüm. This rust is listed by Arthur as heteroecious with the aecidial stage upon *Pinus rigida* Mill. This host does not occur in this region so that this form is properly placed with the hemiuredo group in this list.

Melampsora Bigelowii Thüm and *Melampsora Medusae* Thüm are given by Arthur as heteroecious with the aecidial stage upon *Larix Lyalli*. No *Larix* species are known here so that these rusts are properly classed as hemiuredo forms.

Gymnosporangium Nidus-avis Thaxt., is given by Sydow as having the aecidial stage on *Amelanchier* and *Cydonia* species. Infection experiments by Arthur (*Mycologia*, Vol. 2, p. 230) obtained no results for teleutospore sowings upon *Amelanchier*, but resulted in O upon *Crataegus Pringlei* and O I upon *Pyrus ioensis*.

Puccinia Bolleyana Sacc. Arthur combines this form with *Puccinia Atkinsonia* Diet. under the name *Puccinia Sambuci* (Schw.) Arth. (*Bot. Gaz.* Vol. 35, p. 14) for the reason that sowings of teleutospores from *Carex trichocharpa* and *Carex lurida*, the teleuto hosts of *P. Bolleyana* and *P. Atkinsonia* respectively, gave aecidial infections upon *Sambucus* which is listed by Sydow to be the aecidial host of *P. Bolleyana*.

Puccinia coronata Cda. Sydow has divided this form into *Puccinia Lolii* Niels. and *Puccinia coronata* Cda. on the basis of cultural experiments by Nielson and Klebahn. The former

has its aecidial stage upon *Rhamnus cathartica* L., the latter upon *R. Frangula* L. The American hosts of *P. coronata* are *R. cathartica* (introduced), *R. lanceolata* Pursh, and *R. caroliniana* Walt. It has not been experimentally determined whether or not the American form is the same as the two European forms although it appears to be closely related in having one common host, *R. cathartica*. Since the American *P. coronata* is not definitely known to occur in the two distinct forms of the European rust, it is thought best to list it here under the older name, *Puccinia coronata* Cda.

Puccinia Cyperi Arth. This is not listed for this host by Sydow.

Puccinia Eatoniae (Schw.) Arth. This form is not listed by Sydow. The relation of *Ranunculus abortivus* and *Sphenopholis pallens* (Spreng.) Scribn. (*Eatonia pennsylvanica* Gray), as aecidial and teleuto hosts respectively, was determined by Arthur (Jour. Myc. Vol. 10, 1904, p. 18.)

Puccinia Helianthi Schw. Sydow does not list this form as having an aecidial stage. Arthur (Jour. Myc. Vol. 11, 1905, p. 15; Jour. Myc. Vol. 10, 1904, p. 12) has produced this stage on several species by teleutosporic sowings. Careleton also obtained an aecidial stage by teleutosporic sowings. It is stated as occurring rarely. (Bul. Plant Industry, 1904, Vol. 63, p. 12.)

Puccinia Impatiens (Schw.) This is not listed by Sydow. Arthur (Bot. Gaz. Vol. 35, 1903, p. 19) showed the connection of the aecidial stage upon *Impatiens pallida* Nutt. with the uredo and teleuto stages appearing on *Elymus virginica*. Later,

in *Mycologia*, Vol. 2, 1910, the latter stage is reported to occur upon *Elymus striatus* and *E. canadensis*. Arthur believes it is found on all *Elymus* species occurring east of the Rocky Mountains.

Puccinia Maydis Bereng. Syn. *P. Sorghi* Schw. No aecidial stage is described by Sydow. Arthur (*Bot. Gaz.* Vol. 38, 1904, pp. 64-67) describes this stage which occurs upon *Oxalis corniculata* L.

Puccinia Podophylli Schw. Arthur states (*Jour. Myc.* Vol. 11, 1905, p. 65) that the secondary aecidia described by Sydow (*Monog. Ured.* Vol. 1, p. 526) are due to teleutosporic germinations and infection on the host. Sowings of aecidiospores produced no secondary aecidiospores, resulting only in teleutospores. Sydow also states that the primary aecidial stage occurs early and the secondary aecidial stage later with the teleutospores. A heavy aecidial stage was found on May 7, 1913, in Columbia with teleutospores appearing on the sheath enclosing the leaf stalk at the base, on the leaf stalk, and on the leaves.

Puccinia Polygoni-amphibii Pers. This form is listed by Sydow as having only the II and III stages. Arthur (*Jour. Myc.* Vol. 12, 1906, p. 18) found (after Tranzsch, St. Petersburg) that an aecidial stage occurred on *Geranium maculatum* L.

Puccinia Rubigo-vera (DC) Wint. This rust is divided by Sydow into *P. glumarum* with five, and *P. dispersa* with six sub-groups, on the ground of restriction to certain hosts. The form *P. glumarum* has not been reported in America. The form that appears here, as described by Carleton, *Bul.* 16, pp. 20-45,

does not correspond to the European forms in its distribution among the various hosts, so that the American form seems to show a specialization into biologic forms different from that of the European forms. Freeman and Johnson (Bul. 216, U. S. Dept. Agr. Bureau of Plt. Ind., 1911) experienced no difficulty in transferring the American form from one grain host to another. The form found in the local collection corresponded most closely to *P. triticina* Erikss. listed in Sydow, but was not confined to the hosts listed there. In view of these facts, it is thought best to list the rust here under the old name.

Uromyces Howei Pk. This rust is not reported by Sydow or Arthur for this host.

Uromyces proeminens (DC.) Lev., and *Uromyces Poinsettiae* Tranzsch. are combined by Arthur under the name *U. proeminens* (DC.) Arth.

Uromyces Toxicodendri Berk. & Rav. This is listed by Arthur under the name *Pileolaria Toxicodendri* (Berk. & Rav.) Arth. and described as having pycnidia present, but not aecidia. Sydow describes no pycnidia but speaks of primary and secondary uredospores.

Uromyces Trifolii (Hedw.) Lev. This is grouped by Arthur with *U. Trifolii-repentis* (Cast.) Liro. under the name *Nigredo Trifolii* (Hedw.) Arth, and described as having pycnidia and aecidia.

Table No. III.

Rust			Host				
Family	Genera	No. Sp.	Family	Spore forms known	Genera	No. Sp.	No. Coll.
I Colesporiaceae	Colesporium	4	Compositae	II III	Elephantopus	1	2
					Aster	2	6
					Solidago	7	10
					Silphium	2	4
					Vernonia	2	6
	Summary	4	1		5	14	28
			Table No.				
II Uredinaceae	Bubakia	1	Euphorbiaceae	II III	Croton	2	5
	Melampsora	2	Salicaceae	II III	Salix	1	4
				II III	Populus	1	6
	Summary	3	2		3	4	15
				No. sp. = number species. No. Coll = number collections			

Rust			Host				
Family	Genera	No. Sp.	Family	Spore forms known	Genera	No. Sp.	No. Coll.
Puccinea ceae	Gymnosporangium	4	Rosaceae	0I	Crataegus	4	15
					Pyrus	3	12
			Pinaceae	III	Juniperus	1	15
	Summary	4	2		3	8	42
	Gymnoconia	1	Rosaceae	0I III	Rubus	1	3
	Phragmidium	2	Rosaceae	0I II III	Rosa	1	1
					Potentilla	1	1
	Summary	2	1		2	2	2
	Uromyces	1	Anacardiaceae	II III	Rhus	1	5
		1	Araceae	0I II III	Arisaema	2	9
		1	Asclepiadaceae	II III	Asclepias	2	4
		2	Euphorbiaceae	0I II III	Euphorbia	2	6
		1	Juncaceae	II III	Juncus	1	1
			Compositae	0I	Silphium	1	1

Rust			Host				
Family	Genera	No. Sp.	Family	Spore forms known	Genera	No. Sp.	No. Col.
		4	Leguminosae	II III	Desmodium	4	7
				I II III	Lespedeza	3	3
					(Phaseolus	1	1
				0 I II III	Strophostyles	1	1
					(Vignia	1	1
				0 I II III	Trifolium	1	2
		1	Polygonaceae	0 I II III	Polygonum	1	1
	Summary	11	8		13	21	42
	Puccinia	1	Acanthaceae	II III	Ruelliae	1	7
			Berberidaceae	0 I III	Podophyllum	1	11
			Compositae	III	Ambrosia	1	1
				0 I II III	Helianthus	4	8
				II III	Krigia	1	1
				III	Silphium	2	2

Rust			Host				
Family	Genera	No. Sp.	Family	Shore forms known	Genera	No. Sp.	No. Col.
				II III	Taraxacum	1	4
				III	Xanthium	2	5
		4	Cyperaceae	II III	Carex	2	8
				II III	Cyperus	1	1
				II III	Scirpus	1	1
		1	Caprifoliaceae	01	Sambucus	1	3
		3	Compositae	01	Aster	2	7
				01	Erigeron	4	5
				01	Solidago	3	6
		1	Onagraceae	01	Oenothera	1	2
		1	Saxifragaceae	01	Ribes	1	3
Summary of Cyperaceae and Related Hosts		10	5		9	16	36

Rust			Host				
Family	Genera	No. Sp.	Family	Spore forms known	Genera	No. Sp.	No. Col.
		7	Gramineae	II III	Andropogon	1	1
				II III	Avena	1	13
				II III	Dactylis	1	1
				II III	Poa	1	1
				II III	Hordeum	4	35
				II III	Phleum	1	3
				II III	Secale	1	1
				II III	Tridens	1	6
				II III	Triticum	10	92
				II III	Zea	1	1
	Summary				10	22	154
		1	Balsaminaceae	OI	Impatiens	1	3
			Oleaceae	OI	Fraxinus	1	1
			Ranunculaceae	OI	Ranunculus	1	4

Rust			Host				
Family	Genera	No. Sp.	Family	Spore forms known	Genera	No. Sp.	No. Col.
			Rutaceae	01	Clematis	1	1
					Ptelea	1	10
Summary of Gramineae and Related Hosts		11	5		15	27	73
		1	Labiatae		Blephilia	1	2
		2	Liliaceae	01 III III	Monarda	1	7
		1	Lobeliaceae	I II III	Allium	1	1
		1	Polygonaceae	01 II III	Asparagus	1	2
		1	Geraaniaceae	III	Lobelia	1	1
		3	Umbelliferae	II III	Polygonum	4	8
				01	Geranium	1	5
				II III	Chaerophyllum	1	2
				I II III	Osmorrhiza	2	6
				I II III	Sanicula		

Rust			Host				
Family	Genera	No. Sp.	Family	Spore Forms Known	Genera	No. Sp.	No. Col.
		1	Violaceae	0 I II III	Viola	6	17
Summary	5	37	19		43	76	300
General Summary of Table							
Coleosporiaceae	1	4	1		5	14	28
Uredinaceae	2	3	2		3	4	15
Pucciniaceae	5	55	31		61	108	389
Summary of Rusts and Hosts.	8	64	34		69	126	432

Relation to Hosts

Only a few rust forms have been reported on the ferns and none of these are represented in the local collection. Of the forms occurring on the seed plants by far the greater number are found on the Angiosperms. In fact only three species of *Gymnosporangium* have been collected on one Gymnosperm of the pine family, *Juniperus virginiana*. The Angiosperms, on the other hand, are represented by twenty-seven families.

The distribution of the rusts found on the local flora by families and genera of rusts and hosts, is given in Table III. The Coleosporiaceae and Uredinaceae are limited in the local collection to one or two families, and listed by Arthur on ten and thirty-one, respectively. The Pucciniaceae are found on thirty-one families and listed by Sydow on one hundred and nineteen for the published genera. Gray lists one hundred and forty-six families of seed plants for the central United States and Canada, and Daniels one hundred and four for Columbia and vicinity, so it may be seen that the limited character of the present rust collection is at least not necessarily due to a corresponding smallness of the number of possible host families.

In Table III the genera *Puccinia* and *Uromyces* are seen to be the most varied in kinds and hosts. A comparison of these with Sydow's lists is given in Table IV.

Table IV

Rust Genera	Host Families in Sydow	Host Families in Boone Co. Collected
Puccinia	91	19
Uromyces	61	8
Gymnosporangium	3	2

With these is inserted the genus *Gymnosporangium*, which is peculiar in its close restriction to two widely separated families wherever it appears.

A summary of Table III shows for the three families of rusts present in the collection, a total of eight genera and sixty-two species, most of which belong to the Pucciniaceae. These occur on hosts representing thirty-four families, sixty-nine genera, and one hundred and twenty-six species. The host families showing the largest representation are the Gramineae with ten genera and twenty-two species and the composites with nine genera and twenty-seven species.

Autoecious and Heteroecious Rusts

As stated previously, rusts are divisible into autoecious forms having all the stages present in the life cycle occurring upon a single host; and heteroecious forms having usually two hosts, one with the O II stages present, termed usually the aecidial host, the other with the II III stages or III alone, termed here the teleuto host. Where heteroecism occurs, the

aecidiospores can give rise only to the II and III or III stages upon the teleuto host, and the sporidia to the 0 and I stages upon the aecidial host. A reference to Table III will show that on some host families only the II and III or III stages are present, and on others only the 0 and I stages. For any particular form the II and III stages are limited in all cases to one family of hosts, while the 0 and I stages may occur on one or several other families. In Table V is given a list of the families of host plants arranged according to Gray's Manual, showing the relation to the rust genera present in the Boone County collection.

In Table VI is given a summary of the host families given in Table V, according to rust genera. The genera *Puccinia* and *Uromyces* are seen to be the only ones containing both autoecious and heteroecious forms.

Table V.

Host Plants		Rusts							
		Coleosporium	Melampsora.	Bubakia.	Gymnosporangium	Gymnoconia	Phragmidium.	Uromyces	Puccinia.
I	Gymnospermae Pinaceae				+				
II	Angiospermae								
	A. Monocotyledonae								
	Gramineae								+
	Cyperaceae								+
	Araceae							⊕	
	Juncaceae							+	
	Liliaceae								⊕
	B. Dicotyledonae								
	Archiochlamydeae								
	Salicaceae		+						
	Polygonaceae							⊕	+
	Ranunculaceae								⊕
	Berberidaceae								⊕
	Saxifragaceae								⊕
	Rosaceae				○	⊕	⊕		
	Leguminosae							⊕	
	Geraniaceae								○
	Rutaceae								○
	Euphorbiaceae			+				⊕	
	Anacardiaceae							+	
	Balsaminaceae								○
	Violaceae								⊕
	Onagraceae								○
	Metachlamydeae								
	Umbelliferae								⊕
	Oleaceae								○
	Asclepiadaceae							+	
	Labiatae								+
	Acanthaceae								+
	Caprifoliaceae								○
	Lobeliaceae								+
	Compositae	+						○	⊕

○ = Stages 0, I.

+ = Stages II, III.

⊕ = Stages 0, I, II, III.

Table No. VII

Rust Genera	Eu forms		Opsis forms		Hemi forms	Micro Lepto forms
	Autoecious	Heteroecious	Autoecious	Heteroecious		
<i>Coleosporium</i>		1			3	
<i>Melampsora</i>		2				
<i>Bubakia</i>					1	
<i>Gymnosporangium</i>				4		
<i>Gymnoconia</i>			1			
<i>Phragmidium</i>	2					
<i>Uromyces</i>	8	1			2	
<i>Puccinia</i>	7	18	1		7	4
<i>Totals</i>	17	22	2	4	13	4

Table No. VI.

Genera	Number of Families		
	Autoecious 0 I II III	Heteroecious	
		0 I	II III or III
<i>Coleosporium</i>			1
<i>Melampsora</i>			1
<i>Bubakia</i>			1
<i>Gymnosporangium</i>		1	1
<i>Gymnoconia</i>	1		
<i>Phragmidium</i>	1		
<i>Uromyces</i>	4	1	2
<i>Puccinia</i>	5	4	6
<i>Totals</i>	11	11	12

Presence of Spore Forms

According to the division of rusts into Eu, Brachy, Opsis, Hemi, Micro, and Lepto types, and further into Antoeocious and Heteroeocious forms, the distribution of the genera present in the local collection is given in Table VII. No Brachy forms are present. The Micro and Lepto forms are grouped together for the reason that the distinguishing character of immediate or delayed germination of the teleutospore is known for but one of the four, *Puccinia Xanthii*. This is a Lepto form. The genera *Uromyces* are here again seen to show the most diversity. The genus *Uromyces* is predominantly Autouredo forms. The Puccinias are one-half Euheterouredo forms. Most of the seven Hemi-Puccinias all the facts were known, would doubtless prove to be Eu forms.

In the following pages are given lists of the different types. With each form is also given a list, as complete as possible, of the hosts present in the local flora, upon which each may occur. The hosts on which the rust is present in the collection already made, are indicated by an asterisk before each specific name. Hosts occurring in the collection and not previously reported as hosts for the particular form, are indicated similarly by two asterisks. Hosts with the specific name preceded by a small circle (°) are cultivated forms.

The large number of hosts unrepresented in the present collection shows again the incompleteness of the collection.

Euautouredo Forms (O, I, II, III.)

Phragmidium americanum Diet.

Rosa lumulis Marsh., *(sp. indet.)

Phragmidium potentillae-canadensis Diet.

potentilla **canadensis* L., *Montspeliensis* L.

Puccinia asparagi DC.

Asparagus **officinalis* L.

Puccinia granilispora Ell. & Gall.

Allium **canadense* L.

Puccinia Helianthus Schw.

Helianthus **annuus* L., *divaricatus* L., **hirsutus* Raf.,

strumosus mollis T. & G., **strumosus* L., **tuberosus* L.

Puccinia marylandica Lindr.

Sanicula **marylandica canadensis* (L.) Torr.

Puccinia Menthae Pers. var. *americana* Burr.

Bleplilia **hirsuta* (Pursh.) Benth., *Hedeoma pulegioides* (L.)

Pers., *Mentha canadensis glabrata* (Benth.) Fernald.,

Monarda Bradburiana Beck., **fistulosa* L.

Puccinia osmorrhizae (Pk.) Cke. & Pk.

Osmorrhiza **Claytoni* (Michx.) Clarke., *longistylis* (Torr) DC.

Puccinia Violae (Schum.) DC.

Viola blanda Willd., **cucullata* Ait., *hastata* Michx.,
 ***missouriensis* Greene., *palmata* L., *pedata* L.,
 ***papilionaceae* Pursh., **pubescens* Ait., *rotundifolia*
 Michx., **scabriuscula* Schw., **striata* Ait.

Uromyces appendiculatus (Pers.) Sk.

Phaseolus **vulgaris* L., *Strophostyles* **helvola* (L.) Brit.,
 **Vigna sinensis* (L.) Endl.

Uromyces arisaemae Cke.

Arisaema **Dracontium* (L.) Schott., **triphellum* (L.) Schott.

Uromyces hedysari-paniculata (Schw.) Farl.

Desmodium bracteosum Michx., *bracteosum longifolium* (T. & G.)
 Robinson., *canadense* (L.) DC., **canescens* (L.) DC.,
Dillenii Darl., *grandiflorum* (Walt.) DC., *illinoense*
 Gray., **paniculatum* (L.) DC., **pauciflorum* (Nutt.) DC.,
rotundifolium (Michx.) DC., **rigidum* (Ell.) DC., *sessili-*
folium (Torr.) T. & G., *viridiflorum* (L.) Beck.,
 *(sp. indet.)

Uromyces Howei Pk.

Asclepias decumbens L., *incarnata* L., **purpurascens* L.,
quadrifolia Jacq., **syriaca* L., *tuberosa* L.

Uromyces Lespedeza-procumbentis (Schw.) Lagh.

Lespedeza **frutescens* (L.) Brit., *procumbens* Michx.,
 **repens* (L.) Bart., *stuvei* Nutt., *violacea* (L.) Pers.,
 **virginica* (L.) Brit.

Uromyces Poinsettiae Tranzsch.

Euphorbia **dentata* Michx., *heterophylla* L.

Uromyces polygoni (Pers.) Fuckel.

Polygonum aviculare L., **erectum* L.

Uromyces proeminens (DC.) Lev.

Euphorbia corollata L., *heterophylla* L., *humistrata* Engelm.,
maculata L., *marginata* Pursh., **Preslii* Guss.

Uromyces heterouredo Forms (0, I, II, III.)

Coleosporium solidaginis (Schw.) Thüm.

A. *Pinus rigida* Mill.

B. *Aster cordifolius* L., *Drummondii* Lindl., *dumosus* L.,
ericoides L., *laterifolius* (L.) Brit., *paniculatus* Lam.,
paniculatus simplex (Willd.) Burg., *preanthoides* Muhl.,
**sagittifolius* Willd., *salicifolius* Lam., **Tradescanti* L.,
umbellatus Mill.

Solidago **caesia* L., **canadensis* L., *graminifolia* (L.)
Salisb., **latifolia* L., **nemoralis* Ait., *procera* Ait.,
**radula* Nutt., *rugosa* Mill., **serotina* Ait., *ulmi-*
folia Muhl.

Melampsora Bigelowii Thüm.

A. *Larix Lyalli* Parl., *decidua* Mill.

B. *Salix amygdaloides* Anders, *cordata* Muhl., *cordata angus-*
tata (Pursh) Anders, **longifolia* Muhl., *longipes* Anders.,
Missouriensis Bebb., *nigra* Marsh.

Melampsora medusae Thüm.

A. *Larix* (species.)

B. *Populus* **deltoides* Marsh.

Puccinia agropyri Ell. & Ev.

A. *Clematis* **virginiana* L.

B. *Agropyron Smithii* Rydb.

Puccinia albiperidia Arth.

- A. *Ribes cynosbati* L., **gracile* Michx.
- B. *Carex pubescens* Muhl., *squarrosa* L., *crinita* Lam.

Puccinia Bolleyana Sacc.

- A. *Sambucus* **canadensis* L.
- B. *Carex trichocarpa aristata* (R. Br.) Bailey., *Frankii* Kunth.

Puccinia caricis (Schum.) Rebent.

- A. *Urtica dioica* L., *gracilis* Ait.
- B. *Carex crinita* Lam., *pallescens* L., *pennsylvanica* Lam.,
rostrata utriculata (Boott.) Bailey, *straminea* Willd.
(The hosts in the collection were not identified because of insufficient material.)

Puccinia Caricis-Asteris Arth.

- A. *Asteris* **cordifolius* L., *paniculatus* Lam., *salicifolius* Ait., **sagittifolius* Wede.
- B. *Carex rosea* Schrk.

Puccinia Caricis-Erigerontis Arth.

- A. *Erigeron annuus* (L.) Pers., *pulchellus* Michx., *canadensis* L., *philadelphicus* L., *ramosus* (Walt.) BSP.
- B. *Carex straminea* Willd.

Puccinia caricis-Solidaginis Arth.

- A. *Solidago bicolor* L., *caesia* L., *canadensis* L., *graminifolia* (L.) Salisb., **latifolia* L., *rigida* L., *serotina* Ait., ***speciosa* Nutt., **ulmifolia* Muhl.
- B. *Carex Jamesii* Schw., *stipata* Muhl.

Puccinia coronata Corda.

- A. *Rhamnus cathartica* L., *lanceolata* Pursh.
- B. *Agrostis alba* L., *alba vulgaris* (With.) Thunb., *alopecuri pratensis* L., *avena *sativa* L., *Festuca elatior* L.,
Lolium perenne L.

Puccinia Eatoniae Arth.

- A. *Ranunculus *abortivus* L.
- B. *Sphenopholis pallens* (Spreng.) Scribn.

Puccinia graminis Pers.

- A. ----- (No aecidial host known here).
- B. *Agrostis alba* L., *alba vulgaris* (With.) Thunb.,
hyemalis (Walt.) BSP.
Alopecurus pratensis L.
Arrhenatherum elatius (L.) Beauv.
*Avena *sativa* L.
Bromus ciliatus L., *hordeaceus* L., *secalinus* L.,
tectorum L.
*Dactylis *glomerata* L.
Elymus canadensis L., *canadensis glaucifolius* (Muhl.) Gray,
striatus Willd., *virginicus* L.
Festuca orina L., *octoflora* Walt.
Hordeum jubatum L., °**distichon.*, °**tetrastichon.*,
°**hexastichon.*, °**vulgare.*
Koeleria cristata (L.) Pers.
Leersia oryzoides (L.) Sw.
Lolium perenne L.
Poa compressa L., *nemoralis* L., *pratensis* L.

Sphenopholis obtusata (Michx.) Scribn.

°*Secale cereale* L.

Triticum °**compactum*, °**dicoccum*, °**durum*, °***freycenetii*,

°**Monococcum*, °**polonicum*, °**Spelta* L., °***thaondar* L.,

°***turgidum*, °**vulgaris* Vill.

Puccinia Impatientis (Schw.) Arth.

A. *Impatiens* **pallida* Nutt.

B. *Elymus canadensis* L., *striatus* Willd., *virginicus* L.

Puccinia Maydis Bereng.

A. *Oxalis corniculata* L.

B. *Zea* °**mays* L.

Puccinia obtecta Pk.

A. *Bidens frondosa* L., *connata* Muhl.

B. *Scirpus* **americanus* Pers., *validus* Vahl., *occidentalis*
(Wats.) Chase.

Puccinia Peckii (DeToni) Kellerm.

A. *Oenothera* **biennis* L.

B. *Carex trichocarpa* Muhl.

Puccinia peridermiospora (Ell. & Tracy) Arth.

A. *Fraxinus americana* L., *nigra* Marsh., **pennsylvanica*
Marsh., *pennsylvanica lanceolata* (Borkk.) Sarg.

B. *Spartina cynosuroides* (L.) Roth.

Puccinia Polygoni-amphibii Pers.

A. *Geranium* **maculatum* L.

B. *Polygonum* **acre* HBK., *amphibium* L., *convolvulus* L.,
durmatorum L., *Muhlbergii* (Weisn.) Wats., *lapathi-*
folium L., *pennsylvanicum* L., *Persicaria* L., **scandens* L.,
**virginianum* L.

Puccinia Rubigo-vera (DC.) Wint.

- A. (no aecidial host is known for America.)
- B. *Bromus hordeaceus* L., *Hordeum hexastichon* L., *jubatum* L.,
 °*vulgaris*, *Secale* °*cereale*., *Triticum* °*compactum*.,
 °*dicoccum* Schrk., °*durum* Desf., °*polonicum* L.,
 °*spelta* L., °°*thaouidar* Boiss., °*turgidum* L., °*vul-*
garé Vill.

Puccinia Windsoriae Schw.

- A. *Ptelea* **trifolia*.
- B. *Tridens* **flavus* (L.) Hitchc.

Uromyces Junci-tenuis Syd.

- A. *Silphium integrifolium* Michx., *laciniatum* L., **perfoliatum*
 L., *terebinthaceum* Jacq.
- B. *Juncus dichotomus* Ell., *dichotomus plataphyllus* Wiegand.,
 **tenuis* Willd.

Opsiautouredo Forms (0, I, III.)*Gymnoconia peckiana* (Howe) Trot.

- Rubus* **alleggheniensis* Porter, *occidentalis* L., **villosus* Ait.

Puccinia Podophylli Schw.

- Podophyllum* **peltatum* L.

Opsiheterouredo Forms (0, I, III)*Gymnosporanium clavipes* Cke. & Pk.

- A. *Crataegus***punctata* Jacq.
- B.-*Juniperus virginianum* .

Gymnosporangium globosum Parl.

- A. *Crataegus biltmoreana* Bead., **Chapmani* Ashe., *coccinea* L.,
coccinoides Ashe., **Crus-galli* L., *macrantha* Lodd.,

mollis (T. & G.) Scheele., phaenopyrum Medic., punctata Jacq., pyriformis Brit., *rotundifolia Moench., tomentosa L.

Pyrus malus L., *communis* L., *americana* (Marsh) DC.

Gymnosporangium Juniperi-virginianae Schw.

A. *Pyrus angustifolia* Ait., **ioensis* (Wood) Bailey, *malus* L.

B. *Juniperus* **virginiana* L.

Gymnosporangium Nidus-avis Thaxt.

A. *Amelanchier canadensis* (L.) Medic.

pyrus ioensis (Wood) Bailey.

B. *Juniperus* **virginiana* L.

Hemiuredo Forms (II, III)

Bubakia crotonis (Cke.) Arth.

Crotonis **capitatus* Michx., **Monanthognus* Michx.

Coleosporium Elephantopodis Schw.

Elephantopus angustifolius Sw., **carolinianus* Willd.,

nudatus Gray, *tomentosus* L.

Coleosporium Terebinthinaceae (Schw.) Arth.

Parthenium integrifolium L., *Silphium* **integrifolium* Michx.,

laciniatum L., **perfoliatum* L., *terebinthinaceum* Jacq.

Coleosporium Vernoniae B. & C.

Vernonia altissima Nutt., **Baldwini* Torr., *crinita* Raf.,

fasiculata Michx., **glaucula* (L.) Willd., *missurica* Raf.,

noveboracensis Willd.

Ruccinia Cyperi Arth.

Cyperus esculentus L., *filmiculmis* Vahl., *strigosus* L.,

**Hallii* Brit.

Puccinia Ellisiana Thuem.

Andropogon furcatus Muhl., **scoparius* Michx.

Puccinia krigiae Syd.

Krigia **amplexicaulis* Nutt.

Puccinia myrrhis Schw.

Chaerophyllum **procumbens* (L.) Grantz.

Puccinia Phlei-pratensis Erikss. & Henn.

Phleum **pratense* L.

Puccinia Ruelliae (B. & Br.) Lagh.

Ruellia **strepens* L.

Puccinia Taraxaci (Rebent.) Plowr.

Taraxacum **officinale* weber.

Uromyces Toxicodendri Berk. & Rav.

Rhus canadensis Marsh., **Toxicodenron* L.

Uromyces trifolii (Hedw.) Lev.

Trifolium hybridum L., *medium* L., **pratense* L.

Microuredo & Leptourede Forms (III)

Puccinia Lobeliae Ger.

Lobelia **syphilitica* L.

Puccinia Silphii Schw.

Silphium **integrifolium* Michx., **perfoliatum* L.

Puccinia Thompsonii Hume.

Carex **Frankii* Kunth.

Puccinia Xanthii Schw.

Ambrosia artemisiifolia L., *psilostachya* DC., *trifida* L.,

Xanthium **canadense* Mill., **strumarium*.

As already stated, the present collection consists of eight genera and sixty-two species occurring on one hundred and twenty-six different hosts. Although only the relatively common rusts have been secured, and no systematic attempt has been made to obtain all the existing forms, the collection may be considered, at least, as fairly representative. However, only a beginning has been made, and careful search for these plant parasites will result in adding to the collection many additional species, as well as adding to the known distribution of species already obtained on new hosts. Further study will doubtless reveal a large and diversified rust flora in this region.

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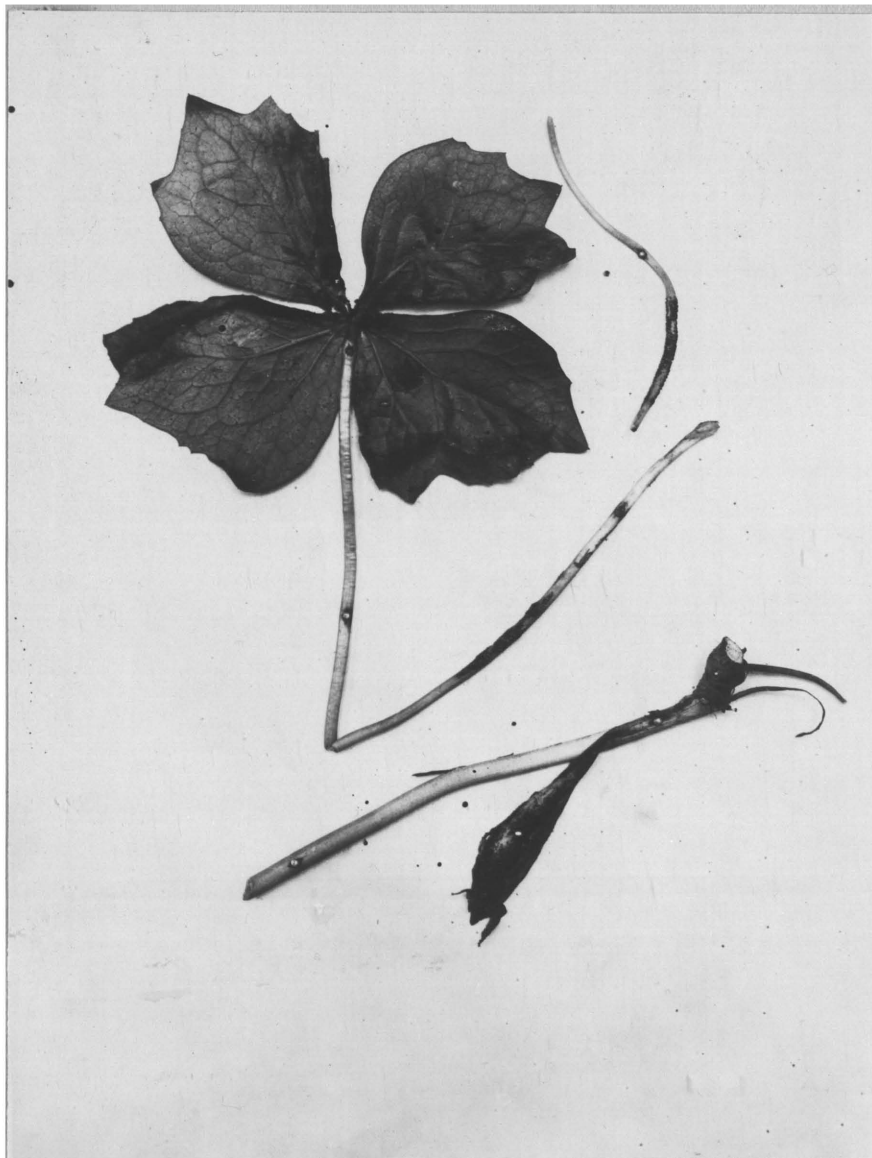
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ILLUSTRATIONS.

The following photographs show a few of the commoner rust forms mentioned in the preceding list. Most of these were collected in April and May of the present Spring, 1913.

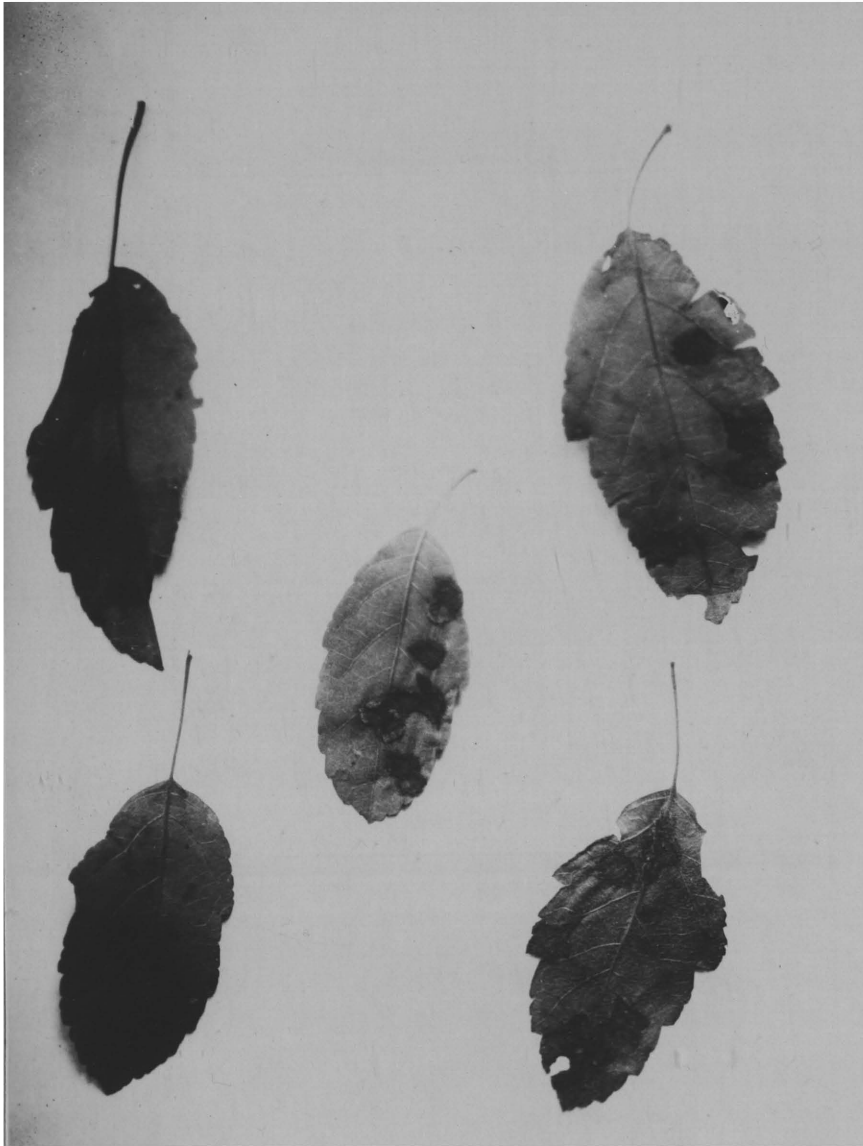


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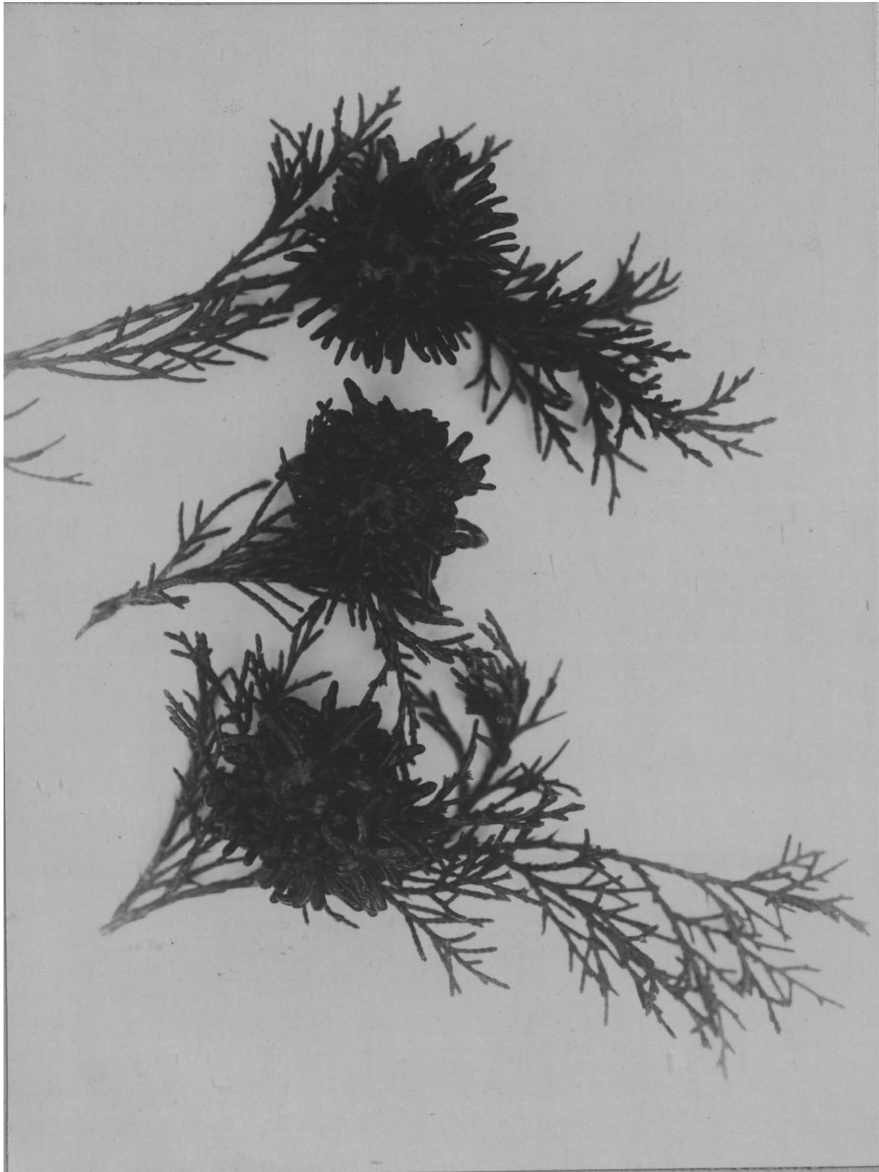
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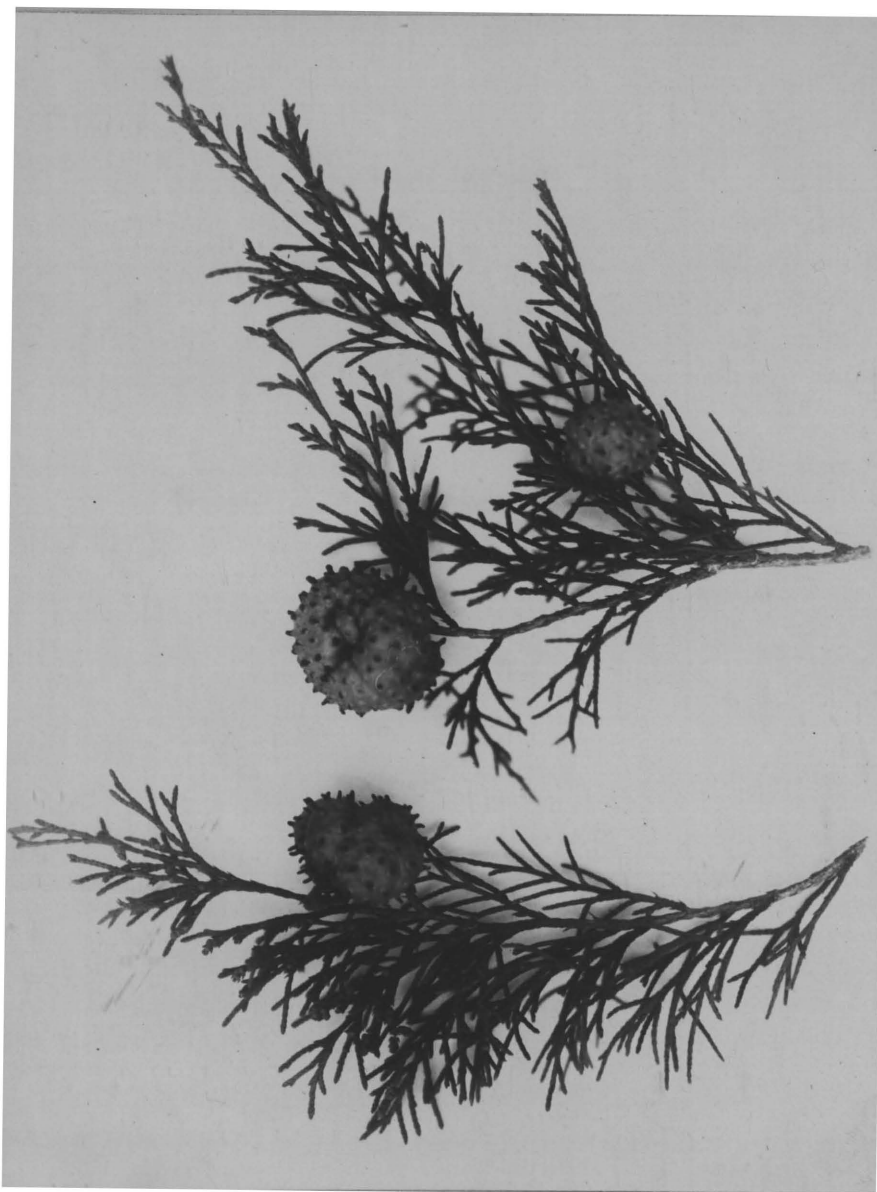


GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE

Aecidial stage on Pyrus Malus



GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE
Cedar apples with teleutosporic masses
entirely protruding.



GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE
Cedar apples with teleutosporic masses
protruding slightly.



GYMNOSPORANGIUM GLOBOSUM

Cedar apples with globular teleutosporic masses protruding.



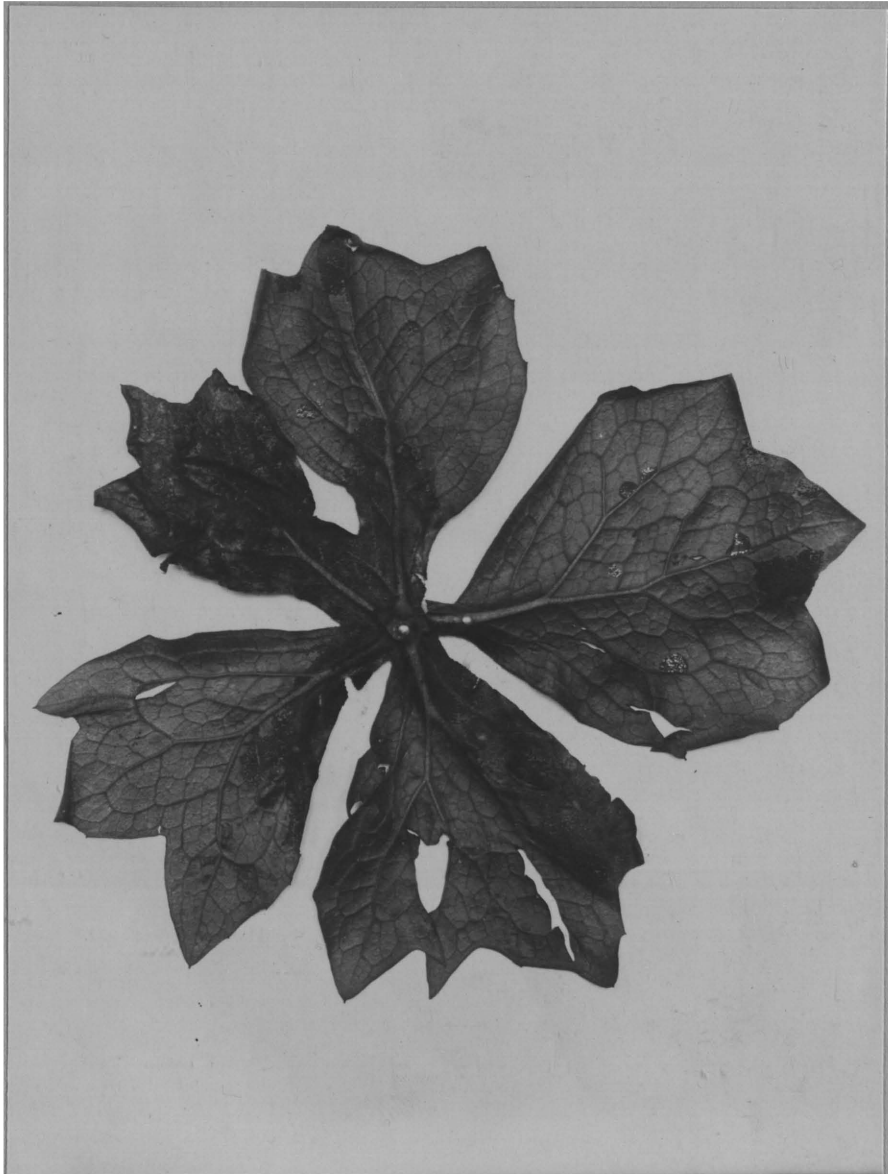
GYMNOSPORANGIUM NIDUS-AVIS

Witches broom with teleutosporic
masses protruding from wood por-
tions.



P U C C I N I A G R A M I N I S

Uredo stage on seedlings of *Avena sativa*



P U C C I N I A P O D O P H Y L L I

Aecidial stage on lower surface of leaf



UROMYCES ARISAEMAE

Aecidial stage on leaves and flower of
Ansaema triphyllum.



P U C C I N I A E A T O N I A E

Aecidial stage on Ranunculus abortivus



PUCCINIA VIOLAE

Aecidial stage on Viola scabriuscula



GYMNOC ONIA PECKIANA

Aecidial stage on Rubus Allegheniensis



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~~This thesis is now in the hands of the~~
~~author. It is to be checked out~~
~~again.~~

