

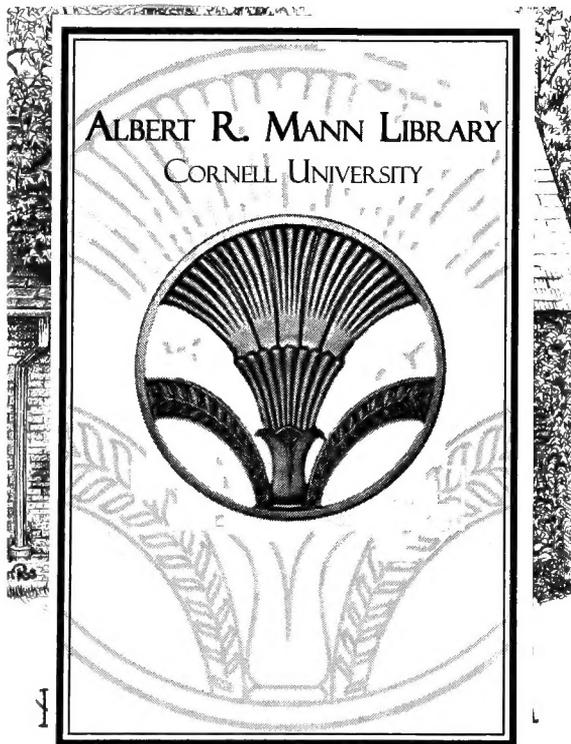
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BULLETIN

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Illinois State Laboratory

OF

NATURAL HISTORY.

VOLUME II.

ARTICLE III.—PARASITIC FUNGI OF ILLINOIS. PART I.

By T. J. BURRELL.

.1885

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PARASITIC FUNGI OF ILLINOIS.

PART I.—UREDINEÆ.

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ARTICLE III.—*Parasitic Fungi of Illinois*. PART I. By T. J. BURRILL, Professor of Botany, Illinois Industrial University.

INTRODUCTION

MOST of the plants herein described were collected in Illinois during 1881 and 1882, by Mr. A. B. Seymour, who was employed for the purpose by the Illinois State Laboratory of Natural History. The entire collection consists of three thousand seven hundred and eighty-four numbers, many of which are of course duplicates, or are different stages of the same species, leaving, however, a very large number of distinct specific forms—much larger than is usually supposed to exist in our flora.

The determinations have been made at the Illinois Industrial University by myself, efficiently aided by Mr. Seymour. For this work, besides the facilities offered by the library and herbarium of the University, the State Laboratory of Natural History furnished many books and specimens. Among the latter are the following sets of exsiccata: DeThümen's *Mycotheca Universalis*, Ellis' *North American Fungi*, Ravenel's *Fungi Caroliniani* and *Fungi Americani*.

The entire work has been stimulated and aided in every possible way by Professor S. A. Forbes, as director of the State Laboratory, and as an earnest and efficient worker in our rich fields of scientific and practical biology. Acknowledgements are also gratefully made for assistance in various ways, especially in the determination of specimens submitted to their inspection, to Prof. W. G. Farlow, and the State Botanist of New York, Chas. H. Peck; to F. S. Earle, J. C. Arthur, and C. A. Hart, for the contribution of specimens found by them in Illinois, and to Professor Wm. Trelease, J. B. Ellis, and others for several favors.

It needs no argument to show the practical value of the studies undertaken upon these minute—probably degraded—members of the vegetable world, for they subsist on living plants of the higher orders, upon which our domestic animals and ourselves depend for the means and materials of physical existence. It is not, indeed, usually known or suspected what proportion of our crops and useful vegetation is destroyed by the microscopic growths which live as parasites or saprophytes upon them; but when we come to understand that in very great measure the things called “blights,” “mildews,” “rusts,” “smuts,” “rots,” “ferments,” etc., are really due to the despoliations of these same microscopic but multitudinous forms of fungi, some appreciation can be gained by anyone, even with a moment’s thought, of the immense aggregate loss that occurs. Perhaps, in one sense, it is well that cultivators do not fully realize the number and variety of parasitic growths which await the development of their valuable plants, and which are liable so badly to injure the latter, and so seriously to affect the receipts for the expended labor. Surely in many cases there would be sufficient ground for discouragement and hesitation to venture in opposition to such an array of dangerous enemies, against whose insidious and covert attacks fighting seems futile.

But knowledge of the existence of such things cannot make that existence more hazardous, nor the results more distressing; while here, as in the other battles of life, to be forewarned is to be forearmed. Knowledge is power, and as much so in this case as in any other; if the latter is still wanting, it is only because the former has not been attained. Is it attainable? There are difficulties in the way. The objects are very minute; we cannot see them by the unaided eye as individuals, we cannot thus watch their modes of dissemination, germination, growth and development, we only see them, if at all, in the mass, and know of their presence by their results. They have singular, and to the students of other forms of life, unfamiliar physiological powers and properties; they assume peculiar disguises, and pass through unlooked-for stages of development, of which the connecting links are hard to make out; they lie dormant now, and again become wondrously quickened and enormously multiplied under circumstances not readily

traced. But little by little qualified observers have acquainted themselves with their existence as true species, veritable and distinct plants, and little by little have learned something of the mysteries of their life histories. Sometimes the advance in knowledge is gained by casual and lucky observations; but mostly by painstaking, systematic research, aided by all the appliances of the equipped laboratory and the fruitful skill of trained powers of manipulation and acute perception. A step gained is not only so much secured, but renders more possible other or further advance. The more becomes known, the easier progress is made, since that already acquired points the way towards new achievements. The beginning has been made, though this can scarcely be said to have been true until within very recent times. The men are now living and working who have made known nearly all the ascertained facts of physiological processes and results in these parasitic fungi. The germination of fungous spores was not observed until within the present century.

During the last part of the first half of this century learned discussions arose upon the specific distinction between the parasite and the host, and esteemed botanists held the view, that what was taken for the former was but a diseased condition of the latter—the rust of wheat, for example, was only the degraded cell-tissues of the wheat itself. Such difference of opinion, however, no longer exists among those who have possession of the information now acquired. The tissues of higher plants do not change by any processes of degradation or transformation into the things called fungi, neither do the latter originate in any other manner than as descendants of preëxisting parent forms through as rigid specific lines as can be traced among any animals or plants. It is known, too, that however much the fungus is found within the tissues of the host plant, it began its growth outside of the latter, and gained introduction only by forcible entrance. Spores are never taken up by absorption and carried by the aqueous currents from part to part of the plant. The fungus passes through the tissues very much as roots pass through soil, sometimes apparently without in any degree successful opposition,

sometimes nearly or quite baffled in the struggle by the mechanical and physiological resistances of the host plant.

I repeat, we now know that the numerous "rusts," "smuts," etc., found on the various kinds of vegetation, are themselves true plants, and that as such they are limited in their development like other organic species by certain conditions and surroundings. Some of these limitations are well known, others are yet to be ascertained. At present there is, except in a few cases, not enough of trustworthy information to enable us to suggest practical remedies or means of effectually destroying the injurious fungi which so reduce the products of our fields, fruit plantations, and gardens; which so disfigure our ornamental trees and defoliate our forests. But the difficulty exists not so much in the unconquerable nature of the enemies, as in the want of fuller attainable knowledge concerning them and their ways. There is reason to predict that the time will come when the mastery of man will prevail in this as in so many triumphs of the past by the application of power made available through persevering research and educated perception.

In some cases, however, we now know practical methods of exterminating the parasites, and in other cases of preventing their ravages by various processes of cultivation, selection or application. Usually these methods are quite beyond haphazard discovery, and often very remote from previous conception. For example: the leaves of apple trees are sometimes destroyed by a parasitic fungus which shows itself in prominent, scurfy bunches occurring here and there on the under side of the affected leaves, while upon the upper surface of the same spots the thickened area has a yellow or sometimes a crimson color. The leaf is distorted in shape, shows very evident signs of injury, and finally becomes ragged and withered. When a large number of the leaves of a tree are thus diseased the latter perceptibly suffers, and though seldom killed outright, after an unequal struggle for some years is rendered entirely worthless, and may as well be removed by the axe in the hands of the disappointed proprietor. Now the injury arises from a parasitic fungus described below (*Gymnosporium macropus*), which, in an alternation of development, takes a very different form on

the common red cedar, constituting the so-called "cedar balls," of orange color, especially noticeable after a rain in the month of May. The relation of these two forms of the fungus was not suspected until carefully established by Oersted, a botanist giving special attention to such matters, and well qualified for such observations and experiments. The fact having been ascertained, a thoroughly practical remedy consists in clearing away the worthless red cedars, or, in case of a few of these trees, which for any reason are wished to be saved, picking off and burning the "cedar balls." In this case the spores produced on the apple leaves cannot germinate and grow on the apple, but must reach, by wind currents or otherwise, the cedar leaves, where alone one essential stage of development takes place. From the cedar the spores must again be carried to the apple tree, or allied host, thus alternating back and forth as a necessary requirement of continued existence.

This is by no means a solitary example of known alternations which render possible the agency of man in preventing plant diseases caused by these pernicious parasites; but to gain the fullest possible mastery we still need much investigation and experiment by those most competent to conduct them. It has long been known that the rust of wheat (*Puccinia graminis*) has an alternate form on the barberry bush, but since the rust occurs in vast regions of our country where no barberry exists, we know that this plant is not positively essential to the continuous development of the rust. It now seems probable that the barberry stage is a reality, and perhaps in some way beneficial to the *Puccinia* (rust), but not essential. It still remains, however, to be ascertained whether or not there is some other common plant usually found in or near the wheat fields, which takes the place of the barberry, and thus permits the continued growth of the rust.

What might be the practical value of investigation in this direction? There are annually produced in Illinois about 50,000,000 bushels of wheat. The destruction of one-hundredth part of the crop by this fungus probably falls, as an estimate, far within the actual limits of loss as an annual average. This represents 500,000 bushels, which, at seventy-five cents per bushel, is \$375,000. If it could be demonstrated that the eradi-

cation of some worthless or otherwise noxious weed would at the same time dispose of the rust fungus, what a step of progress would be made! It cannot be said, from what we now know, that this is probable, but it certainly is possible, and not this only. In such cases no estimates can be ventured as to the value, measured in dollars and cents, of the smallest contribution to positive knowledge. Years of patient and able research may pass without reward, or a day's labor may beneficially affect the world. The field is very large and the soil very rich; but the cultivators have little more than begun their labors, and those competent for the task are still few. No great pecuniary inducements urge them forward. There are no patents to be had on discoveries they may make. The products of their labors, however rich, are not to be appropriated by themselves, but the gathered harvests must equally be divided among all men. Science may be enthusiastically pursued for its own sake, and mankind owe much to labors thus pursued; but it is certainly proper that the State should provide the means of equipment and livelihood for those able and willing to devote their energies to such investigations and experiments.

Illinois is one of the few States of the Union which have provided by legislative action for an officer whose duty it is to investigate and report upon insect depredations, and is alone in the establishment of a well equipped and well appointed laboratory of natural history, while the maintenance of the State University, with its departments of science and practical art, shows the high official appreciation of studies and investigations of this kind, and the intelligent views of those shaping and directing the affairs of the State pertaining to our natural resources and the value of natural science. The beginning thus made gives much hope for the future. It is not hazardous to predict increased interest as the work goes on, not only on the part of those conducting the investigations, but among the people at large, many of whom care little or nothing for the methods and processes by which results are reached, but quickly appreciate the practical value of the results themselves when wrought out.

Nothing has so far been done by the United States' authorities for the study of the diseases of plants, though recently

much attention has been given to contagious diseases of animals. The importance of scientific investigations in this latter direction cannot be overestimated, yet it would not be difficult to show that every argument in support of these is applicable also to encouragement upon the study of the diseases of plants. In fact, it has now come to be generally admitted that these very maladies of animals are directly due to various species of the same classes of low vegetable organisms which afflict, as parasites, the valuable plants and crops. In some instances the very same species of fungi prey upon plants or plant-products and living animals. The common moulds are fungous growths, and mouldy grains and other articles of vegetable foods are commonly believed to be injurious to man and animals. Some contagious diseases of man have been proved to be due to organisms normally living on vegetable substances, and there is much reason to suppose that all the pathogenic bacteria, and their allies, are or were primarily simply decomposing agents of dead substances. Certainly the nature of the contagious diseases of animals cannot be fully known without the closest investigations of the life of the disease organisms outside of the animal body. The studies of fermentations and putrefactions have already lead to most important results in pathology, and it is confidently believed that there is much more to be gained in the same way for the advancement of knowledge in regard to disease and injury, not of animals only, but of plants as well; while a proper study of the diseases of plants must help to a better understanding of the serious maladies of man and the domestic animals.

The nomenclature adopted in this paper has been the result of considerable inquiry and an earnest endeavor to conform to the latest opinions of the best authorities, as well as to most nearly fulfill the requisites of this branch of science. Unfortunately, in numerous cases there are many synonyms, and as names were given to species before any natural classification could possibly be made, and as the life history was in the earlier times usually unknown, different writers assigned the same species to widely different positions in their systems of arrangement. The descriptions by the older authors are mostly meager, and entirely devoid of accurate microscopic character-

istics on which so much reliance is now placed, so that in the absence of type specimens it is difficult or impossible to ascertain to what species their names should be applied. Besides this, what we now know to be different forms of "fruit" of the same species, were formerly regarded as wholly distinct plants belonging to widely separated genera; as each of these forms received a name it now becomes necessary to choose one from two, three, or even more, to designate the species and reduce the others to synonyms. In the case of the Uredinæ there are in numerous species four spore-forms, now known as "teleutospores," "uredospores," "æcidiospores," and "spermatia," from which one must be selected as the mature or final "fruit," and its name taken for the species as a whole. But as no process of fertilization has been discovered for any of these spore productions, there is a difference of opinion among investigators as to which ought to be considered this mature or final form. Sachs, whose judgment must be highly respected, adopts the æcidium stage as that most probably the result of some kind of fertilization, while others, equally competent, believe the teleutospores — as the name indicates — are the final and, if any, the fertilized bodies. Sachs, therefore, inclines to call the common rust of wheat *Æcidium graminis*, instead of *Puccinia graminis*, the name used by all authorities up to this time. Winter, in his recent revision of Rabenhorst's *Pilze* (Fungi), attempts to apply rigorously the law of priority of names to whatever form of the species the first name was given, and most naturalists making a specialty of any other department of nature would doubtless commend his endeavor. But there are very serious difficulties in the way. While we may accept as proved that certain *Æcidia* are genetic forms of known *Pucciniæ*, in the great number of cases such relation is simply *supposed* to exist. Shall we revise our nomenclature on the basis of a supposition? In the writings of early mycologists the descriptive characteristics following a name are often equally applicable to several species as we now know them. In the absence of herbarium types, shall we guess at the plant held in hand when the description was drawn up? Not unfrequently the oldest name is given to what was deemed a variety, and later another name by another or the same author is adopted

for the same plant as a species. Shall we now write the earliest varietal name as specific, and quote the first botanist as authority? The question is not whether the second writer should have adopted the first name; it is now a question of choice between two names already in literature.

The authority after a binomial appellation is clearly that of the one who associates the generic and specific parts of the name, and applies it, thus constituted, to the designated plant. For phænogams there seems to be little need of preserving with the name any further item of bibliography. The change of genera is not so frequent as to cause serious confusion, and the descriptions are ordinarily full and unmistakable. Mycologists, however, find it important to quote the name of the original authority for the specific name, agreeing in this with the custom among zoölogical writers, especially with those who devote themselves to the lower and less known orders of animals. A very considerable number of the names of fungi must thus be accompanied with two authorities, that for the original specific name occurring first in parenthesis, and that for the binomial whole afterward. It is true this decidedly increases the difficulty of writing and of memorizing, but the benefits more than counterbalance the drawbacks. Certainly it will not answer to quote alone that which, as above, is put in parenthesis, even though by the use of the parenthesis change of genus is indicated. The parenthetical reference is dropped by students of phænogams, and we should, as mycologists, prefer this to the practice of some botanists and zoölogists of omitting the authority for the entire name as it exists.

Without further discussion of this often discussed topic, the following may be stated as the basis of nomenclature in this paper.

(1). The use of the oldest specific name known to have been used for the *species* as such. Varietal names by the older authors, not subsequently adopted by those raising the varieties to species, have not been herein perpetuated except in peculiar cases. When the vague descriptions of the early writers give no reasonable certainty of the intended application, priority is not strained to retain the names.

(2). In the Uredineæ the names of the teleutospore and uredospore stages are alone considered in the question of priority. *Æcidial* names are not recognized, mainly from the uncertainty that exists as to the genetic connection of the forms, as well as from the obscurity of descriptions, and the inferior value of herbarium specimens as types.

(3). The name of the author responsible for the specific appellation has been appended, being inclosed in parenthesis in case the generic association has been changed; and the name of the author of the binomial combination, whether the parts were adopted from others or not, finally follows. In quite a number of cases this author is not known to us, owing to the too prevalent habit of omitting the citation.

The descriptions of species are taken from nature, and as far as possible from typical or average specimens. The measurements given are intended to include the variations which commonly occur in such specimens; but the extreme limits of exceptionally large or small spores are not indicated. In most cases the measurements were made of spores immersed in a solution of potash, so as to obtain the size of the mature but undried specimens. For the study of the surface markings, examinations were made when necessary of spores either dry or wetted with pure water, whichever method was found from experience to produce best the particular effects required. The color given is as closely as possible that of nature rather than an interpretation of the appearance of a few spores in the field of the microscope. It need scarcely be said that the tint is much lighter in the latter case. The best objectives of different makers were used, and for the closer studies a magnifying power of about five hundred diameters was employed.

It has been deemed worth the while to quote the description given by another author; usually, when accessible, the original description of the species in each case. The quoted descriptions are printed in different type, and are followed by a reference, with name, date, and page, of the work from which the extracts are made.

Notes are appended when required; these follow the collector's numbers and designations of localities, and are intended to record any special facts about, or information upon, the

species. It has not been considered wise to try to give a full list of synonyms, yet such references are made in the notes as are needed to justify any departure from common usage in the selection of names. In a few instances changes have been made with much regret, since the current names are well established; but in these cases the law of priority clearly demands the substitutions made. For instance, the rust on the leaves of the common sunflower, and other allied plants, has long been known as *Puccinia helianthi*, Schweinitz. Probably no species of *Puccinia* is more commonly found or better recognized in the herbaria of our country, and nearly or quite uniformly under the name quoted. But Schweinitz published this name in 1822 (*Syn. Fungi Carol.* p. 73), seven years after De Candolle had published the description of a species of *Puccinia* under the name of *P. tanacetii* (*Flore Franc.* II. p. 222). Now it is found that no specific difference can be maintained between these, and therefore the latter name must be adopted for the collections made in America as well as for those of Europe.

T. J. BURRILL.

ILLINOIS INDUSTRIAL UNIVERSITY,
December 29, 1884.

DESCRIPTIVE CATALOG

UREDINEÆ, DE BARY.

Parasitic plants of minute size, growing in the tissues of living phænogams, or, in a few cases, of living vascular cryptogams; mycelium articulated, variously branched, penetrating or growing between the cells of the host; spores usually produced by constriction, singly or in chains, from the ends of fertile hyphæ (mycelium branches), formed beneath, rarely within the cells of, the epidermis, which is ultimately ruptured; spore or fruit forms of different kinds, viz: æcidium and spermogonium, uredo and teleutoforms.

The Uredineæ are parasites, and affect a very large number of the species of the higher plants, being found most often upon the leaves, but also in some instances upon the stems and parts of the flower or fruit. The roots alone are free from their intrusion, and these probably because protected by the soil.

The most remarkable thing concerning the Uredineæ is their peculiar alternations of fruit forms—"dimorphism," "polymorphism," or "pleomorphism." The teleutospores, the last in the series, and usually the only ones surviving over winter, upon germination emit a slender tube called the promycelium. This is never very long or complex in structure, but may be with or without septa, simple or branched. It produces at once, on minute stalks (sterigmata), one to several thin-walled, more or less globular bodies, rich in protoplasm, and known as sporidia. These in turn soon germinate by sending out a little tube, which, upon the proper host, penetrates the tissues and forms the mycelium or vegetative structure of the parasitic plant. Then follow in order, as products of the mycelium, the fruit forms known as spermogonium, æcidium, uredo, and teleutospore. The two first are usually produced simul-

taneously, or nearly so, on the infected area of the host, but most often on the opposite sides, if of a leaf. In some cases the other fruit forms subsequently develop in the order named, upon the same mycelium, but in others only on a new mycelium produced from the germination of the æcidium spores, and either on the same or different hosts, according to the habit of the species. These alternations may be best understood by consulting what is said under the genus *Puccinia*.

But this full series of forms is not found in all the species. Indeed, there are comparatively few which are really known to have in their regular course of development all the stages as necessary requirements of growth. In a few instances it is known that species, which under some circumstances have this or that form produced, may, under other circumstances, perpetuate themselves though one or more forms are omitted. In very many cases the genetic connection of different fruit forms has not been satisfactorily made out; but contributions to knowledge of this kind are from time to time gained, and through the interest now taken in the matter more rapid advance may be expected in the future. For this purpose artificial cultures, with the most painstaking care to avoid mistakes, are required. The spores must be placed on the proper host under proper conditions, and the development carefully followed through the season. It is believed that in some species only teleutospores are produced, in others only uredo and teleutoforms, and these from the same mycelium; in still others only æcidium and teleutoforms. The office of the spermogonia has not been conclusively ascertained. Cornu, of France has seen the spermatia from them germinate in certain nutritive fluids, but not in water, and he has supposed they may under certain conditions reproduce the plants like other spores. Many have attributed to them sexual functions, but the proof is unsatisfactory. It has been observed that some spermogonia are fragrant, and insects are known to visit them, hence the inference that the special office may be for dissemination.

In most cases the mycelium of these plants wanders little from the point of penetration of the host tissues—in this strikingly differing from the usual growth of the species of *Ustilagineæ* and some other groups of fungus parasites. In

leaves the vegetative threads are seldom found at a greater lateral than vertical distance, the latter limited by the thickness of the leaf; yet the whole tissue may be permeated by the mycelium of different, perhaps very numerous, spores.

In the preparation for the formation of spores, mycelium-threads become densely aggregated into a parenchyma-like tissue in a little area just beneath the epidermis, and from the upper surface of this minute cushion the spores are produced by the enlargement and modification of the end of a thread, either singly; or by the formation of septa, from two to several — in the latter case so as usually to form a single vertical row from each fertile filament. The clusters of spores (sori), usually very densely packed, are naked, or surrounded by peculiar sterile cells (paraphyses), produced from the mycelium or entirely inclosed in a membranous envelope (pseudoperidium), originating from the same source. By the growth of the fungus the epidermis of the host is pushed up and finally ruptured, so that the spores, mostly just at maturity, are exposed to the air, in the currents of which they are light enough to be carried as fine dust.

The species of *Uredineæ* are limited to particular host species, mostly to one, or at farthest to the species of one genus or closely allied genera. None are certainly known to grow upon plants of different natural orders, except in the alternation of fruit forms. In the latter case the teleutospores produced upon grasses or sedges give origin, in some species, to æcidia on the leaves of certain exogens. In fact, it seems to be most common that when the æcidium is not grown on the same host with the uredo and teleutoforms, very wide divergence in this respect is made. Wheat and the barberry bush, oats and the buckthorn, red cedars and apple trees, are three examples of this remarkable peculiarity, the teleutoform in each case being found on the first named, the æcidium on the second.

Following the descriptions of species in this paper, references are given for each species to the host plants, the localities by counties (of Illinois), and the date of collection. The numbers in Arabic figures are those of the herbarium specimens, corresponding with those of the collector's notes; the

Roman numerals often following the above indicate the stage of development of the fungus; viz. I., æcidium; II., uredo; III., teleutospore.

KEY TO THE GENERA OF UREDINEÆ.

- I. Spores at maturity forming a more or less powdery mass.
 - A. Spores with a permanent pedicel, mostly smooth and dark brown.
 - 1. Spores one-celled UROMYCES.
 - 2. Spores two-celled, septum horizontal . . . PUCCINIA.
 - 3. Spores three-celled, septa in different planes.
TRIPHragMIUM.
 - 4. Spores three or more celled, septa horizontal.
PHragMIIDIUM.
 - 5. Spores many-celled, septa variously placed.
RAVENELIA.
 - B. Spores with deciduous pedicels or none, one-celled, mostly roughened with minute projections, usually yellow or reddish-brown.
 - 1. Sorus with a peridium, spores produced in vertical chains, without pedicels.
 - a. Peridium cup-shaped, rim-border mostly toothed or lobed and recurved ÆCIDIUM.
 - b. Peridium hemispherical or bowl shaped, deeply immersed ENDOPHYLLUM.
 - c. Peridium elongated, usually cylindrical or conical, soon split-fringed above RÆSTELIA.
 - d. Peridium various, bursting irregularly, white, on Coniferæ PERIDERMIIUM.
 - 2. Sorus without peridium.
 - a. Spores produced in vertical chains, without pedicels, usually accompanied with spermogonia.
CÆOMA.
 - b. Spores produced on pedicels (deciduous), not accompanied with spermogonia UREDO.
- II. Spores at maturity embedded in gelatine, two-celled, septum horizontal, pedicel long GYMnosPORANGIUM.

III. Spores at maturity in a dense, waxy or crust-like stratum, not separating from each other.

A. Spores one-celled, less commonly several-celled, and then the septa almost never horizontal, mostly dull reddish brown.

1. Spores one-celled, oblong, united in an erect (often curved) cylindrical column. *CRONARTIUM*.

2. Spores one or more celled, septa, when present, mostly vertical or oblique, united in a flat or convex stratum. *MELAMPSORA*.

B. Spores several-celled, septa horizontal, mostly reddish-orange.

1. Spore cells short (not longer than wide), united in a flat waxy mass, cell rows simple. *COLEOSPORIUM*.

2. Spore cells oblong or cylindrical, in simple or branched vertical rows, not waxy. *CHRYSOMYXA*.

UROMYCES LINK.

Teleutospores one-celled, brown, produced singly on permanent pedicels, usually longer than the spore, arising from a compact layer of small irregularly shaped cells beneath the epidermis, which is finally ruptured, exposing the more or less powdery mass.

Like most of the genera of *Uredineæ* the biological development of the *Uromyces* is very complex, and in the different species variously diversified. All the spore-forms exist on the same or different hosts, or any one, or even all but one (the teleutospore) may be wanting. In most cases the teleutospore germinates only after a considerable period of rest, but in a few species exceptions to this occur, and there are also exceptions in regard to the permanence of the pedicels. When the spores readily fall from the stalks, they can be distinguished from stalked uredospores by the different appearance — usually smooth instead of being roughened with minute and mostly sharp-pointed prominences — or by the tardy germination when ripe. Puzzling forms occur, in which some of the

teleutospores are divided like a *Puccinia*; but because a few such spores are found among many of single cells, the species should not be transferred to the latter genus unless there is good reason to suppose that the single celled spores are the abnormal ones.

In England the æcidial forms of the greater proportion of the *Uromyces* are supposed to be known; but in our own flora almost nothing has been demonstrated. In the following those species which have their æcidia on the same host are thus indicated in the notes.

U. hyperici, (Schw.) Curt.

I. Hypophyllous; spots small, scattered, purplish; æcidia minute, about six (one to nine) in a cluster, semi-immersed; short; spores orange.

II., III. Hypogenous; spots small, light cinnamon or purple; sori numerous, scattered. Uredoforms and teleutoforms often in the same sorus, the latter succeeding the former. II. Sori small, roundish, long covered by the epidermis, then surrounded by its ruptured remains; spores light yellow, globose to elliptical-oblong, minutely echinulate, 16–19 by 19–27 μ . III. Sori becoming larger, angular and conspicuous, ruptured epidermis prominent; spores elliptical or oblong, tapering to the base, strongly thickened at the obtuse or rounded apex; 12 by 21–27 μ ; pedicel tinted, 1–2 times the length of the spore.

Spots on the stem pilose-strigose, purple; sori scattered, acuminate-ovate, bullate, elevated, surrounded by the ruptured epidermis.—Schw. N. Am. Fungi, No. 2843, p. 292.

On *Hypericum mutilum*: Union, Oct. 25, 2008, I., III.; *Elodes virginica*: Cook, Sept. 6, 1447, II., III.; Sept. 8, 1462, II., III.; LaSalle, Sept. 28, 6218.

Cooke (Proceedings Portland Soc. Nat. Hist., Vol. 1, part II., p. 184) described, under the name *Uromyces triquetra*, a species on *Hypericum*, and questioned its identity with the plant described by Schweinitz. Peck (25th Rep. p. 74) adopts the name given by Cooke, but Farlow (Ellis N. A. Fungi, 281) uses, for what seems to be the same, Schweinitz's name. In

the exsiccated specimen of Ellis, and the Illinois collections, sori also occur on the stems, in this differing from Cooke's description of *U. triquetra*, and the spores are not commonly angular, certainly not usually three-sided. The above description is drawn from specimens on *Elodes virginica*. On *Hypericum mutilum* the sori occur on both stems and leaves, are smaller and rounded, and the spores are rather smaller and lighter colored.

U. terebinthi, (DC.) Wint.

Amphigenous; spots yellow or yellowish red or none, usually small; sori minute, scattered or crowded, soon naked. II. Spores elliptical, often roundish or oblong, usually obtusely pointed, covered with spiral lines of minute warts or beads, yellowish brown, 25 by 25–40 μ , on a short hyaline deciduous pedicel. III. Spores vertically compressed or globose, with an obtuse cap-like point, verrucose with prominences in short irregular undulating lines, dark brown, about 25 μ long (vertical dimension) and 30 μ wide; pedicel hyaline, stout, permanent, several times as long as the spore.

Uromyces toxicodendri, B. & R. Effused, rufous; spores ovate, obtuse or apiculate, marked with short lines somewhat like the sporidia of *Ascobolus furfuraceus*.—Berk. Grev. vol. III., p. 56.

Pileolaria brevipes, B. & R. Forming little specks on the under side of the leaves; stem short, flexuous; spores at first globose, with three coats, then depressed with a central nucleus. .00114 in. diam.—Berk. Grev. vol. III., p. 56.

On leaves, petioles and stems of *Rhus toxicodendron*: Champaign, June 9, 4928, II.; Adams, June 27, 5319, II., July 6, 5432, II., July 12, 5523, II.; McLean, July 12, 2442, II., July 16, 2437, II., III., 2438, II., III., July 20, 5605, II., 5606, II., July 22, 2439, II., 2440, II., III., Aug. 1, 2442, II., III., Aug. 4, 2443, II., III., Sept. 6, 5657, II., III., Oct. 6, 1811; Piatt, Aug. 15, 1066, II., III.; McHenry, Aug. 24, 1266, II., III.; La Salle, Sept. 14, 1534, II., III.; Stephenson, Sept. 14, 5883; Ogle, Sept. 25, 6167; Jersey, Oct. 14, 6317; Union, Oct. 25, 2019.

This is often referred to the genus *Pileolaria*, Cast.; but mycologists are pretty well agreed (Léveillé, Tulasne, Winter,

Farlow, and others) that the plant is not generically distinct from *Uromyces*. This being admitted, a further question comes upon the specific distinction between the American plant on *Rhus* and the European one on *Pistacea*, an allied genus. Ours was published in Ravenel's *Fungi Car. Sup.* (1855), under the names of *Uredo toxicodendri*, Berk. & Rav., for the uredoform, and *Pileolaria brevipes*, Berk. & Rav., for the teleutoform, and the latter name has been commonly used, though the significance of the specific appellation is unintelligible or incorrect, for the pedicels are conspicuously long. Upon comparing specimens and descriptions of European and American plants, it does not appear that the latter can be maintained as a distinct species, hence the name previously given to the former has here been adopted (*Uredo terebinthi*, D. C. Flore Franc. [1815], VI, p. 71). The teleutospores are not at all different, but in the poor specimens at hand of the European uredospores, the spiral arrangement of the prominences cannot be so well made out; however, Schröter (*Hedwigia* XIV. [1875], p. 170) does not find any difference between them. Doubtless there is none.

It is peculiar that a difference of opinion should exist as to which of the forms is the teleutospore. In these specimens the yellowish fragile-stalked form appears alone in the collections of July, in those of August this is well scattered but present, while the thick-walled long-stalked form may be found in sori still mostly covered by the epidermis, and later (October) only this last is found.

U. hedysari-paniculati, (Schw.) Farlow.

II., III. Spots yellow or none; sori amphigenous, scattered over the whole under surface of the leaf, few above. II. Sori small, yellowish brown, scattered; spores subglobose, echinulate, 18 by 21 μ . III. Sori small, compact, soon diffuse and confluent, brown or blackish; spores acute or oval, obtuse, conspicuously papillate, reddish brown, epispore thick, size 18 by 21 μ ; pedicels broad, slightly colored, slightly curved below, twice the length of the spore.

Sori minute, but thickly scattered over the whole leaf, innate with the epidermis. Spores long-pedicelled, with the pedicels articulate, pel-

lucid or opaque, ovate, obtuse, not cylindrical, obscurely septate, not articulate, constricted.—Schw. N. Am. Fung., No. 2947, p. 297.

On leaves of *Desmodium paniculatum*: LaSalle, Sept. 17, 1561, II., III.; Union, Oct. 22, 1941, Oct. 24, 1992; Pulaski, Nov. 4, 2254, II., III. *D. cuspidatum*: Henry, Sept. 28, 1729; Union, Oct. 22, 1944, 1948 and 1954, Oct. 24, 1980 and 1990, II., III. *D. Canadense*: JoDaviess, Sept. 15, 5913, Sept. 20, 6015; Jersey, Oct. 13, 6290. *D. rotundifolium*: Jersey, Oct. 14, 6321. *Desmodium* spp.: Union, Oct. 24, 1979 and 1991.

In Schweinitz's Syn. Fung. Car. (No. 503) this species is named *Puccinia Hedysari paniculati*, but in his N. Am. Fungi (p. 297, No. 2947), subsequently published, the name is *Phragmidium Hedysari*. The plant called *Hedysarum paniculatum* by Schweinitz is now transferred to the genus *Desmodium*, with other species upon which the fungus also occurs. In March, 1878 (Hedw. XVII., p. 39), Cooke described the same plant under the name *Uromyces Desmodii*; and Thümen, at the same time (Bull. Torr. Bot. Club, VI, p. 215), also bestowed the latter name upon the species, with a still fuller and better description. Farlow (Ellis N. Am. Fungi, No. 246 [1879]) restored the original specific name, and wrote *Uromyces Hedysari-paniculati* (Schw.).

U. lespedezae, (Schw.) Peck.

II., III. Hypogenous and often also sparingly epigenous; spots yellowish, very small; sori small, scattered, at first covered by the epidermis, lead-colored, soon exposed, black, surrounded by the ruptured remains of the epidermis. Uredo sori light brown. Both kinds of sori often surrounded by curved paraphyses. II. Spores pale, subglobose, 16–18 by 18–21 μ ; epispore rather obscurely echinulate. III. Spores rounded to oblong, with the rounded, obtuse, or pointed apex strongly thickened, frequently forming one third of the length of the spore, blackish brown, smooth, 12–15 by 21–27 μ ; pedicel hyaline, rather broad, about 36 μ long. Paraphyses hyaline, of nearly uniform diameter, rounded apex, 6–9 μ broad.

On leaves of *Lespedeza procumbens*: Jackson, Oct. 22, 1952; Union, Oct. 24, 1982. *L. repens*: McLean, July 29, 2349. I., II.; Stephenson, Sept. 14, 5884, Oct. 13, 1860; La

Salle, Sept. 14, 1523, I., II.; Union, Oct. 21, 1910, Oct. 22, 1943, Oct. 26, 2026, Oct. 31, 2148. *L. violacea*: Cook, Sept. 5, 1443; JoDaviess, Sept. 15, 5914; Jersey, Oct. 12, 6264; Union, Oct. 22, 1942, Oct. 31, 2147. *L. hirta*: Union, Oct. 21, 1918, Oct. 22, 1963, Oct. 26, 2025. *L. capitata*: McHenry, Aug. 25, 1293, Aug. 27, 1338; Cook, Sept. 7, 1461; Lee, Sept. 11, 5781; LaSalle, Sept. 17, 1568; JoDaviess, Sept. 20, 6016; Ogle, Sept. 23, 6145.

The so-called "capitata" form is common on most species except *L. violacea*. Paraphyses usually accompany this form, and are mostly absent in the typical one, but many exceptions occur.

Schweinitz (Syn. Fung. Car. [1822] Nos. 497 and 498) describes this species under the names *Puccinia Lespedezæ procumbentis* (497) and *P. Lespedezæ polystachyæ* (498).

U. fabæ, (Pers.) DBy.

II., III. Spots small, black; sori amphigenous, sparse above, scattered, round or oblong, black, surrounded by the prominent remains of the ruptured epidermis. II. Spores in roundish, small and inconspicuous brownish sori, globose or oval, obscurely warty, pale brown, 21–24 by 24–29 μ . III. Spores roundish-oval, obovate, oblong, pyriform or often irregular, epispore smooth, apex strongly thickened, obtuse or rounded, 18–21 by 27–47 μ ; pedicels broad, a little longer than the spore.

On leaves of *Lathyrus palustris*: McHenry, Aug. 23, 1238, II., III. *L. venenosus*: McHenry, Aug. 20, 1156; Stephenson, Sept. 13, 5827. *L. ochroleucus*: Lake, Aug. 27, 1343.

Persoon, in 1794 (Roemer's N. Mag. I, p. 93), named a fungus *Uredo Fabæ*, and this is presumably the uredo form of the present species. In 1801 (Syn. Fung. p. 221) he described under the name of *Uredo Viciæ Fabæ* what is no doubt the teleutoform. DeBary (Ann. Sc. Nat. IV. XX. [1863]) wrote *Uromyces Fabæ*.

U. viciæ, *U. viciæ-fabæ*, *U. ervi* and *U. orobi* are synonyms.

U. appendiculata, (Pers.) Lév.

II., III. Spots yellowish and indefinite or none; sori amphigenous, scattered, pulverulent, often confluent. II. Sori

yellowish brown, spores subglobose or oval, echinulate, 18–21 by 21–24 μ . III. Sori blackish purple, elliptical to subrotund, with a prominent obtuse hyaline apiculus, epispore thick, smooth, 18–24 by 27–32 μ ; pedicels hyaline, fragile, $1\frac{1}{2}$ to 2 times the length of the spore.

On *Phaseolus vulgaris*: Boone, Sept. 2, 1425, II., III.; Union, Oct. 21, II., III., Oct. 24, 1983, II., III. *P. diversifolius*: Cook, Sept. 5, 1442, Sept. 6, 1448, II., III.; Lee, Sept. 9, 5753, II., III.; LaSalle, Sept. 17, 1562, II., III.; Rock Island, Sept. 24, 1643, II., III.; Union, Oct. 21, 1907, Oct. 24, 1981, Nov. 3, 2189. *P. helvolus*: Union, Oct. 24, 1967, Oct. 25, 1995, Oct. 29, 2112.

In Obs. Myc. I, p. 17, Persoon described *Uredo appendiculata*, and in Syn. Fung. pp. 221–222, repeated it with var. *phaseoli*, and two other varieties. The latter have been referred to other species, leaving the original name for this form; but the name *Uromyces phaseoli* is frequently used.

U. *cænothææ*, Burrill.

I. Infected leaves somewhat involute or revolute; peridia irregularly scattered over both surfaces of the leaf, minute, short, roundish or slightly elongated, with a whitish, spreading or somewhat recurved, irregularly lacerated border; spores pale, globose-angular, 15 μ in diameter. II. Spots red-purple, indefinite; sori epigenous, roundish, soon naked, brown; spores subglobose, minutely echinulate, brown, 15–18 by 16–24 μ . III. Spots same; sori roundish or oblong, epigenous and soon naked, or cauline and long covered by the epidermis, blackish; spores oval, elliptical, or oblong, strongly thickened at the apex, broadly rounded or variously pointed, dark brown, 16–18 by 24–30 μ ; pedicels about $1\frac{1}{2}$ times the length of the spore, often broad, tinted, especially close to the spore.

On *Cenothera linifolia*: Jackson, April 27, 4342, I., II., III., April 28, 4359, I., II., III.

The æcidia occur on the cauline leaves, affecting all alike, but sparingly on the radical leaves; the uredo- and teleutoforms are mostly confined to the radical leaves. The pedicels of the uredo spores are frequently persistent.

U. spermacoces,* (Schw.) Curt.

II., III. Amphigenous, on stems and leaves; spots, none observed; sori numerous, scattered, very prominent, rounded, black, surrounded by the upturned epidermis. II. Spores subglobose, yellowish, very minutely warty, 21–25 by 22–27 μ . III. Spores subglobose, smooth, uniformly very dark colored, 24–27 by 30 μ ; pedicels persistent, about 3–4 times the length of the spore.

On stems and leaves of *Diodia teres*: Union, Oct. 25, 1994, Oct. 29, 2122, Nov. 1, 2199. The uredo form was collected in Union Co., Aug. 1880, by C. W. Butler.

U. Rudbeckiæ, Arth. & Hol. (*in lit.*).

Hypophyllous; spots pale, then brown or black, numerous, scattered; sori small, densely clustered, somewhat circinating, slightly raised, clusters plane, epidermis at length vanishing with no remains around the cinnamon-colored sori; spores oblong-obovate, obtuse or obtusely pointed, pallid, about 12 by 20 μ ; pedicel slender, hyaline, somewhat longer than the spore.

On *Rudbeckia laciniata*: McHenry, Aug. 24, 1273; Stephenson, Sept. 21, 6084.

The spots resemble some forms of *Puccinia asteris*, the leaf soon breaking away, leaving holes as if eaten by an insect.

U. Howei, Peck.

III. Spots none; sori hypogenous, scattered, indefinitely clustered, often confluent, surrounded by the remains of the ruptured epidermis, blackish purple; spores oval or subglobose, warty, 18–21 by 21–25 μ ; pedicels about twice the length of the spore, very fragile, breaking off, leaving a small portion attached to the spore, which therefore appears to be very short-pedicled.

Hypogenous, sori scattered or subconfluent, surrounded by the ruptured epidermis, from one-half to one line in diameter; spores brown, subglobose, roughened with slight indentations (?), .00083 to .0010 in. in diameter.—Peck, 23d Rpt. N. Y. State Museum [1873], p. 58.

On leaves of *Asclepias cornuti*: Champaign, Aug. 11, 1016; Cook, Sept. 8, 2351; Lee, Sept. 9, 5755; Stephenson, Sept. 13,

5826; JoDavies, Sept. 18, 5983; Rock Island, Sept. 24, 1649; LaSalle, Sept. 28, 6225; McLean, Oct. 19, 1892. *A. tuberosa*: McHenry, Aug. 26, 1818; Champaign, Sept. 20. *A. incarnata*: LaSalle, Sept. 28, 6211.

The pedicels in this species very easily break away. They are not short and permanent in specimens examined, as indicated by Peck, 30th Rep. N. Y. State Mus., p. 75. The minute roughness of the surface is indicative of a uredoform, but no other form has been found, and these are certainly often produced very late in the season. On account of the deciduous pedicels, Peck at first described the species under the generic name of *Trichobasis* (23d Rep. N. Y. State Mus. [1873], p. 58), but in 30th Rpt. [1878], p. 75, transferred it to *Uromyces*, where it doubtless belongs. Perhaps strictness would require the insertion of Peck in parenthesis, as authority for the specific name.

This is *Uromyces asclepiadis*, Cke. (*Grevillea* V. [1877], p. 152).

U. polygoni, (Pers.) Fckl.

I. Amphigenous; spots minute, inconspicuous; æcidia few, irregularly collected in little groups, small, very short, lacerated border scarcely recurved; spores subglobose or elliptical, epispore thin, tuberculate, 15–18 by 18–21 μ , spermogonia not found. II. Amphigenous; spots yellowish, sori small, scattered, rotund, somewhat elevated; spores subglobose, epispore thick, minutely roughened, 21 by 24 μ . III. Sori cauline, elongated, confluent, dark brown, prominent; spores oval, obovate or oblong, obtuse, epispore smooth, thickened at the apex, 15–24 by 21–35 μ ; pedicels long, persistent, sometimes reaching 100 μ .

On *Polygonum aviculare*, var. *erectum*: McLean, May 23, 4745, I., May 25, 4796, I., II., June 1, 4888, I., II., July 11, 2350, II., Oct. 11, 1834, II., III.; LaSalle, June 19, 5238, II.; Champaign, Aug. 11, 1009, II.; McHenry, Aug. 31, 1395, II., III.; LaSalle, Sept. 12, 1488, II., Sept. 13, 1493, II., III.; Union, Oct. 26, 2030, II., III. *P. ramosissimum*: Lake, Aug. 22, 1222; Lee, Sept. 9, II., III.; Union, Oct. 31, 2152, II., III.

The teleutoform occasionally occurs on the midribs of the leaves and (in No. 2152) even on the blade.

In 1797 Persoon (Disp. Meth.) named this plant *Puccinia polygoni*, but afterwards wrote *P. Polygoni Aviculariæ* (Syn. Fung. [1801], p. 227.) Schröter in 1869 (Rost u. Br. Pilze Schlesiens) adopted the name *Uromyces Aviculariæ*. Fuckel published the name as *Uromyces Polygoni* in 1869 (Symb. Myc., p. 64).

U. euphorbiæ, C. P.

II., III. Amphigenous; spots purple or yellowish; sori scattered, round, small. II. Sori distinguished by their lighter brown color, spores globose, minutely roughened, pale brown, 15–21 μ in diameter. III. Spores subglobose, oval or obovate, slightly apiculate, warty, 15–18 by 18–25 μ , interspersed with numerous slender paraphyses; pedicels about twice the length of the spore, slender, hyaline, very fragile and deciduous, leaving a small portion attached to the spore.

Leaves generally stained with red or purple; sori amphigenous, subrotund, slightly convex, surrounded by the ruptured epidermis, ferruginous-brown or blackish-brown; spores subglobose, rough, often with a large nucleus, about .0008 in. in diameter; peduncle short, hyaline.—Peck, XXX Rep. N. Y. Mus. p. 90.

On leaves of *Euphorbia maculata*: McLean, July 16, 2352; McHenry, Aug. 22, 1221, Aug. 25, 1301; LaSalle, Sept. 16, 1548 and 1550; Lee, Sept. 8, 5712; Rock Island, Sept. 21, 1616; Jersey, Oct. 14, 6316. *E. hypericifolia*: Adams, July 6, 5431, II., III.; McLean, July 7, 2353, Oct. 6, 1802; Tazewell, July 22, 2354; Piatt, Aug. 15, 1064, Aug. 17, 1104; Rock Island, Sept. 21, 1615; Ogle, Sept. 23, 6143; Union, Oct. 21, 1840. *E. dentata*: Adams, July 6, 5427, II., III., 5428, II., III.; Jersey, Oct. 12, 6263, II., III. *E. heterophylla*: Ogle, Aug. 28, 5641, II., III., Sept. 23, 6144, Sept. 28, 6182, II., III.; Lee, Sept. 9, 5754, II., III. *Euphorbia* sps.: McHenry, Sept. 1, 1409.

The pedicels are deciduous, as are those of *U. Howeii*, Peck, and the surface of the spore is similarly roughened. *Æcidium euphorbiæ*, Pers., accompanies the *Uromyces* in Nos. 1064, 1548, 1616, and 2353, but it is believed by most botanists to have no connection with this *Uromyces*.

The synonymy of this species is discussed by Professor Farlow in the Bulletin of the Bussey Institution, II, p. 245.

U. caladii, (Schw.) Farlow.

I. *Æcidia* scattered over the whole under surface of the leaf, short, with a spreading border; spores subglobose to elliptical, angular, minutely roughened, 15-18 by 18-24 μ ; spermogonia also hypophyllous, scattered, preceding and accompanying the *æcidia*. II, III. Amphigenous; sori scattered, round or oblong, often long remaining partly covered by the epidermis, frequently confluent. II. Spores pyriform, truncate at the base, epispore thick, slightly thicker at the apex, conspicuously echinulate, 15-21 by 25-32 μ . III. Spores oval, subglobose or pyriform, smooth, apiculate, 16-21 by 25-32 μ ; pedicels about as long as the spores, very fragile and deciduous, leaving a small portion attached.

On *Arisæma triphyllum*: McLean, May 23, 4755, I., Aug. 1, 2359, III., Aug. 6, 2358, III.; LaSalle, June 15, 4991, I. *A. draconitium*: Union, April 14, 4098 (spermogones), April 17, 4135, I., April 29, 4394, I.; Jackson, April 18, 4164, I., April 19, 4193, I.; Pulaski, May 1, 4399, I., II., May 2, 4423, I., May 6, 4527, I., II., III., May 10, 4590, I.; Johnson, May 12, 4633, I., II.; McLean, May 23, 4754, I., July 20, 2357, III., July 29, 2356, III.: LaSalle, June 21, 5258, I., II., III.; Adams, July 3, 5391, II., III., July 5, 5410, III., July 6, 5435, II., III., July 7, 5445, II., III., July 10, 5459, I., III.; Tazewell, July 22, 2355, III.; Piatt, Aug. 17, 1114, III.; Kane, Aug. 30, 1384, III.; Rock Island, Sept. 24, 1642, III. *Peltandra virginica*: Indiana, near Cook Co. line, Sept. 7, 1456, II., III.

The following is the synonymy of this species: *Uredo Caladii*, Schw. Syn. Fung. Car. [1822], No. 480. *Cæoma* (*Uredo*) *Ari Virginici*, Schw. Syn. N. Am. Fungi [1834], No. 2839. *Uromyces Peltandræ*, Howe. Bull. Torr. Bot. Club, V. [1874], p. 43. *Uromyces Ari-Virginici*, Howe. l. c., p. 43. *Uromyces Pontedericæ*, Ger. l. c. VI, p. 31. *Uromyces Arisæmæ*, Cke. l. c., p. 32.

Schweinitz was probably mistaken at first in his host plant, and means to correct the error by changing the specific name to *Ari Virginici* in the N. Am. Fungi. His description in the

latter work shows that his specimens were the teleutoform, and priority requires the name *Uromyces caladii* (Schw.) as used by Farlow (Ellis N. Am. Fungi No. 232 [1879]).

U. pyriformis, Cke.

III. Spots none; sori amphigenous, frequently arranged in an ellipse, elongated, very dark; spores pyriform, obtuse, episore smooth, thickened at the apex, 15–20 by 25–23 μ ; pedicel half as long to as long as the spore, colored.

Amphigenous, erumpent, sori linear, sometimes confluent, rather pulverulent, purple-brown, episore thickened above; pedicels rather short, thick, persistent, colored in the upper portion.—Cooke, XXIX. Rep. N. Y. Mus. p. 69.

On leaves of *Acorus calamus*: Lake, Aug. 27, 1839; Cook, Sept. 5, 1434, Sept. 6, 1449, Sept. 7, 1459.

Mr. Peck remarks after the above description, "The species is very closely allied to *U. sparganii*, but appears to differ in habit." It is very doubtful whether it is distinct.

U. sparganii, C. & P.

III. Spots inconspicuous or none; sori amphigenous, scattered or in elongated clusters, round or elongated, often confluent, dark, pulverulent; spores pyriform or oblong, apex rounded or truncate, episore smooth, strongly thickened at the apex, 15–20 by 24–32 μ ; pedicels colored, half as long to as long as the spore.

Sori minute, oblong, crowded, black, spores pyriform or oblong-pyriform, about .001 in. long; pedicel colored, shorter than or equal to the length of the spore.—Peck, XXVI. Rep. N. Y. Mus. p. 77.

On both sides of leaves of *Sparganium eurycarpum*: Cook, Sept. 6, 1450, Sept. 8, 1450.

U. erytheronii, (DC.)

I. Spots purplish, inconspicuous; æcidia few, single or in small clusters or lines, short, with a narrow, delicate, many-lobed border; spores subglobose or oval, somewhat angular, smooth or obscurely roughened, 15–21 by 21–27 μ . III. Spots

none; sori amphigenous, few, scattered, elliptical, usually remaining partly covered by the epidermis; teleutospores subglobose to oblong, apiculate, marked with longitudinal striæ, 15-21 by 20-30 μ ; pedicels fragile, deciduous.

On leaves of *Allium striatum*: Union, April 12, 4028, I., III., April 15, 4108, I., III., April 17, 4139, I., III.; Jackson, April 28, 4365.

The only perceptible difference between the Illinois specimens and those on *Erythronium* from Europe is in the small number of æcidia in a cluster.

U. junci, (Schw.) Tul.

II., III. Sori amphigenous, scattered or sometimes confluent, roundish or elongated, prominent, long covered by the epidermis, and after the rupture of the latter its edges conspicuous, the uredosori yellowish brown, the teleuto sori dark brown. Uredospores subglobose, elliptical or sometimes pyriform, echinulate, 12-18 by 18-21 μ , occasionally longer. Teleutospores clavate or irregularly elliptical, usually widest towards the top, smooth; apex obtuse, rounded or truncate, strongly thickened, deep brown; base narrowed; pedicel somewhat colored, nearly or quite as long as the spore; 14-18 by 21-32 μ .

On *Juncus tenuis*: Pulaski, May 1, 4404, II.; Stephenson, Sept. 13, 5830, II., III.

The teleutosori are often much infested with *Darlucium filum*, a parasite on a parasite. On *Juncus tenuis* this seems especially true.

U. scirpi, Burrill.

II., III. Amphigenous, spots brown, indeterminate; sori long covered by the epidermis, minute and rounded, or larger, oblong, sometimes confluent end to end, forming clusters up to one fourth of an inch long, nearly black. Spores among the teleutospores few, irregularly elliptical, yellowish brown, sparsely echinulate, 15-20 by 27-36 μ . III. Spores clavate-elliptical, widest at centre, mostly pointed, brown, apex darker, and thickened, 18 by 32-42 μ ; pedicel stout, subhyaline, about the length of the spore.

On leaves of *Scirpus fluviatilis*: Champaign, Aug. 13, 1031, II., III.; Piatt, Aug. 16, 1088; LaSalle, Sept. 16, 1551, Sept. 20, 1597; Ogle, Sept. 22, 6114, II., III.

The leaves are thickly mottled with conspicuous brown spots, not definitely circumscribed. The appearance is nearest to that of *Uromyces spartinae*, Farlow (*U. junci*, var. *spartinae*, Ellis Exs. No. 239), of anything found, but it is sufficiently distinct in the characteristics of the sori, and in the larger, differently shaped spores.

U. acuminatus, Arthur.

II., III. Hypogenous, sori scattered, elongated, soon naked, ruptured epidermis ragged, conspicuous. Uredospores globose or oval, somewhat echinulate. Teleutospores very irregular, subglobose to clavate, sometimes rounded or truncate, but usually conspicuously and variously pointed; episporium thin, smooth, yellowish brown, 15-18 by 24-39 μ ; pedicel rather slender, somewhat colored, from one to three times length of spores.

I. Unknown. II., III. Sori linear, narrow, elongated, on the under surface of the leaves plane or slightly convex, sunken, soon naked; encircling epidermis somewhat conspicuous. II. Uredosori yellowish, inconspicuous; uredospores large, round or elliptical, finely and plentifully echinulate, brownish yellow, .00088 to .0012 in. broad by .00102 to .0014 in. long. III. Teleutosori brownish black; teleutospores oblong-club-shape and oblong lanceolate to obovate, smooth, golden brown, darker at the apex, .0006 to .00088 in. broad by .0010 to .00163 in. long; wall thin; apex much thickened, .00032 to .00048 in. thick, more or less obliquely acuminate, or rarely only apiculate, sometimes with two pointed terminations, one longer than the other, very rarely obtuse or rounded; base narrowed or only acute; pedicel of uniform thickness, as long as the spore, or shorter, very rarely longer, colored.—Arthur, Bull. Minn. Acad. Nat. Sci. Vol. XI. p. 35.

On leaves of *Spartina cynosuroides*: McHenry, Aug. 26, 1326, I., II.; LaSalle, Sept. 16, 1559.

Among the *Uromyces* inhabiting grasses this is readily distinguished by the irregular and peculiar shape of the teleutospores. While some are no longer than wide, many are oblong or nearly lanceolate, while the apex has a multitude of forms: sometimes straight, sometimes acutely acuminate; often

turned sidewise, beak-like; not seldom double; and occasionally suggesting the appendages at the apex of the teleutospores of *Puccinia coronata*.

U. *graminicola*, Burrill.

II., III. Sori amphigenous, but more common on under surface, scattered, small, oblong or linear, soon uncovered, the ruptured epidermis ragged, but usually its remains plainly apparent. Uredosori yellow, teleutosori blackish brown; uredospores spheroidal or oval, minutely echinulate, 15–18 by 18–22 μ . Teleutospores variable, subglobose, oval or oblong, smooth; apex rounded or angular, thickened, 12–18 by 21–30 μ ; pedicel somewhat colored, thick, scarcely tapering below, once to twice the length of the spore.

On *Panicum virgatum*: McLean, July 20, 2347, II., III., Oct. 11, 1832; Champaign, Aug. 13, 1036, II., III.; McHenry, Sept. 1, 1407. *Elymus virginicus*: Piatt, Aug. 10, 1001.

This species resembles somewhat closely *U. junci*, (Schw.) Tul., from which, however, it is sufficiently distinct aside from the difference in host. Compared with the latter the present species has larger and sooner opened sori, the uredospores have finer echinulations, and the teleutospores are usually shorter, rounder, with apex less produced and pedicel very distinct, being thicker, longer, and less tapering below. Among the *Uromyces* on grasses this seems distinct from *U. Peckianus*, Farlow, to which it bears some resemblance. The latter has the teleutospores more nearly subglobose, epispore uniformly thickened, not produced at apex, and with longer and different pedicels. Perhaps the nearest approach is to *U. spartinae*, Farlow, which, however, has much larger and thicker-walled uredospores, and the teleutospores are lighter colored, more regular in shape, with longer and more slender pedicels.

PUCCINIA, PERS.

Teleutospores two-celled, one above the other, brown, produced on permanent pedicels which arise in dense masses from a cushion-like layer of irregular cells beneath the epidermis.

The characteristics of the genera *Uromyces* and *Puccinia*

are substantially identical, except that in the former the teleutospore consists of a single cell, and in the latter of two cells, formed by a horizontal septum, usually placed somewhat below the middle. The æcidium and uredo forms of the two genera are not distinguishable. That the two genera are very closely allied is also shown by the fact that in some species of *Uromyces* two-celled spores are met with, while, especially when not fully nourished, single-celled spores are quite common in certain *Pucciniæ*. Occasionally more than two cells are observed in true *Puccinia* spores, but in this case there is less difficulty in determining the classification, because the spores in genera characterized by two or more transverse septa (*Phragmidium*, etc.) are considerably different in appearance.

In exact strictness each cell in all these divided forms should be called a spore, for each is independent of the others in germination. Some have even called the whole body a spore sack (ascus), and the single cells spores; but there is no distinct wall for the former.

The genus has been divided as follows:—

1. *Leptopuccinia*.—Only teleutospores produced, which are firmly attached to their stems and germinate soon after maturity; sori quite firm, mostly hemispherical.

2. *Micropuccinia*.—Only teleutospores known, these readily separating from the pedicels, germinating only after a long period of rest.

3. *Hemipuccinia*.—Uredo- and teleutospores known, æcidia not known.

4. *Pucciniopsis*.—Æcidia and teleutospores known, uredo wanting.

5. *Eupuccinia*.—Æcidia, uredo- and teleutospores known.

a. *Autopuccinia*.—All sporeforms on the same plant.

b. *Heteropuccinia*.—Æcidia (and spermagonia) on a different host species from the uredo- and teleutospores.

The third division now undoubtedly contains many species which further information will transfer to the fifth, and the same may be said, with less probability, of the fourth. Since this classification is not applied in what follows, we simply cite as examples of the first: *P. anemones-virginianæ*, Schw.; *P.*

circeæ, Pers.; *P. asteris*, Duby; of the second — none in the list known; of the third: *P. pruni-spinosæ*, Pers.; *P. scirpi*, DC.; *P. maydis*, Cda.; of the fourth: *P. aculeata*, Schw.; of the fifth, first division: *P. tanacetii*, DC.; *P. flosculosorum*, *P. menthæ*, Pers., second division: *P. caricis* (Schum.); *P. graminis*, Pers.

P. anemones-virginianæ, Schw.

III. Spots dark brown; sori hypophyllous, prominent, small, but commonly in dense, wart-like clusters, dark-brown; spores linear-oblong, obtuse, slightly constricted, light-brown below, darker above, the upper cell the shorter, and with the epispore thickened at the apex, 12–15 by 35–55 μ ; pedicels very short, colored.

Spots none; sori scattered, rather large, so compact that they appear solid, black; spores at length easily breaking up. The sori are scattered over the whole leaf, and at first lutescent, and as if sunken.—Schweinitz N. Am. Fungi, No. 2937, p. 296.

On leaves of *Anemone cylindrica*: McHenry, Aug. 23, 1241, Sept. 1, 1404; Cook, Sept. 5, 1441; LaSalle, Sept. 13, 1495. *A. Virginiana*: Piatt, Aug. 17, 1115; Union, Aug. 17, 2519; McHenry, Aug. 27, 1335; McLean, Sept. 6, 5668; LaSalle, Sept. 12, 1471, Sept. 20, 1598; Lee, Sept. 21, 5797; JoDavie, Sept. 16, 5953, Sept. 18, 5991, Sept. 20, 6037.

The spores are light colored and fragile, when dry, much shrunken. Only teleutoform known.

Schweinitz first gave the name cited above (Syn. Fung. Car. [1822] p. 46), and afterward (N. Am. Fungi [1834] p. 296) changed it to *P. solida*.

P. ranunculi, Seymour.

III. Amphigenous, but mostly epiphyllous. Sori irregularly associated, often crowded but scarcely confluent, occupying large areas or the whole of the leaf surface, little elevated, circular, powdery, surrounded by the upturned edges of the epidermis, æcidium-like, cinnamon-brown; teleutospores broadly elliptical, usually little or not at all constricted at the septum, ends rounded, vertex more rarely furnished with a low,

pale apiculus, thickly but minutely tuberculate, 18–24 by 22–39 μ ; pedicel hyaline, fragile, short, sometimes more or less lateral.

On *Ranunculus repens*: Riverside, Illinois, near Chicago, June 2, 1883, J. C. Arthur.

The little warts of the epispore are scarcely or not at all visible in soaked specimens. The teleutospores sometimes germinate in the sorus in June. One-celled specimens are not uncommon, and some vary widely from the described type.

P. podophylli, Schw.

I. Hypogenous. Spots indefinite, mostly large, sometimes confluent over the whole leaf, yellow; æcidia densely crowded, very short, deeply and numerously split and much recurved, very fragile; æcidiaspores subglobose or elliptical, epispore very thin, minutely tuberculate, 16–27 μ ; spermagonia minute, rather sparsely scattered, opposite the æcidia. (*Æcidium podophylli*, Schw.) II. Unknown. III. Amphigenous on leaves and stems, on the former mostly beneath; sori small, rounded, usually more or less confluent; spores ovate, obovate or elliptical, beset with straight or curved conspicuous spines, 20–27 by 39–48 μ ; pedicel very delicate and fugacious.

On *Podophyllum peltatum*: Union, April 12, 4031, I, April 14, 4085, I., 4086, I., III., April 15, 4107, I., III., April 17, 4130, I., III., April 18, 4167, I., III., April 19, 4174, I., III., April 24, 4244, I., III., April 26, 4302, I., III., 4304, I., III., April 29, 4392, I., III.; Jackson, April 20, 4196, I., III., April 21, 4215, I., III., April 27, 4341, I., III.; Pulaski, May 1, 4400, I., III., 4419, I., May 4, 4482, I., III., May 5, 4496, III., May 6, 4526, I., III.; McLean, July 5, 2279, July 7, 2283, July 12, 2282, Aug. 1, 2281; Tazewell, July 22, 2288; McHenry, Aug. 20, 1140; Lake, Aug. 27, 1348.

Commonly known as *P. aculeata*, Schw., but the above name has priority. The species is readily identified by the spines of the teleutospore. The æcidia occur on the parenchymatous portions of the leaf, and the teleutospores are not unfrequently subsequently produced along the veins and upon the stems, having no apparent mycelial connection with the æcidia. In other cases they are produced either in the midst of the æcidia or in close proximity to them.

P. violæ, DC.

I., II., III. Amphigenous, or often hypogenous. I. Spots definite or moræ or less diffused, sometimes covering large areas of the blades and of the petioles; æcidia irregularly (usually densely) clustered, short, rather coarsely and deeply lacerated and irregularly recurved; spores subglobose, epispore very thin, minutely tuberculate, 12–18 μ ; spermagonia not found. II., III. Sori sparsely scattered, or collected in little irregular groups upon discolored spots (*Æcidium violæ*, Schum.). II. Spores subglobose, elliptical or obovate, epispore thick, sharply echinulate, cinnamon-brown, nearly as dark as the teleutospore, 18–24 μ . II. Spores usually broadly elliptical, frequently irregular, little or not at all constricted at the septum, which is thick, vertex thickened, furnished with a conspicuous, tinted, usually obtuse apiculus, and a somewhat similar projection sometimes occurs on the side of the under segment near the septum, base mostly obtusely rounded, epispore rather thick, conspicuously but rather finely tuberculate, 18–24 by 26–37 μ ; pedicels hyaline, fragile, sometimes more or less lateral, not longer than the spore.

On *Viola cucullata*: McLean, Aug. 4, 2284; McHenry, Aug. 22, 1207, II., III., Aug. 31, 1391; Lake, Aug. 29, 1360; Stephenson, Sept. 14, 5888, II., III.; JoDavie, Sept. 20, 6034, III.; Ogle, Sept. 23, 6137, III. *V. striata*: Jackson, April 18, 4163, I., April 19, 4173, I.; Union, April 24, 4245, I., III. *V. pubescens*: McLean, June 24, 5285, II., III., July 15, 2286, Aug. 1, 2285, Aug. 6, 2287, Adams, June 28, 5326, II., III. *Viola sp.*: Kane, Aug. 30, 1381.

P. Mariæ-Wilsoni, Clinton.

I. Amphigenous. *Æcidia* regularly scattered, often closely associated over large areas of the host; peridia lacinated and excurved; spores subglobose, epispore thin, finely echinulate, 15–18 μ ; spermogonia scattered among the *æcidia*. III. Sori hypogenous, irregularly clustered, little elevated, long covered by the epidermis; spores irregular and various, more often elliptical, not constricted at septum, the latter strongly developed; apex obtuse, sometimes furnished with a

very short apiculus, epispore thick, conspicuously, though rather finely tuberculate, 21-27 by 30-48 μ ; pedicel hyaline, fragile, short.

Cœoma (*Æcidium*) *Claytoniatum*, L. v. S. Almost simple and without spots, occupying the whole leaf. Pseudoperidia broad, scattered. Spores orange.—Schw. N. Am. Fung., No. 2892, p. 294.

Puccinia Maria-Wilsoni, Clinton. Amphigenous; spots none; sori scattered or clustered unequal, at first covered by the epidermis, then surrounded by its ruptured remains; reddish brown; spores subelliptical, scarcely constricted, crowned with a pustule, .0013-.0018 in. long, .0007-.0008 in. broad.—Peck, 25 Rep. N. Y. State Mus. p. 115.

On *Claytonia Virginica*: Both forms were collected at Riverside, Illinois, near Chicago, June 2, 1883, by J. C. Arthur.

This compound specific name ought not to be tolerated. Whatever may be said of the Schweinitzian and other old specific names composed of the binomial name of the host, there is no excuse in such a case as the present for disregarding a well-established and appropriate rule.

In the accessible descriptions nothing is said of the tuberculate surface of the teleutospores.

P. heterospora, B. & C.

III. Spots purple, definite; sori hypogenous, small, densey and definitely clustered, soon naked, ruptured, epidermis inconspicuous; spores subglobose or rarely elongated, mostly single-celled, but frequently septate in any direction, epispore smooth, gradually thickened toward the apex, diameter 18-27 μ ; pedicel hyaline, slender, diminishing below, about three to five times the length of the spore.

Sori minute, collected in orbicular groups, brown; spores subglobose, with the pedicel attenuated downward, subequal, at length septate.—Berkeley, Journ. Linn. Soc. Vol. X., p. 356.

On *Sida spinosa*: Union, Sept. 17, 1882, 5033. F. S. Earle.

This is *Uromyces pulcherrima*, B. & C. (Grev. III. [1874] p. 56, also *U. Thwaitesii*, B. & Br. Journ. Linn. Soc. XIV. [1875] p. 92,).

The original description by Berkeley and Curtis is in Jour. Linn. Soc. X. [1869] p. 356. See A. B. Seymour, Botanical Gazette, 1884, p. 357.

The species is properly a *Puccinia* since the septate cells, though usually less in number than the simple ones, are numerous and normal in character—evidently the highest development of the plant.

P. nolitangeris, Cda.

Hypophyllous. II., III. Sori minute, scattered uredosori yellowish; teleutosori brown; uredospores subglobose, obscurely echinulate, diameter 16–19 μ ; teleutospores elliptical to oval, but irregular, rounded at both ends and slightly constricted, with a prominent hyaline apiculus, 15–18 by 25–33 μ ; pedicels hyaline, very fragile and deciduous, apparently about as long as the spores.

Spots irregular, confluent, flavescent; sori gregarious, rufo-fuscous; spores oblong, obtuse or attenuated, apiculate, amœne fuscous, hyaline; epispore simple, thin; nucleus grumulose; oil globules white; terminal apiculus hyaline, whitish; pedicel rudimentary, almost none, white. Length of spore, .00134.—Corda, Icon. IV, p. 16.

On leaves of *Impatiens fulva*: La Salle, Sept. 12, 1479, II, III, Sept. 14, 1536, II, III. *I. pallida*: La Salle, Sept. 12, 1480, II., III., Sept. 17, 1590, II., III. *Impatiens*: LaSalle, Sept. 30, 6245, II., III.

This species has now been found for four successive years in the "Lower Park," at Deer Park, LaSalle Co., though diligent search fails to discover it in any of the similar localities in that region, nor has it been found elsewhere in the State.

P. amorphæ, Curt.

II. Sori usually epiphyllous, small, few, clustered, surrounded by numerous closely packed, clavate, incurved, brown paraphyses; spores ovate or oval, minutely echinulate, 12–15 by 18–21 μ . III. Amphigenous; sori small, scattered, or above clustered and circinate; paraphyses as in II; spores much constricted, cells globose, enveloped by a thick, hyaline, readily separable coat, without latter, 24–30 by 42–45 μ ; pedicels hyaline, fragile.

Amphigenous, sori scattered and approximate in yellow spots, subrotund, black; spores compact, oval, rarely globose, constricted in the middle, opaque; pedicel short or none....Sporidia remarkable for a

loose, transparent, vesicular (?) epidermis, often enclosing and bordering the opaque nucleus.—Curtis, Am. Jour. Sci. & Arts, 2 Ser., Vol. VI. p. 353.

On leaves of *Amorpha fruticosa*: Adams, July 11, 5503, II.; McLean, July 29, 2289, II., III., Oct. 13, 1859; Piatt, Aug. 15, 1076, Aug. 16, 1080, II., III., Aug. 17, 1133; Lee, Sept. 9, 5765, II., III., 5766; LaSalle, Sept. 12, 1476, II., III., Sept. 13, 1515, Sept. 14, 1535; Ogle, Sept. 25, 6162; Fulton, Oct. 1, 1772. *A. canescens*: McHenry, Aug. 24, 1264, Aug. 25, 1290, Aug. 27, 1332, II., III.; Lake, Aug. 27, 1345; Lee, Sept. 11, 5785; Stephenson, Sept. 14, 5891; JoDavie, Sept. 15, 5915; Ogle, Sept. 22, 6097.

This is *Uropyxis amorphae*, Schröter; but aside from the peculiar coating of the teleutospore there is nothing to separate the species from *Puccinia*. The uredoform would have been considered a good *Lecythia*, and is much like that of *Melamp-sora* on willows. The teleutosori on the upper side of the leaf are compact, the spores crowded together. On the under side the spores are diffusely associated in the sori.

P. pruni-spinosæ, Pers.

II., III. Hypophyllous. Spots above small, scattered or confluent, II. yellow, III. purple; sori scattered, small, rounded, teleutosori purplish brown; uredospores oblong or clavate-elliptical, smooth, 15–18 by 32–39 μ ; paraphyses pedicel-like, then swollen at the end and often curved; teleutospores deeply constricted, the segments often globose, easily separable or more closely united and irregular, strongly echinulate, 21–24 by 24–39 μ ; pedicels hyaline, very fragile, about the length of the spore; the paraphyses numerous, much enlarged above, and brown.

Scattered, minute, punctiform, spores globose, twin; pedicels very short.—Pers. Syn. Fung. p. 226.

On leaves of *Prunus Americana*: Lake, Aug. 29, 1361; McHenry, Aug. 31, 1387; Lee, Sept. 9, 5759; LaSalle, Sept. 13, 1502; JoDavie, Sept. 16, 5954, Sept. 18, 5988, Sept. 19, 5994; Ogle, Sept. 25, 6171. *P. Virginiana*: McLean, Aug. 6, 2290. *P. serotina*: Ogle, Sept. 22, 6112, II., III., Sept. 26, 6191, II., III.

The uredoform is *Uromyces prunorum*, Fckl. The shape and attachment of the cells of the teleutospores vary on different hosts. On *Prunus Americana* the cells are nearly or quite globular, and easily separated, while on *P. serotina* they are well joined and variable.

Nees (Syst. d. Pilze u. Schwämme [1816]), under the generic name of *Dicœoma*, separated the *Puccinia* species in which the spores spontaneously-divided at the septum before germination. *P. pruni-spinosæ* belongs to this group.

P. Peckiana, Howe.

III. Hypogenous. Sori small, scattered, few or many, sometimes sparingly confluent, cinnamon-brown, powdery; spores in one view more or less triangular, in the other, at right angles to the first, elliptical, not constricted at segment, upper segment triangular, with a small hyaline, obtusely rounded apiculus, lower segment in side view somewhat quadrate, with two basal projections, to one of which the pedicel is attached, and the other is terminated with a hyaline apiculus similar to that of the upper segment, 22-27 (base) by 36-45 μ ; pedicel hyaline, fragile.

On *Rubus villosus*: Urbana, July 24, 1884, T. J. Burrill.

This may be the teleutoform of what is called *Cœoma nitens*, Schw., the "orange rust" of the blackberry, so well known to horticulturists. The *Puccinia* has also been found on raspberry leaves in New York, and the *Cœoma* sometimes occurs on the latter host. *Puccinia tripustulata*, Peck, is the same species, and so admitted by the author of the latter name.

P. tiarellæ, B. & C.

III. Amphigenous. Spots small, distinct, reddish brown; sori scattered, circular, prominent, on the petioles more or less elongated and sometimes confluent, chestnut-brown; spores elliptical, constricted at the septum, vertex much thickened, and usually prominently pointed, base mostly obtusely rounded, epispore rather thin, smooth, 12-18 by 21-36 μ ; pedicel nearly hyaline, very slender, once to twice as long as the spore.

On *Mitella diphylla*: Kane, Aug. 30, 1882.

Thanks are due to Professor W. G. Farlow for the comparison of this with original specimens.

P. proserpinacæ, Farlow.

II., III. Amphigenous, but often only hypophyllous. Sori rounded, scattered or collected in irregular groups, sometimes, especially along the veins, confluent, rarely naked, the uredosori surrounded by the remains of the ruptured epidermis, the two kinds nearly of the same color, chestnut-brown, the teleutosori becoming grayish from the germinating filaments; uredospores obovate, pale cinnamon-colored, epispore rather thick, sharply echinulate, 15–21 by 24–30 μ ; teleutospores oblong, sometimes narrower, usually gradually contracted at the septum, apex thickened and rounded or pointed, epispore thin, smooth, cell contents granular, pale brown, 15–21 by 35–52 μ ; pedicel nearly hyaline, usually about half the length of the spore.

Sori round, scattered, soon becoming naked. Uredospores yellowish brown, oval, echinulate, 20–26.5 μ in diameter, average 22–23 μ . Teleutospores brown, densely packed and germinating in the sorus, short-stalked, clavate, contracted somewhat at the septum, apex rather acute, with thickened cell wall, 38–5.3 μ by 17–21 μ .—Farlow, Proc. Am. Acad. Arts & Sci., Vol. XVIII., p. 80.

On *Proserpinacea palustris*: Ravenswood, near Chicago, Sept. 4, 1883. J. C. Arthur.

P. circææ, Pers.

III. Hypophyllous. Spots definite, purple or brown; sori rounded, clustered, and more or less circinate; spores oblong, slightly constricted, smooth, obtusely pointed, apex thickened, narrowed at base, 15 by 24–66 μ ; pedicel somewhat colored, equalling or exceeding the length of spore.

Scattered, wart-like, chestnut-color, spores ovate and acute.—Pers. Syn. Fung. p. 228.

On *Circæa Lutetiana*: Johnson, May 11, 4611; Adams, June 27, 5309; McLean, July 15, 2295, July 20, 2293, 5602, July 27, 2291, Aug. 1, 2294; Tazewell, July 22, 2292; Piatt, Aug. 17, 1110; McHenry, Aug. 20, 1170, Aug. 22, 1204; Kane, Aug. 30, 1379; Lee, Sept. 11, 5767; LaSalle, Sept. 17, 1567,

Sept. 30, 6251; Stephenson, Sept. 13, 5832; JoDavies, Sept. 15, 5917, Sept. 19, 5995; Ogle, Sept. 23, 6138. *C. alpina*: Kane, Aug. 30, 1380.

On *Circœa Lutetiana* the sori are marked, while on *C. alpina* they are distinct, smaller, and often circinate.

P. pimpinellæ, (Strauss) Lk.

II., III. Amphigenous. Sori rather large, round, scattered, soon naked. Uredospores globose or ovate, minutely roughened, thick-walled, 18–21 by 24–27 μ ; teleutospores broad, ends rounded, little constricted, surface roughened with mesh-like depressions, 18–21 by 29–35 μ ; pedicel hyaline, fragile, sometimes more or less lateral.

Spots obliterated, sori subrotund, scattered, amphigenous, spores cinnamon, of two forms, ovate and obovate, short pedicelled.—Link, Linn. Sp. Plant, VI., P. II., p. 77.

On *Osmorrhiza longistylis*: Fulton, 2269, II., III. (Wolf); Adams, June 30, 5359. *O. brevistylis*: LaSalle, Sept. 29, 6231.

Peck (29 Rep. N. Y. State Mus. [1878] p. 73) mentions without describing *P. osmorrhizæ*, C. & P., on *Osmorrhiza*. Previously (25 Rep. N. Y. State Mus. [1873] p. 112) he describes *P. myrrhis*, Schw. (N. Am. Fungi, [1834] p. 296) on the same host plants. Schröter (Hedw. XIV. [1875] p. 169) shows the latter to be the same as *P. pimpinellæ*, Lk. (Spec. Plant. II. [1824–25] p. 77). Winter (Rabh. Kryptog. Fl. I. [1882] p. 212) unites these two with *P. charophylli*, Purton, (Brit. Plants III. [1821] No. 1553), and other supposed species under the name of *P. pimpinellæ* (Strauss). The above mentioned specimens collected by Wolf were identified by Peck as *P. osmorrhizæ*, C. & P., but they agree with his description of *P. myrrhis*, Schw., and with Thümen's specimens, including those of *P. myrrhis*, Schw. (Mycoth. Univ. No. 1327), collected in New York by Gerard, and *P. charophylli*, Purton, (Mycoth. Univ. No. 1229).

P. galiorum, Lk.

I. *Æcidia* hypophyllous, small, short, reflexed at summit; spores subglobose or broadly oval, smooth, 15–21 μ . II. Not yet found in Illinois. III. Amphigenous; sori usually scattered

singly on leaves and stem, round or somewhat elongated; spores irregular, elongated, mostly oblong or clavate-elliptical, smooth, apex strongly thickened, obtuse or variously pointed, sometimes broadly truncate, usually narrowed to the base, 18–21 by 23–45 μ ; pedicels hyaline, about the length of the spore.

On *Galium concinnum*: Champaign, Aug. 13, 1037; Piatt, Aug. 15, 1062, Aug. 17, 1116; McHenry, Aug. 20, 1188, Aug. 22, 1201, Aug. 23, 1237, Aug. 28, 1306; Lee, Sept. 8, 5723; La Salle, Sept. 13, 1519, Sept. 30, 6253; Stephenson, Sept. 13, 5831; JoDavies, Sept. 16, 5955; Ogle, Sept. 23, 6137½; Henry, Sept. 28, 1727; Jersey, Oct. 14, 6039. *G. triflorum*: Champaign, June 9, 4935, I., III., June 10, 4957, I., III.; Adams, June 27, 5308, I., III., June 29, 5343, I., III.

Single-celled teleutospores are rather numerously found.

P. tenuis, Burrill.

I. Hypophyllous, rarely also epiphyllous; æcidia clustered in little irregular groups or sparsely scattered, very small, short, the narrow border irregularly lacerated and recurved; spores subglobose, very minutely tuberculate, 14–18 μ . (*Æcidium tenue*, Schw.) III. Hypophyllous; spots small, often confluent, mostly yellow, with a broad blackish center; sori sometimes scattered, usually confluent, effused, slightly convex, covered by the epidermis, dull grayish black; spores oblong-clavate, slightly constricted, usually angular or variously conspicuously pointed, 15 by 40 μ ; pedicels hyaline or slightly colored, half as long as the spore.

Æcidium tenue, Schw. Spots yellowish, evanescent, very small; peridia scattered, little elevated, but, what is peculiar, amphigenous—closed on the upper surface, open on the lower; spores pallid.—Schweinitz, N. Am. Fungi, No. 2889.

On leaves of *Eupatorium ageratoides*: Johnson, May 11, 4612, I.; McLean, Aug. 6, 2302; Champaign, Aug. 13, 1058; Piatt, Aug. 17, 1103; Lake, Aug. 27, 1340.

P. Kuhniæ, Schw.

II., III. Amphigenous; sori not prominent nor compact, often ragged from the uneven height of the spores. II.

Spores with the teleutospores, subglobose to oblong, echinulate, yellowish brown, 16–27 by 27–30 μ . III. Spores quite uniform, rounded at both ends, broad, with a very short, nearly hyaline apiculus, and sometimes a similar projection on the side of the lower segment, thick walled, dark colored, smooth, 30 by 44 μ ; pedicels as long as 90 μ .

Spots none; sori amphigenous, pulvinate, densely aggregated, blackish brown; spores rather large, broad, long pedicelled.—Schweinitz, N. Am. Fungi, No. 2931, p. 296.

On *Kuhnia eupatorioides*: Lee, Sept. 9, 5761, II., III.; La Salle, Sept. 12, 1478, Sept. 14, 1542; Stephenson, Sept. 14, 5889, II., III.; Champaign, Sept. 23; McLean, Oct. 7, 1823; Jersey, Oct. 12, 6270.

P. conoclinii, Seymour.

II., III. Mostly hypophyllous; spots small, purple, often confluent over large areas, becoming pale; sori scattered, sparse or very numerous associated, not often confluent, uredosori cinnamon-brown; teleutosori dark reddish brown; uredospores subglobose to oval, sharply echinulate, 18–27 μ ; teleutospores broadly oval, little constricted, ends rounded, walls thick, warty, 27 by 32–42 μ ; pedicel nearly hyaline, firm, crooked, very long, about three times the length of the spores.

On *Conoclinium caelestinum*: Pine Hills, Union Co., Sept. 11, 5034, II., III. F. S. Earle.

This is *P. centaureæ*, DC. of Berkeley's Notices of North American Fungi (Grevillea III. p. 53) ascertained by examination of the original specimens in Herb. Curtis, but differs from other authentic specimens bearing this name.

P. asteris, Duby.

III. Hypophyllous. Sori densely crowded in round, distinct, and firm clusters, the latter scattered, few or many, light to dark brown; spores smooth, clavate, gradually narrowed to the septum and toward the base, upper segment widest, apex thickened, rounded or pointed, 15–18 by 33–45 μ ; pedicel nearly hyaline, usually somewhat shorter than the spore.

Spots above yellowish, sori large, fuscous, orbicular and elongated, convex, compact, and powdery, scattered, hypophyllous, surrounded by

the ruptured epidermis. Stipe white, filiform, nearly equaling the elongate elliptical spore, which is constricted in the middle, lower article elongate-turbinate, upper obtuse, elliptical or ovate-globose.—Duby, *Botanicon Gallicum*, Vol. II. p. 888.

On leaves of *Aster shortii*: McLean, July 15, 2308 and 2309, Aug. 4, 2307, Aug. 6, 2306. *A. sagittifolius*: McLean, July 7, 2313 and 2315, July 12, 2319, July 15, 2315, July 16, 2316, July 29, 2318, Aug. 1, 2320, Aug. 4, 2310, Aug. 6, 2311, 2312, Oct. 19, 1894; Ogle, Sept. 23, 6141; Fulton, Oct. 3, 1737. *A. miser*: McLean, Oct. 11, 1833. *A. Novae-Angliæ*: McLean, July 25, 2314; Stephenson, Sept. 13, 5836. *Aster* spp.: McLean, July 7, 2323, July 14, 5537, July 17, 5581, Oct. 6, 1797; Adams, July 10, 5455; Tazewell, July 22, 2321 and 2322; Piatt, Aug. 16, 1083, Aug. 17, 1123; McHenry, Aug. 24, 1269, Aug. 31, 1388.

There is no apparent reason for keeping separate the variable forms known as *P. asteris*, Schw., and *P. Gerardii*, Peck. On *A. sagittifolius* both are found on the same leaf in several instances. The younger more rapidly grown specimens are lighter colored, and there are all degrees of distinctness and confluence of the sori. When on thin leaves the spots quickly die, the spores are very poorly developed, light-colored, thin-walled, and very fragile. In other cases the sori are somewhat circinate in arrangement and not crowded. The central and older ones are covered with the epidermis, the outer, younger, and lighter brown ones burst through and are thus naked. Sori very rarely occur on the upper side of the leaf. On *Aster Novae-Angliæ* the spores are better developed, plumper, stronger, darker brown, yet on dead spots are the opposite. Here the sori are usually much scattered, not collected in clusters. Sometimes on thin leaves of several species, dead spots soon fall out, leaving more or less rounded holes.

Again, Schweinitz's name (*N. Am. Fungi* [1834] p. 296) is untenable, having been previously used by Duby (*Bot. Gall.* [1828-30] p. 888). For this reason the name *P. Gerardii*, much more recently given by Peck (25 *Rep. N. Y. State Mus.* [1870] p. 91) should be adopted if either. But there is a further question, whether or not the American specimens are specifically distinct from those of Europe. Three names have been

given to the latter, *P. Asteris*, Duby, *P. Tripolii*, Wallr. (Flora Crypt. Germ. [1831-3] II. p. 223), and *P. Asteris*, Fckl. (Symb. Mycol. [1875] p. 53), which have been pronounced synonyms by several botanists, and from the material and descriptions at hand it is impossible to separate from these the American forms. Schröter (Hedw. XIV. [1875] p. 169), after an examination of original specimens, confidently declares that the forms are specifically identical. Cooke (Grevillea III. [1875], p. 169) seems to regard Schweinitz's species as distinct from the European plant, though not supposing *P. Gerardii*, Peck, specifically different from the former. After careful comparison of specimens, all are here referred, as may be seen, to the species called *Puccinia Asteris* by Duby.

P. silphii, Schw.

III. Hypogenous; spots scabious, numerous, scattered, concave, with a raised rim; sori very prominent, wart-like, compact, dull grayish brown; spores irregular, oblong-clavate, conspicuously and angularly pointed, firm, dark colored, but not thick walled, smooth, contents granular, 13 by 40 μ ; pedicel tinted, firm, about the length of the spore. The leaves are often thickly spotted and scarred by the fungus, and large patches of sori occur also on the stems.

Spots rather small, purple; sori thick, pulvinate, confluent, aggregated, black; spores compact, of uniform color.—Schweinitz N. Am. Fungi, No. 2929, p. 296.

On *Silphium terebinthinaceum*: McLean, June 23, 5275. *S. integrifolium*: McLean, June 23, 5276, July 14, 5536, July 16, 2338, July 26, 2382; Champaign, Aug. 13, 1039; McHenry, Aug. 26, 1322, Aug. 27, 1337, Aug. 31, 1389, Sept. 1, 1408; La-Salle, Sept. 16, 1558. *S. perfoliatum*: McLean, May 30, 4823; June 19, 5265, July 17, 5579; Adams, June 30, 5368; McHenry, Aug. 24, 1272; Lee, Sept. 9, 5763.

P. xanthii, Schw.

III. Hypophyllous. Sori small, mostly closely clustered in spots or patches; spores smooth, oblong, evidently constricted, apex slightly thickened, round, or beak-like, 15-21 by 36-51 μ ; pedicel slightly colored, usually shorter than spore.

On leaves of *Ambrosia trifida*: McLean, July 5, 2383, July 29, 2336, Aug. 4, 2384; Champaign, Aug. 12, 1066; Piatt, Aug. 17, 1109; Fulton, Oct. 3, 1734. *Xanthium strumarium*: McLean, July 4, 2387, July 6, 2337, July 11, 2388, July 14, 5538; July 29, 2385, Oct. 6, 1796; Tazewell, July 22, 2386; Champaign, Aug. 13, 1041; Piatt, Aug. 17, 1128; McHenry, Aug. 22, 1205; Lee, Sept. 8, 5719; LaSalle, June 19, 5236, Sept. 12, 1477; JoDaviess, Sept. 18, 5985; Rock Island, Sept. 21, 1611; Union, Oct. 21, 1932, Oct. 25, 1993 and 2004; Pulaski, Nov. 4, 2249.

In the specimens on *Ambrosia* the spores are somewhat thinner walled and more rounded than in those on *Xanthium*, but the difference is slight.

P. tanacetii, DC.

II., III. Amphigenous. Sori mostly rather large, scattered, often sprinkled over the entire leaf; uredospores globose to ovate, echinulate, 21-24 by 27-32 μ ; teleutospores variable, broadly oblong to broadly oval with rounded ends, usually little constricted, smooth, or sometimes warty towards the apex, the latter thickened or not, 21-27 by 34-60 μ ; pedicel hyaline, very long, two to four times the length of the spore.

On leaves of *Helianthus annuus*: Piatt, Aug. 10, 1006; Lake, Aug. 22, 1206, I., II.; Kane, Aug. 30, 1366, I., II.; Cook, Sept. 8, 1468, I., II.; Rock Island, Sept. 27, 1601. *H. rigidus*: McLean, July 26, 2297, Oct. 11, 1831; Piatt, Aug. 10, 1004; LaSalle, Sept. 12, 1491, Sept. 14, 1539, Sept. 16, 1557, Sept. 20, 1598. *H. mollis*: Marion, Oct. 20, 1902. *H. decapetalus*: McLean, Aug. 4, 2299, Oct. 6, 1799. *Helianthus* spp.: Adams, June 30, 5361, II.; McLean, July 15, 2301, July 29, 2300, II., III., Oct. 6, 1798, Oct. 7, 1822, Oct. 11, 1837, Oct. 18, 1871; Champaign, Aug. 13, 1038; Piatt, Aug. 17, 1129; McHenry, Sept. 20, 1160; Kane, Aug. 30, 1365; Cook, Sept. 5, 1437; Lee, Sept. 11, 5784; LaSalle, Sept. 13, 1496, Sept. 14, 1541, Sept. 17, 1565; Stephenson, Sept. 13, 5835, II., III., 5844, II., III.; JoDaviess, Sept. 15, 5916, II., III.; Ogle, Sept. 23, 6146, III.; Rock Island, Sept. 21, 1612, II., III., Sept. 26, 1665, Sept. 27, 1675; Henry, Sept. 28, 1723; Fulton, Oct. 1, 1766, Oct. 3, 1738; Jersey, Oct. 13, 6291; Union, Oct. 21, 1904, Oct. 28, 2097.

Var. *Vernoniæ*.

Amphigenous; spots small, purple, with a pale yellow border, or yellow only, sometimes indistinct: sori scattered, subrotund, prominent, blackish brown or black; spores oblong-elliptical, mostly regularly rounded at the ends, slightly constricted, a central nucleus in each cell, 20 by 42 μ ; pedicel hyaline, about four times as long as the spore. Uredospores preceding or accompanying the teleutospores, not numerous, subglobose, sharply echinulate, about 25 μ in diameter.

On *Vernonia fasciculata*: Champaign, Aug. 11, 1014; Piatt, Aug. 16, 1094, Aug. 17, 1098, 1102; McLean, Sept. 6, 5670, Oct. 12, 1844, 1850; LaSalle, Sept. 14, 1527, Sept. 30, 6254; JoDaviess, Sept. 19, 5996.

Schweinitz (N. Am. Fungi, No. 2926) calls this form *P. Vernoniæ*, and describes it as follows:

“Spots none. Differing from *P. helianthi* in the rather large pulvinate sori, and the delicate ferruginous color of the spores. It sometimes occurs also on species of *Helianthus*.”

But the gradation of forms between this and the typical *P. helianthi* leaves no sufficient ground for *specific* distinction. Further, *P. helianthi* seems to be *P. tanacetii*, DC. Winter (Rabh. Krypt., Fl. I., p. 209) unites the two, while Schröter (Hedw. XIV., p. 180) maintains that they are distinct, basing his arguments on distribution. The size, shape, and color of the spores vary greatly, but are so connected by intermediate forms that no specific distinction can be founded on these characteristics. Cultures are necessary to determine such distinction if there is any. In the meantime, so long as we are unable to recognize a difference by appearance, there can be no question as to which name to choose, even though this carries us against common usage and our own habit.

P. flosculosorum, (Alb. & Schw.) Roehl.

II.; III. Amphigenous. Sori small, scattered or in small clusters. Uredospores subglobose, sharply echinulate, mostly rather thick walled, 24–30 μ ; teleutospores broadly elliptical or oval, constriction little or none, rarely thickened at the apex,

usually furnished with punctiform to wart-like projections, 18-25 by 30-45 μ ; pedicels hyaline, fragile, not usually longer than the spore.

Uredo flosculosorum, Alb. & Schw. Uredo black, sori scattered, minute, subrotund, pulvinate, powder rather loose, spores unequal, subcaudate.—Albertini and Schweinitz, *Conspect. Fung.* p. 128.

On *Cirsium discolor*: Adams, July 6, 5425, II. *C. lanceolatum*: LaSalle, June 19, 5237, II., Sept. 29, 6241, II., III.; Tazewell, July 22, 2410, II., Lee, Sept. 8, 5718, II.; Stephenson, Sept. 14, 5890, II.; JoDaviess, Sept. 18, 5986, II., III.; Rock Island, Sept. 21, 1608, II., III., Sept. 24, 1645, II., III., Sept. 26, 1663, II., III., Sept. 27, 1674, II., III.; Ogle, Sept. 23, 6149, II.; Fulton, Oct. 1, 1770, II., III., McLean, Oct. 6, 1794, II., III., Oct. 12, 1841, II., III., 1843, II., III., Oct. 13, 1858, II., III., Oct. 18, 1890, II., III.; Champaign, Nov. 9, 2389, II., III., Nov. 12, 2390. *Taraxacum dens-leonis*: McLean, May 25, 4776, II., May 20, 4828, II., July 6, 2391, II., July 16, 2392, II., July 25, 2393, II., Oct. 11, 1835, II.; Champaign, June 8, 4902, II., Nov. 7, 2277, II., III.; LaSalle, June 19, 5229, II., Sept. 14, 1540; Adams, July 7, 5447, II., July 11, 5501, II.; McHenry, Aug. 22, 1218, II.; Boone, Sept. 2, 1419, II.; Stephenson, Sept. 13, 5828, II.; Rock Island, Sept. 21, 1613, II., Sept. 24, 1653, II. *Hieracium Canadense*: McHenry, Aug. 20, 1197; Boone, Sept. 2, 1426; Stephenson, Sept. 13, 5833, II., III.; Ogle, Sept. 23, 6130, II., III.; LaSalle, Sept. 30, 6256, II., III.

Under this species are included the forms that have been known on *Cirsium* as *P. cirsii*, Lasch., and *P. compositarum*, Schl., on *Taraxacum* as *P. variabilis*, Grev., and on *Hieracium* as *P. hieracii*, Mart. The teleutospores of American specimens are very minutely warty, or apparently smooth, agreeing with Winter's remarks on this species in *Hedwigia*, XIX., p. 20. Nearly or quite all the specimens on *Cirsium* (except No. 2410) present both uredo- and teleutoforms, but on *Taraxacum* teleutospores are found only in specimens collected late in the season (No. 2277).

P. maculosa, Schw.

III. Amphigenous. Sori scattered or regularly collected in definite circinate clusters, often appearing on both sides of the leaf over the same area, cinnamon-brown; spores clavate-oblong, thin walled, fragile, smooth, much constricted, upper segment widest, apex thickened, rounded or variously pointed, base narrowed to the pedicel, 15-18 by 30-45 μ ; pedicel hyaline, usually less in length than the spore.

On *Cynthia Virginica*: Johnson, May 16, 4709.

Schweinitz (Syn. Fungi Am. Bor., p. 295, No. 2922,) refers this species to *P. maculosa*, Strauss; but the latter is *P. prenanthis* (Schum.), and is very different from the present species.

P. lobeliæ, Gerard.

III. Mostly hypophyllous. Sori small, scattered or irregularly and rather loosely clustered, cinnamon-brown; spores oblong, smooth, thin walled, very deeply constricted, fragile, segments equal, or the lower narrower, 15-18 by 30-39 μ ; pedicel very fragile, shorter than the spore.

Sori minute, scattered or confluent, tawny brown; spores oblong-elliptical, slightly constricted at the septum and easily separating into two parts, pale, .0013-.0016 in. long; pedicel short or obsolete.—Peck, XXVI. Rep. N. Y. Mus., p. 77.

On *Lobelia syphilitica*: Adams, July 7, 5444; McLean, Aug. 6, 2303, Sept. 6, 5669; LaSalle, Sept. 13, 1517, Sept. 17, 1566; JoDaviess, Sept. 20, 6026. *L. puberula*: Johnson, May 13, 4710; Union, Aug. 18.

This is *P. microsperma*, B. & C. in *Grevillea* III., p. 55. The sori are usually more densely aggregated on *L. puberula*, but there is no other difference.

P. seymeriæ, Burrill.

III. Hypophyllous, and on stems and calyces. Spots definite, dark-colored; sori rather large, mostly crowded in conspicuous circular clusters a fifth of an inch in diameter, these sometimes confluent, dark brown; spores elliptical or oval, little constricted, obtusely rounded at the ends, smooth, wall firm, brown, 15-21 by 30-36 μ ; pedicel hyaline, broad, persistent, twice as long as the spore.

On *Seymeria macrophylla*: McLean, July 29, 2304, 2305, Sept. 2; Champaign, July 31; Union, Aug. 16.

This is perhaps near *P. veronicæ* (Schum.), from which it differs in the size of the sori, the shape of the spores, and especially in the stout persistent pedicels. In the form of *P. veronicæ* with persistent pedicels, the spores are oblong to spindle-form, as well as furnished with a thickened apex.

P. lateripes, B. & R.

II., III. Amphigenous. Sori usually small, round or angular, scattered, or sometimes irregularly clustered; uredospores subglobose, strongly echinulate, 16–21 by 21–24 μ ; teleutospores broadly oval, little constricted, ends rounded, segments nearly equal, surface minutely roughened, 20–22 by 25–32 μ ; pedicel hyaline, once to twice the length of the spore, usually more or less laterally produced.

Spots yellow or quite obsolete; sori scattered; spores short, obtuse at either end, almost horizontal, with a long, lateral, flexuous stem.—Berkeley, *Grevillea* III., p. 52.

On *Ruellia ciliosa*: Lee, Sept. 9, 5762; Rock Island, Sept. 26, 1662; Ogle, Sept. 26, 6183; Jersey, Oct. 12, 6269; Union, Oct. 22, 1958, II., III. *R. strepens*: LaSalle, Sept. 14, 1529; Jersey, Oct. 13, 6292, Oct. 14, 6310; Union, Oct. 31, 2150, II., III.; Champaign, Oct. 31, 6378.

This occurs on both sides of the leaf and also on the stem. Uredospores occur sparingly among the teleutospores. Those on *R. ciliosa* are globose, slightly echinulate, 22 μ in diameter; and the teleutospores 21–22 by 30–32 μ . The pedicels attain a length of 35 μ , but are easily broken. The uredospores on *R. strepens* are subglobose, 16–18 by 21 μ ; the teleutospores are smaller, darker colored and firmer, and the pedicel longer and less easily broken, size 19–21 by 25–28 μ ; and the pedicels reach a length of 75 μ .

P. menthæ, Pers.

I. *Æcidia* irregularly clustered upon dark-colored more or less swollen spots on the leaves and stems, round, or on the

latter usually much elongated and often confluent, erect, short, irregularly split, not recurved; spores elliptical or ovate-oblong, minutely echinulate, 15-18 by 22-28 μ .

II., III. Hypogenous. Spots yellow or brown, often conspicuous, frequently confluent; sori scattered, round, rather large, uredosori yellowish brown, flat, teleutosori blackish, prominent; uredospores subglobose or ovate, minutely echinulate, thin walled, about 18-21 by 21-24 μ ; teleutospores short, broadly ovate or broadly oval, somewhat constricted, ends rounded, furnished with a short, obtuse, almost hyaline, apiculus, surface beset with minute warts, 21-27 μ ; pedicel hyaline, once to twice length of spore.

Scattered, punctiform, obscurely spadiceous, spores subquadrangular; pedicel very short.—Persoon Syn. Fung., p. 227.

On leaves of *Mentha Canadensis*: Ogle, Sept. 25, 6169, II., III. *Mentha* sps: Lee, Sept. 27, 6206, II., III. *Cunila Mariana*: Johnson, May 11, 4620, I., II., May 12, 4652, II., May 15, 4690, I., II., III., May 16, 4707, II., 4711, II.; III., Jersey, Oct. 12, 6268, II., III., Oct. 13, 6293, II., III.; Union, Oct. 25, 2009, II., III. *Pycnanthemum pilosum*: Adams, July 6, 5436, II., July 7, 5446, II. *P. lanceolatum*: McHenry, Aug. 20, 1163, II., III.; Stephenson, Sept. 13, 5837, II., III.; JoDavie, Sept. 15, 5918, II., III. *P. linifolium*: Jersey, Oct. 12, 6267, II., III. *Monarda fistulosa*: Johnson, May 12, 4653, II., May 15, 4691, II.; Adams, June 28, 5322, II., June 30, 5369, II., III., July 5, 5419, II., III.; McLean, July 11, 2394, II., July 15, 2395, II., July 16, 2396, II., July 17, 5578, II., III.; McHenry, Aug. 20, 1180, II., III., Aug. 24, 1285, II., III.; Lake, Aug. 27, 1357, II., III., Aug. 29, 1367, II., III.; Lee, Sept. 8, 5722, II., III.; Stephenson, Sept. 13, 5799, II., III.; Rock Island, Sept. 21, 1610, II., III., Sept. 26, 1664, II., III., Sept. 27, 1672; Fulton, Oct. 1, 1769, II., III.; Jersey, Oct. 12, 6265, II., III.; Champaign, Nov. 7, 2276. *M. Bradburiana*: Johnson, May 11, 4619, II.; Jersey, Oct. 18, 6294, II., III. *M. punctata*: Cook, Sept. 3, II., III., coll. J. C. Arthur; Lee, Sept. 11, 5782, II. *Blephilia hirsuta*: Pulaski, May 2, 4443, II., May 5, 4494, II., Johnson, May 11, 4618, II.; Adams, June 28, 5323, II.; Mc-

Lean, July 20, 2494, II., 5604, II., Aug. 1, 2493, II., Aug. 6, 2495, II., Oct. 18, 1876, II., Oct. 19, 1895, II., Stephenson, Sept. 21, 6065, II., III. *

The æcidium form is not usually present, but occurs on the same host with II. and III., both of which are abundant.

The American form differs from the European in having the teleutospores echinulate, and has been called var. *Americana*. On *Blephilia hirsuta* the parasite is plainly different from the type. The sori more frequently have a circular arrangement around one evidently older, the epidermis is later rupturing, and afterwards is less apparent as a border; the spores are much lighter colored, and the epispore is thinner. This is the uredoform. The teleutospores seem to be rarely developed.

P. glechomatis, DC.

III. Hypogenous; spots small, distinct, at first light yellow, soon becoming blackish and breaking out, leaving more or less circular holes; sori usually closely clustered, often somewhat circinating, rarely scattered, ferruginous brown; spores subelliptical, very variable, sometimes obtusely rounded, but often conspicuously pointed above or below, oblong-elliptical, light-colored, 13 by 31 μ ; pedicel hyaline, fragile, nearly as long as the spore.

P. hyssopi, Schw. Spots lutescent, effuse; sori aggregated, compact, tawny, somewhat circinate and undulately confluent, at first blackish, small, but occurring copiously on the leaves. Spores tawny, becoming loose.—Schweinitz, N. Am. Fungi, No. 2944, p. 296.

On leaves of *Lophanthus nepetoides*: Kane, Aug. 30, 1370, 1383; Lee, Sept. 8, 5721; Stephenson, Sept. 13, 5829.

This is *P. glechoma*, DC. (Fl. Fr., VI. p. 55), and *P. hyssopi*, Schw.

P. plumbaria, Peck.

III. Amphigenous. Sori scattered on stems and leaves, small or large, sometimes confluent, covered until late with the more or less fissured and peculiar lead-colored epidermis, when naked dark reddish brown, powdery; spores irregular, broad,

mostly broadly ovate, obovate or elliptical, little constricted, apex usually slightly thickened or apiculate, smooth or minutely roughened, 21–25 by 32–50 μ , commonly about 39 μ long; pedicel hyaline, rather fragile, from less than one to one and a half times the length of the spore, sometimes more or less lateral.

Spots brown and indefinite, sometimes none; sori mostly hypophyllous, sometimes amphigenous, orbicular, oblong or irregular, scattered or crowded, sometimes confluent, prominent, at first covered by the epidermis and then of a peculiar lead-color, blackish when exposed; spores obovate or elliptical, obtuse, slightly constricted at the septum, minutely rough, .0012–.0016 of an inch long, .0008–.001 of an inch broad, the pedicel very short, colorless.—Peck, Bot. Gaz., Vol. VI., p. 228.

On *Phlox divaricata*: Adams, June 30, 5358.

The description by Peck is from specimens collected in Utah. During the same year, but believed to be later, DeThünen sent out Century XXI of his *Mycotheca Universalis*, containing, with No. 32, a description, with specimens from Idaho, on *Gilia*, under the name of *P. Wilcoxiana*. By comparison of authentic specimens these prove to be specifically indistinguishable, as well as those of Ellis' North American Fungi, No. 1044—however, the latter bears the varietal name of *phlogina*. This last has a different nuclear spot in each segment, and the epispore is more distinctly roughened. The Illinois specimens on *Phlox* are very nearly smooth, and do not have this round segmental spot, hence are more like the typical specimens of Peck in these respects. They are somewhat more irregular in shape than any of the others, and the pedicel more often obliquely produced.

P. convolvuli, Cast.

I. Hypogenous. Spots small, distinct, or sparingly confluent, brown; æcidia irregularly clustered or sometimes subcircinate, short, small, pseudoperidium fragile, becoming powdery soon after opening, spores subglobose or elliptical, epispore thin, tuberculate, 16–18 by 18–25 μ ; spermagonia few, central, above. (*Æcidium calyptegiæ*, Desm., *Æ. dubium*, Clint.)

II., III. Amphigenous, more common beneath; sori rounded or angular, long covered by the epidermis; uredosori

light brown, naked teleutosori black; uredospores subglobose, finely echinulate, 18–21 by 21–30 μ ; teleutospores clavate-obovate, constricted, obtusely rounded above, but sometimes having a thickened and angular apex, narrowed below to the thick pedicel, smooth, 22–27 by 42–54 μ ; pedicel stout, colored, shorter than spore.

On leaves of *Calystegia sepium*: Champaign, June 8, 4914, I., Aug. 11, 1013, II., III.; LaSalle, June 21, 5254, I., II., Sept. 12, 1486, II., III., Sept. 16, 1556, II., Sept. 17, 1564; Fulton, I., coll. J. Wolf; McLean, July 6, 2452, II., July 7, 2398, II., July 12, 2400, II., July 15, 5561, II., III., July 20, 2397, II., July 25, 2399, II., 2401, II., Aug. 1, 2403, II., Oct. 6, 1795, II., III.; Piatt, Aug. 17, 1101, II.; McHenry, Aug. 28, 1248, II.; Lake, Aug. 29, 1362, II.; Kane, Aug. 30, 1372; Boone, Sept. 2, 1424; Lee, Sept. 8, 5717, II., III., Sept. 9, 5764, II., III.; JoDaviss, Sept. 18, 5984, II., III.; Ogle, Sept. 22, 6110, II., III.; Rock Island, Sept. 24, 1652, II., III., Sept. 27, 1677.

While covered by the epidermis the sori have a livid hue, and this condition usually lasts some time.

P. gentianæ, (Strauss) Lk.

II., III. Epiphyllous or amphigenous. Spots none; sori scattered, often rather large, long or even persistently covered by the epidermis; uredospores subglobose or oval, sharply echinulate, thick walled, rather dark brown, 18–24 by 21–27 μ ; teleutospores very broadly oval, sometimes almost subglobose, little constricted, apex slightly thickened or somewhat apiculate, each segment often showing a small nuclear spot, smooth, 21–30 by 30–37 μ ; pedicel hyaline, fragile, usually crooked, about twice the length of the spore.

On *Gentiana puberula*: Lee, Sept. 11, 5786, II., III.; Sept. 27, 6202, II., III.

The teleutospores are quite often single celled.

P. polygoni-amphibii, Pers.

II., III. Amphigenous. Sori small, round or angular, in a circle about a larger sorus, or irregularly collected in small clusters, long covered by the epidermis, often very numerous;

uredospores subglobose or oval, sharply echinulate, 18–22 by 21–27 μ ; teleutospores clavate or clavate-obovate, constricted, apex more or less strongly thickened, truncate, obtuse or variously pointed, narrowed below to the rather thick pedicel, smooth, wall rather thin, 12–21 by 33–54 μ ; pedicel somewhat colored, short, half the length of the spore.

Opaque, spadiceous, depressed, spores oblong-ovate, narrowed into a slender pedicel.—Persoon, Syn. Fung., p. 227.

On leaves of *Polygonum amphibium*: Champaign, July 24; McHenry, Aug. 25, 1291, II., III., Aug. 26, 1314, II., 1331, 2404, II., III.; Lake, Aug. 27, 1344, II., III., 1347, II.; Kane, Aug. 30, 1371; Cook, Sept. 5, 1439; Lee, Sept. 9, 5758, II., III.; Stephenson, Sept. 13, 5800, II., III., Sept. 21, 6062, II., III., 6063, II., III.; LaSalle, Sept. 16, 1560, Sept. 19, 1593, Sept. 28, 6224, II., III.; JoDavies, Sept. 20, 6013, II., III., 6014, II., III.; Ogle, Sept. 22, 6111, II., III.; Henry, Sept. 28, 1703, II., III.; Fulton, Oct. 1, 1788. *P. Virginianum*: Rock Island, Sept. 26; Adams, July 14, coll. C. A. Hart.

The pedicels of the uredospores are long, and appear in the sori of both states like paraphyses, but the teleutosorus not following in a uredo sorus has none of them.

There is some question about the identity of the *Puccinia* on *Polygonum Virginianum*. The sori are similar, but the teleutospores are more irregular in shape, the apex more commonly truncate, the epispore thinner, and the cell contents of different appearance. But there does not seem to be sufficient reason to separate this as a species or even named variety.

Uredoforms have been collected on *Polygonum acre* and *P. Pennsylvanicum*, without, however, the teleutoform. On the former host the appearance is much like those described, but on the latter the pedicels of the spores are stronger and more persistent.

P. aletridis, B. & C.

II., III. Amphigenous. Sori rather small, scattered, often very numerous; uredosori somewhat prominent, powdery, cinnamon-brown, teleutosori little raised, long covered by the epidermis, blackish; uredospores subglobose or oval, sharply echinulate, wall thick, 18–24 by 21–27 μ ; teleutospores clavate, ob-

long or elliptical, abruptly and rather deeply constricted, apex thickened and mostly narrowed to a rounded point, lower segment usually longer and narrowed to the pedicel, surface smooth, 12–21 by 30–50 μ ; pedicel hyaline, usually less than the length of the spore, but sometimes longer.

On *Aletris farinosa*: Millers, Indiana, near the Illinois line, July 4, 5592, II., E. J. Hill. It probably occurs in Illinois.

P. smilacis, Schw.

II., III. Hypogenous. Spots small, numerous, brick-red; sori scattered or irregularly circinate, punctiform or elongated, surrounded by the ruptured epidermis, and by a row of short club-shaped paraphyses. II. Spores oval, slightly echinulate, pale, 21–27 μ , on fragile pedicels. III. Spores broadly elliptical, conspicuously constricted, upper segment considerably rounded or obtusely pointed, often narrowing below to the pedicel, dark colored, smooth, 21 by 36–42 μ ; pedicel thick, tinted, as long as the lower segment.

On leaves of *Smilax hispida*: Union, Oct. 24, 1968, II., III., Oct. 29, 2120, II., Nov. 4, 2275, II., III.; Pulaski, Nov. 4, 2238, II., III.

P. caricis, (Schum.) Rebert.

II., III. Hypogenous. Sori more or less elongated, variable, scattered, often very numerous and conspicuous, the ruptured epidermis ragged and long adherent, uredosori cinnamon-brown, teleutosori black; uredospores globose, subglobose, or sometimes elongated, conspicuously but not sharply echinulate, 18–24 by 21–27 μ ; teleutospores cuneate, little constricted, much thickened and obtusely rounded or almost truncate above, and narrowed to the pedicel, smooth, 15–20 by 33–45; pedicel hyaline or nearly so, one half to once the length of the spore.

On *Carex* spp.: Union, April 17, 4141, II.; Pulaski, May 1, 4405, II., 4406, II., May 2, 4447, II., May 5, 4511, II.; Champaign, June 10, 4960, II.; Adams, June 27, 5311, II., July 11, 5504, II.; McLean, July 15, 2327, II., July 20, 5603, II., III., Aug. 1, 2325, Aug. 4, 2326, Aug. 6, 2413, Sept. 6, 5667,

II., III., Oct. 19, 1893, II., III.; McHenry, Aug. 20, 1158, Aug. 23, 1252, Aug. 26, 1327, 1328; Kane, Aug. 30, 1369, II., III.; JoDaviess, Sept. 15, 5921, II., III., Sept. 16, 5956, II., III.; Ogle, Sept. 22, 6115, II., III.; Rock Island, Sept. 24, 1646, Sept. 27, 1676, 1680; Fulton, Oct. 3, 1733. *Dulichium spathaceum*: McHenry, Aug. 25, 1311; Cook, Sept. 5, 1438, Sept. 8, 1467, II., III.

Uredo Caricis, Schum. (Enum. Plant. Saell. II. [1803], p. 231), *Puccinia caricis*, Rebent. Fl. Neom. [1804], *P. caricina*, DC. (Fl. Franc. VI. [1815], p. 60).

On *Dulichium spathaceum* the uredospores are smaller and often elliptical to oblong, 12–15 by 15–21 μ ; the teleutospores are variable, more often truncate.

P. obtecta, Peck.

II., III. Amphigenous. Sori scattered or irregularly clustered, often crowded, oblong or more or less circular, long covered by the epidermis, which at length becomes simply cracked or raggedly torn; uredospores elliptical or obovate-oblong, wall rather thick, minutely echinulate, pedicel rather persistent, 15–20 by 21–30 μ ; teleutospores elliptical, somewhat constricted, apex thickened, obtusely rounded or variously produced and pointed, usually narrowed below, often without septum, smooth, 18–20 by 45–60 μ ; pedicel short, not usually more than half the length of the spore, deeply tinted.

On *Scirpus validus*: McLean, July; Fulton, coll. J. Wolf.

P. angustata, Peck.

II., III. Hypogenous. Sori oblong or linear, often arranged in long parallel rows or confluent in long lines, blackish, the remains of the ruptured epidermis persistent; uredospores subglobose to elliptical, thin walled, sharply echinulate, 16–21 by 21–30 μ ; teleutospores narrow, clavate or elongate-parallel, somewhat constricted, apex much thickened, often beak-like, narrowed below to and with the pedicel, 15–21 by 45–60 μ ; pedicel colored, less than one half to once the length of the spore.

Hypogenous; spots pallid or none; sori oblong or linear, sometimes regularly arranged at equal intervals in long parallel lines, narrow, surrounded by the ruptured epidermis, black; spores narrow, oblong-clavate or elongated, septate above the middle, strongly constricted, having the lower cell more narrow than the upper, and cylindrical or slightly tapering downwards, .0018-.0024 in. long, .0006 in. broad; peduncle colored, thick, very short.—Peck, XXV. Rep. N. Y. Mus., p. 123.

On leaves of *Scirpus atrovirens*: Piatt, Aug. 16, 1093; Cook, Sept. 5, 1451.

P. windsoriæ, Schw.

II., III. Hypogenous, occasionally somewhat amphigenous. Sori small, little elevated, irregularly scattered, very numerous, sparingly confluent, linear or oblong, soon naked, the ruptured epidermis scarcely evident; uredospores subglobose or obovate, epispore medium thick, sharply echinulate, rather deep brown, 18-24 μ ; teleutospores broadly elliptical or obovate, slightly or not at all constricted at the septum, mostly obtusely rounded at the ends, upper segment mostly larger, vertex slightly thickened, smooth, 18-21 by 27-39 μ ; pedicel about the length of the spore or shorter, stout, rather deeply colored.

On *Muhlenbergia*: Stephenson, Sept. 13, 5834, II., III.

P. graminis, Pers.

I. Hypogenous. Spots definite, usually small, purple, somewhat thickened; æcidia irregularly crowded, or sometimes circinate, short, border narrow, numerously lacerated, little recurved; spores subglobose or angular, epispore thin, minutely tuberculate, contents fine-granular, 11-15 μ ; spermagonia minute, clustered, not usually numerous, opposite the æcidia.

II., Amphigenous. Sori linear, on the leaves short and scattered, on the leaf-sheaths often confluent in long lines, orange-yellow; spores narrowly obovate or elliptical, epispore thick, strongly echinulate, 18-21 by 27-36 μ .

III. Sori linear to elliptical, often confluent in long lines, mostly on the leaf-sheaths, rather prominent, soon naked, black; spores clavate or narrowly elliptical, mostly somewhat constricted, vertex strongly thickened, often pointed but some-

times rounded, narrowed below to the pedicel, smooth, chestnut-brown, 15-21 by 36-60 μ ; pedicel firm, colored, about the length of the spore, sometimes shorter.

Sori, dense, linear, blackish, spores subturbinate, constricted in the middle.—Persoon, Syn. Fung., p. 228.

On culms, sheaths and leaves of cereals and grasses. On *wheat*: McLean, July 11, 2335 and 2343, July 12, 2341, July 15, 2339; Tazewell, July 22, 2340; Piatt, Aug. 17, 1134; McHenry, Aug. 20, 1145, Aug. 22, 1224; Fulton, Oct. 1, 1773. *Oats*: McLean, July 11, 2334, July 12, 2332 and 2333; Tazewell, July 22, 2329, 2330 and 2331; Champaign, Aug. 13, 1029 and 1033; Piatt, Aug. 15, 1063; McHenry, Aug. 20, 1144, Aug. 26, 1323; Fulton, Oct. 1, 1774. *Agrostis vulgaris*: McHenry, Aug. 24, 1275, Aug. 26, 1324; LaSalle, Sept. 13, 1521; JoDavies, Sept. 18, 5987; Rock Island, Sept. 27, 1673; Fulton, Oct. 3, 1732; McLean, Oct. 4, 1760; Union, Oct. 21, 1905. *Hordeum jubatum*: McLean, July 11, 2346, July 17, 5580, II., III.; July 19, 5593, II., III.; McHenry, Aug. 23, 1231, Aug. 25, 1307, Aug. 26, 1316, Aug. 31, 1392; Rock Island, Sept. 26, 1661.

As here identified a variable species, though some forms often formerly included are specifically separated under the names *P. emaculata*, *P. windsoriv*, and *P. andropogi*. The description is made from specimens on wheat. On *Agrostis* the teleutospores are sometimes nearly typical (No. 1732), in other cases they vary much in shape and thickness of the episporium—shorter, rounder and thinner for the most part on Nos. 1275, 1603, and especially 1905. The uredo is very characteristic in all.

P. phragmites, (Schum.) Kornicke.

II., III. Amphigenous. Sori scattered, very prominent, mostly rather large, elliptical, somewhat powdery, soon naked, the remains of the ruptured epidermis not usually visible; uredospores elliptical, episporium very thick, strongly tuberculate, without paraphyses, 18-21 by 27-32 μ ; teleutospores elliptical or oblong, somewhat but not abruptly constricted, vertex a little thickened and rounded or obtusely pointed, smooth, pale brown, 18-22 by 37-60 μ ; pedicel very long, three to four times

the length of the spore, rather slender but firm, slightly tinted.

On *Spartina cynosuroides*: McLean, July 20, 2348, Oct. 11, 1829; Lake, Aug. 27, 1346; Fulton, Oct. 1, 1771. *Phragmites communis*: McHenry, Aug. 26, 1325; Kane, Aug. 30, 1368. *Andropogon furcatus*: Rock Island, Sept. 24, 1648. *A. scoparius*: JoDavies, Sept. 15, 5920.

This species was first described as *Uredo Phragmitis* by Schumacher (Enum. Plant. Saell. II. [1803] p. 231), and his description shows that his *Uredo* was that of this species, if, indeed, he had not the teleutoform. Hedwig next described it as *Puccinia arundinacea*, which description was published by DeCandolle, together with one of his own, in Lam. Encyc. bot. (1806) p. 250; it is thus explained why DC. is sometimes written as authority for this name instead of Hedw. Schweinitz (Syn. Fung. Car. [1822] No. 487) published it under the name of *Puccinia arundinariae*.

The Illinois specimens on *Phragmites communis* have teleutospores narrower and more constricted, so that the segments are each nearly elliptical, while the European specimens on same host (Rabh. Herb. Mycol. 282) are much like the Illinois specimens on *Spartina cynosuroides* and on *Andropogon*. But the spores on one *Spartina* plant closely resembles the Illinois *phragmites* form.

P. rubigo-vera, (DC.) Winter.

II., III. Amphigenous. Uredosori mostly hypogenous, linear or oblong, irregularly scattered, seldom confluent, somewhat elevated, soon open; teleutosori linear or oblong, scattered or variously confluent, long covered by the unbroken epidermis, black, surrounded by a dense row of dark-brown paraphyses; uredospores subglobose, epispore rather thin, minutely echinulate, 21–25 μ ; teleutospores cuneiform, oblong or elliptical, constricted or not at the septum, but usually tapering below, vertex thickened, truncate, obtusely rounded or sometimes more or less pointed, epispore thin, smooth, cell contents granular, 12–18 by 27–54 μ ; pedicel short, rarely half the length of the spore, deeply tinted.

On *wheat*: Adams, June 26, 5294, June 29, 5344, July 6, 5426, II., III.; McLean, July 11, 2343, July 17, 5583, II., III.;

McHenry, Aug. 22, 1224. *Oats*:— *Rye*: LaSalle, June 19, 5225, II., III. *Elymus Virginicus*: Champaign, Aug. 11, 1022; McHenry, Aug. 24, 1276; Ogle, Sept. 25, 6155, II., III.

This name is founded upon the recognition of the uredoform as *Uredo rubigo-vera*, DC. (Flore Franc. VI. [1815] p. 83), which to say the least is doubtful. The same name has been used for the uredoform of *Puccinia coronata*, and of *Puccinia graminis*, found on the same host species, and doubtless equally included by DeCandolle in his supposed species. Winter (Die Pilze, p. 217) probably had good reasons for accepting the name as here given, but should, for any reason, botanists decline to follow him in this, then *Puccinia striæformis*, Westd. (Bull. de l' Acad. Belg. [1853] XXI.), rather than *Puccinia straminis*, Fuckel (Enumer. Fung. in Jahr. Ver. f. Natur v. Nassau [1861, etc.]), should be adopted, though the latter recognizes DeCandolle's *Uredo rubigo-vera* as the early stage of the teleutoform named by him. Certain it is that *P. coronata* and *P. rubigo-vera* are very closely allied.

P. coronata, Corda.

II., III. Amphigenous. Uredospores subglobose, echinulate, 18–21 by 21–24 μ ; teleutosori small, oblong or linear, slightly raised, surrounded by a dense row of paraphyses, long covered by the epidermis; teleutospores cuneate, scarcely constricted at the septum, more or less truncate above, crowned with one to several conspicuous, obtuse, horn-like projections, episore thin, smooth, cell contents granular, 15–18 by 45–55 μ ; pedicel short, less than half the length of the spore, rather fragile.

Sori linear, short, minute, obscurely fuscous, covered by the pallescent epidermis; spores sessile, subclavate, crowned at the apex with acute, stellate, radiate, flame-yellow teeth, yellow below. Length of spore .00175 in.—Corda, Icon. I, p. 6.

On leaves and sheaths of *oats*: Adams, June 30, 5360, II., III., July 10, 5456, II., III., July 11, 5502, II., III.; McLean, July 11, 2334, Sept. 6, 5665, II., III.; Tazewell, July 22, 2330 and 2331; McHenry, Aug. 20, 1144. *Wheat*: Fulton, Oct. 1, 1767, II., III.

This species is certainly closely related to *Puccinia rubigo-vera*. Indeed, it is scarcely possible to separate them, except by the terminal projections of the teleutospores in *P. coronata*, and these are present in varying degrees, sometimes (as in No. 2334) nearly wanting.

P. emaculata, Schw.

II., III. Mostly epigenous, sometimes amphigenous. Sori small; rather prominent, mostly very numerous, irregularly scattered or crowded, rarely confluent on the leaves, but on the sheaths forming long, irregular lines, black, rather early erumpent but long surrounded by the ruptured epidermis; uredospores subglobose, epispore rather thin, sharply but minutely echinulate, 15–24 μ ; teleutospores elliptical or broadly clavate, slightly constricted, vertex strongly thickened and obtusely pointed or rounded, narrowed below, smooth, not deeply colored, 15–21 by 30–48 μ ; pedicel once to once and a half as long as the spore, tinted.

Entirely without spots; at first sori entirely covered or sparingly erumpent, then often confluent, minute, abbreviated, narrow, parallel, often acuminate at both ends. Spores black, rather small, when immersed in water fuscous. Everywhere on species of *Panicum*, especially *P. pubescens* in fields.—Schweinitz, N. Am. Fung., No. 2912, p. 295.

On *Tricuspis seslerioides*: Union, Nov. 4, 2274. *Eragrostis pectinacea*: Union, Oct. 21, 1903. *Panicum capillare*: LaSalle, Sept. 14, 1537, II., Sept. 29, 6238; Rock Island, Sept. 21, 1609, Sept. 23, 1628, Sept. 26, 1661, Sept. 27, 1679; JoDaviess, Sept. 19, 5993; Stephenson, Sept. 21, 6059; Ogle, Sept. 23, 6142, II., III.; Fulton, Oct. 1, 1768. *P. virgatum*: Lee, Sept. 9, 5760; Ogle, Sept. 22, 6109; Rock Island, Sept. 27, 1695.

On *Panicum virgatum* the teleutospores have in each segment a small circular nuclear spot, and the pedicels are nearly colorless. On *Tricuspis seslerioides* (No. 2274) and *Eragrostis pectinacea* (No. 1903) the sori are mostly hypophyllous, and the teleutospores are often lighter colored, with hyaline pedicels.

P. flaccida, B. & Br.

II., III. Amphigenous. Sori small, oblong to linear, often confluent, at length rupturing the epidermis, reddish-feruginous. Uredospores vary from elliptical to subglobose, the latter about $25\ \mu$, furnished with two or more hyaline points (germinal pores?), sharply echinulate, cinnamon-colored. Teleutospores exceedingly variable, often undivided, the septum, when present, transverse, oblique or longitudinal, equally, or in every degree unequally, dividing the spore. The simple ones are usually clavate, the divided ones vary from clavate to spheroidal, regularly formed or much constricted, and lobed with one or two thickened apical points, length about $30\text{--}40\ \mu$, lighter colored than the uredo; pedicel hyaline, once or twice the length of the spore.

Sori small, short; spores flaccid, with a long hyaline pedicel, obtuse, contracted in the middle.—Berkeley, Jour. Linn. Soc., Vol. XIV., p. 91.

On *Panicum crus-galli*: Henry and Rock Island, Sept. 28, 1701, II., III., 1716, II., III.; Champaign, Oct. 19, 6329, II., III., Oct. 24, 6334, II., III.

A most peculiar species. From two thirds to three fourths or more of the teleutospores are septate, presenting the most varying and aberrant forms. So far as we are informed this has not been previously found in America, but a comparison with specimens kindly furnished by Dr. M. C. Cooke, of *Puccinia flaccida*, B. & Br., from Ceylon, leaves no doubt of the specific identity. The American specimens only differ in possessing more undivided, and upon the average, narrower teleutospores, with somewhat thicker pedicels.

P. andropogi, Schw.

II., III. Hypophyllous. Sori rather small, usually very numerous, elliptical, sometimes confluent in small, elongated groups, soon naked, surrounded by the lacerated remains of the epidermis; uredospores subglobose, epispore rather thick, tuberculate, $21\text{--}30\ \mu$; teleutospores mostly obovate, but varying to elliptical and clavate, slightly constricted at the septum, usually thickened at the vertex, obtusely rounded or sometimes short-

pointed, smooth, dark-brown, 15–22 by 30–45 μ ; pedicel usually about the length of the spore, sometimes longer, more or less tinted.

Spots obliterated, sori densely aggregated, elevated, fuscous, obtuse, linear, abbreviated. Spores fuscous. Although not confluent, yet occupying almost the entire leaf. Very frequent in autumn in leaves, culms and sheaths of various species of *Andropogon*.—Schweinitz, N. Am. Fung., No. 2911, p. 295.

On *Andropogon furcatus*: Boone, Sept. 2, 1423; Ogle, Sept. 26, 6184, II., III.; Rock Island, Sept. 27, 1678. *A. scoparius*: Ogle, Sept. 25, 6172, II., III., Sept. 26, 6200, II., III.; Union, Oct. 22, 1960.

In Thümen's Mycotheca Universalis, No. 1336, the specimens named *Puccinia Ellisiana*, Thüm., which Farlow identifies (Proceed. Am. Acad. Arts & Sc., July, 1883, p. 81) as *P. andropogi*, Schw., the teleutospores are often more narrow and pointed, are lighter in color, and the pedicels are longer than in the Illinois specimens.

In the specimens examined the uredospores vary considerably, even on the same leaf, as well as upon different hosts.

P. maydis, Carradori.

II., III. Amphigenous. Sori subcircular to oblong, irregularly scattered, often confluent, rather tardily rupturing the epidermis, whose upturned edges persistently remain; uredospores subglobose, epispore rather thick, echinulate, 25–30 μ . Teleutospores broadly elliptical, considerably constricted at the septum, ends mostly obtusely rounded, but sometimes thickened at the apex and variously pointed, smooth, 15–22 by 30–45 μ ; pedicel slightly colored, once to twice the length of the spore.

P. sorghi, Schw. Spots none; sori broad, of different forms, variously lobed, at first covered by the epidermis, then denudated but surrounded by the lacerated epidermis, often also internally fissured, 2–4 lines long and broad. Many of the sori occur on the nerves of the leaves. Spores black, large; pedicels short.—Schweinitz, N. Am. Fung., No. 2910, p. 295.

On leaves of *Zea Mays*: McLean, July 20, 2345, II., III., Aug. 4, 2344, II., III., Aug. 19, 5636, II., III., Sept. 6, 5664, Oct. 11, 1830; Champaign, Aug. 13, 1032, II.; McHenry, Aug.

20, 1165, II., III., Aug. 23, 1239, II., III.; Lake, Aug. 27, 1349; Lee, Sept. 8, 5720, II., III.; JoDavies, Sept. 16, 5958, II., III.; LaSalle, Sept. 28, 6216, II., III.; Fulton, Oct. 1, 1765.

This is *Puccinia Sorghi*, Schw. (N. A. Fungi [1834], p. 295). The above name was published in 1815 (see Rabh. Krypt. Fl. I. p. 181).

PHRAGMIDIUM, LINK.

Teleutospores divided by two or more horizontal septa, producing three or more cells in a single vertical row; teleutosori prominent, usually small, tufted, sometimes confluent in patches; uredospores one-celled, borne on deciduous pedicels; æcidiospores produced in vertical chains as in the true *Æcidia*, but without pseudoperidium; uredosori and æcidiosori surrounded by a thick row of club shaped, or more or less capitate, incurved paraphyses.

All the sporeforms of the *Phragmidium* are ordinarily hypophyllous, the æcidium and uredo appearing rather early in summer, and the teleutoform after the first of July; but the two latter are very commonly found together during the later parts of the season. Sometimes the fungi are seated upon the petioles and stems of the host. All grow upon species of *Rosaceæ*, and so far as discovered, upon plants of the genera *Potentilla*, *Rubus* and *Rosa*.

The æcidium has only recently been distinguished from the uredo, the sori of the two stages being mostly very similar, and determined by the manner of the production of the spores, as just indicated. It is somewhat remarkable that in the æcidium stage there is no peridium, hence, according to the characteristics adopted in this paper, the genus form is *Caoma*, not *Uredo* or *Æcidium*.

Ph. fragariæ, (DC.) Rossm.

II., III. Hypogenous. Uredosori small, circular, without paraphyses, scattered; uredospore elliptical or obovate, echinulate, each borne upon a pedicel, 14-16 by 16-21 μ ; teleutosori scattered, rather large, circular, prominent, powdery, chestnut-

brown, teleutospores usually three, sometimes two, more often four-celled, oblong or broadly clavate, somewhat constricted at the septum, vertex slightly thickened, obtusely rounded, narrowed toward the base, epispore thin, smooth, 21-27 by 36-90 μ ; pedicel hyaline, tapering below, from one third to one half the length of the spore.

On leaves of *Potentilla Canadensis*: Union, April 16, 5015, II., April 26, 4311, II., April 29, 4390, II.; Jackson, April 19, 4177, II., April 28, 4366, II.; Pulaski, May 9, 4579, II.; Johnson, May 12, 4651, II.; LaSalle, June 15, 4999, II., Sept. 28, 6223, III., Sept. 29, 6232, III.; Adams, June 27, 5307, II., July 3, 5384, II., July 5, 5407, II., 5417, II., July 6, 5441, II., July 10, 5461, II.; McLean, July 26, 2415, II.; McHenry, Aug. 25, 1321, II., III.; Stephenson, Sept. 13, 5816, II.; JoDavies, Sept. 15, 5896, III.; Ogle, Sept. 26, 6188, II., III.; Fulton, Oct. 3, 1731, II., III.; Jersey, Oct. 12, 6274, III.

This is *Ph. triarticulatum*, B. & C.; but there is little reason to consider the American specimens specifically distinct from the European *Ph. fragariae*, according to Winter's description (*Die Pilze*, p. 228), and the specimens in Rabh. Herb. Myc., 281. On neither the latter nor the Illinois specimens was there observed any roughness of the epispore.

Ph. mucronatum, (Pers.) Lk.

I., II., III. *Æcidia* amphigenous, on the leaves more commonly hypophyllous, and of different sizes, but usually small, in little groups on a distinct reddish, yellow-bordered spot, on the larger veins, petioles, and young stems confluent and swollen, conspicuous, causing more or less distortion of the host, surrounded by clavate, incurved, colorless paraphyses, bright orange-colored; *æcidiospores* subglobose or angular, produced in erect chains, becoming rough-warty towards maturity, 18-24 μ ; *uredosori* hypophyllous, small, scattered, very numerous, sometimes sparingly confluent, surrounded by many incurved, clavate, colorless paraphyses, yellow; *uredospores* subglobose, rough-warty, each produced on a pedicel, 18 μ ; *teleutosori* hypophyllous, scattered, small, powdery, brownish-black; *teleutospores* cylindrical or oblong-elliptical, vertex narrowed and mucronate, apiculus hyaline, six- to eleven-septate, rather coarsely

tuberculate, 24 by 65–77 μ ; pedicel about one and a half times the length of the spore, mostly hyaline, swollen, and elongate-elliptical from above the middle downward.

Puccinia mucronata. Crowded, black, spores pediceled, cylindrical, mucronate. Var. *Rosae*. Spores somewhat swollen, obtuse, parasitic on *Uredo Rosae*.—Persoon, Syn. Fung., p. 230.

On roses: Jackson, April 28, 4376, I.; Pulaski, May 4, 4486, I., 4487, I., May 9, 4580, Nov. 4, 2247; Johnson, May 12, 4639, I., 4640, I., 4641, I., May 13, 4671, I., May 16, 4706, I.; McLean, May 20, 4725, I., May 25, 4778, I., May 29, 4813, I.; Champaign, June 8, 4917, I., June 10, 4941, I., 4958, II., July 11, 6494, I., II., III.; LaSalle, June 15, 5000, I., June 21, 5256, I.; McHenry, Aug. 20, 1159, II., III., Aug. 26, 1317, II., III., Aug. 27, 1342, Aug. 31, 1394, Sept. 1, 1416, II., III.; Lee, Sept. 8, 5713, II., III.; Stephenson, Sept. 13, 5825, II., III.; JoDavies, Sept. 19, 5997, II., III.; Ogle, Sept. 23, 6131, I.; Rock Island, Sept. 27, 1683; Henry, Sept. 28, 1718; Union, Oct. 21, 1909, Oct. 29, 2121, Oct. 31, 2135, Nov. 3, 2197.

Persoon's name (Disp. Meth. [1797] p. 38) for this plant is *Puccinia mucronata* var. *Rosae*. As the other variety has been given another name, this should bear the name of the species rather than of the variety. Link introduced (Spec. Plant. II. [1824–25] p. 84) the genus *Phragmidium*, in which this species is included, hence *Ph. mucronatum*, Lk., is often written. The supposed æcidioform described above, referred to under *Ph. speciosum*, sometimes occurs in midsummer at the same time on the leaves with the uredo and teleutospores. The paraphyses are identical in the forms I. and II., and persist with the teleutoform.

Ph. speciosum, Fries.

III. On the stems, and less commonly on the petioles, forming swollen, distorted areas of more or less extent. Sori irregularly confluent, grayish-black, on year-old stems crust-like; spores cylindrical-oblong, about five to seven celled, sometimes less, scarcely or not at all constricted at the septum, ends rounded, apex mucronate, smooth, almost black. 30 by 60–90 μ ; pedicel hyaline below, tinted above, tapering downward, very long, attaining seven or more times the length of the spore.

On *Rosa*: Pulaski, May 4, 4487, May 9, 4580; Johnson, May 12, 4640, 4641, May 16, 4706; McLean, May 25, 4778, May 29, 4813; Champaign, June 10, 4941; LaSalle, June 15, 5000, June 21, 5256; JoDavies, Sept. 16, 5952; Ogle, Sept. 23, 6131; Jersey, Oct. 12, 6273.

What has been called *Uredo miniata*, Pers., *Cæoma miniata*, Schl., or *Coleosporium miniatum*, Lév., has been considered the æcidioform of *Phragmidium mucronatum*, Pers., with which it is certainly often associated. But it is very commonly found on the green leaves, in the early part of the season, with *Ph. speciosum* on the twigs at the same time. Sometimes, however, the teleutospores of *Ph. mucronatum* occur later in the season on the Cæoma-affected leaves or on other leaves of the same plant.

All the numbers except 5952 and 6273 were accompanied by the above mentioned form.

Ph. rubi-idæi, (Pers.) Winter.

II., III. Hypophyllous. Uredosori small, scattered, usually very numerous; uredospores obovate or elliptical, episore thin, sharply echinulate, 15–18 μ ; teleutosori small, scattered, powdery, black; teleutospores cylindrical, ends obtusely rounded, vertex furnished with a more or less elongated, conical, or often somewhat cylindrical hyaline apiculus, whole surface very rough-warty, almost black, about six- to eight-septate, 27–33 by 67–120 μ ; pedicel tinted near the spore, otherwise hyaline, about one and a half times the length of the spore, from above the middle downward elongate-elliptical, roughened.

On leaves of *Rubus strigosus*: McHenry, Aug. 20, 1177, Aug. 23, 1232; Boone, Sept. 2, 1422, II.; Cook, Sept. 5, 1446, II.; Stephenson, Sept. 14, 5882, II., III.; JoDavies, Sept. 20, 6012, II.

The teleutosori are surrounded by many incurved colorless (dry specimens) clavate paraphyses, but a careful examination of the specimens failed to reveal them with the uredosori, though these were over-mature, and the spores everywhere scattered among the matted hairs of the leaf.

Ph. rubi, (Pers.) Winter.

II., III. Hypophyllous. Sori, very small, scattered; uredosori often very numerous, circular, orange-yellow, without paraphyses; uredospores ovate or elliptical, each borne upon a pedicel, epispore thin, finely echinulate, 12–15 by 15–20 μ ; teleutosori rounded, sometimes confluent, black; teleutospores about four to five septate, cylindrical, somewhat constricted at the septum, ends obtusely rounded, the vertex furnished with a conical, more or less deeply tinted apiculus, surface finely tuberculate, sometimes appearing smooth, dark-brown, 36 by 100 μ ; pedicel as long as the spore or somewhat longer, very much swollen in the lower half.

On *Rubus villosus*: Lee, Sept. 8, 5711, II., III.; JoDavies, Sept. 15, 5908, II.; Sept. 18, 5979, II., Sept. 19, 5999, II.; Ogle, Sept. 23, 6147, II.; Jersey, Oct. 14, 6313, II.; McLean, Oct. 18, 1874, II.

TRIPHragMIUM, LINK.

Teleutospores dark brown, three-celled, triangular, the dividing septa vertical and horizontal or oblique; uredospores similar to those of *Puccinia*.

In this genus æcidioforms have not been certainly recognized, though there are in some cases what have been called two forms of the uredo, the one occurring in the spring on the petioles and veins, the other late in the summer on the leaf surfaces, and spermogonia are developed upon the upper leaf-surface.

The species are comparatively few; none have so far been found in Illinois.

RAVENELIA, BERKELEY.

Teleutospores many-celled, berry-like, with vertical and horizontal septa, usually with a series of hyaline cells at the base, pedicellate or sessile.

This curious genus is comparatively little known, and its standing among the *Uredineæ* has not been firmly established.

It seems the germination of the spores has not been observed neither have other spore forms been certainly found as genetic productions. In *R. stictica*, B. & Br., however, Berkeley says: "The larger pseudospores are accompanied by uredinoid bodies which are minutely papillate." (Linn. Soc. Jour. Bot., Vol. XIV. p. 93.)

The spores attain the largest size among the *Uredineæ*, and are otherwise very readily generically recognized.

Speaking of *R. indica*, Berkeley says, "The glandular bodies consist of a large umbrella-shaped, dark cap, often $\frac{1}{30}$ th of an inch across, composed of a number of closely packed cells, supported by a long, hyaline, delicate, and apparently compound stem, round the end of which are suspended a circle of elongated hyaline bodies, calling to mind, in point of arrangement, the appendages of some species of *Medusæ*, or in general appearance the fruit of some *Marchantia*. In the South Carolina species [*R. glandulosa*, B. & C.] on the contrary, the peduncle is shorter and the appendages are united by their sides into a solid mass."

The species grow on various *Leguminosæ*.

R. glandulæformis, B. & C.

Amphigenous. Sori scattered, rather small, often confluent in areas of variable, sometimes of considerable size, testaceous; spores broadly capitate, the many-celled, dish-like, chestnut-brown upper layer projecting over the hyaline cells beneath, about 75 to 100 μ ; pedicel short, hyaline.

Spores urn-shaped, with a short pedicel, hyaline below and lobed or striate; even above, cellular, colored, projecting beyond the lower division. In some specimens the lower division is even, and the cells of the upper part larger, but it is probably a mere form.—Berkeley, *Grevillea*, III., p. 80.

On *Tephrosia Virginiana*: "Pine Hills," Union County. Collected several times in same locality by F. S. Earle.

GYMNOSPORANGIUM, DC.

Spores with one horizontal septum, less commonly one to six cells in a vertical row, yellow, with epispore thin, on long, slender, hyaline pedicels, imbedded in gelatine, which, when moist, swells into a soft columnar or irregular body. Parasitic on the leaves and branches of various *Cupressineæ*.

The species now assigned to this genus were formerly separated, and a part of them, having the gelatinous material more or less columnar, made to form the genus *Podisoma*. The distinction is not properly generic, and at present most mycologists unite all the species under the generic name of *Gymnosporangium*. The European species agree in the spores having a single septum, and this is usually made a characteristic of the genus, but some of the American species, otherwise similar, have from one to six-celled spores, so that the description of the genus is necessarily extended to include them. The spores are produced in the spring instead of in the autumnal months, as are the teleutospores of most *Uredineæ*; but they germinate in May and June, hence have not a long period of rest. The promycelium is rapidly formed, under the proper conditions, from the mature spores, and sporidia are abundantly produced. These latter are believed to develop only on species of *Pometia*, and produce the æcidial growths included under the so-called genus *Ræstelia*. This alternation of growth has been several times experimentally shown, but for the purposes of this paper the æcidial forms are given by themselves. The mycelium of the teleutosporic form is sometimes annual, but more often perennial, and produces remarkable gall-like distortions upon the host.

G. macropus, Lk.

Sporiferous masses aggregated in globose tufts, surrounded at the base by a ring formed by the raised epidermis and sub-epidermal tissue of the host-plant, orange-yellow, cylindrical, acuminate, half an inch to an inch long, or at times longer; spores ovate-acute, two-celled, generally constricted at the septum, and with a papilla at the apex, 15-20 by 46-60 μ ; promycelia generally four from each cell. Mycelium annual, producing globose or reniform knots in the smaller branches. On leaves and smaller branches of *Juniperus Virginiana*. (Farlow, *Gymnosporangia* of the U. S., p. 13.)

On *Juniperus Virginiana*: Union, May 15, 4705; Campaign, March 16, 2465.

CRONARTIUM, FRIES.

Teleutospores one-celled, without pedicels, compacted in an erect (often curved or bent) cylindrical, solid column; uredospores produced on pedicels, the uredosorus covered by a pseudo-parenchymatous membrane.

The peculiar column, composed of the elongated teleutospores adhering closely to each other, and rising conspicuously from the substratum, clearly designates this genus. The uredospores and teleutospores, so far as known, are produced on the same host, sometimes in the same sorus.

C. asclepiadeum, Kze.

Var. *thesii*, Berk.

II., III. Uredosori small, scattered, or collected in irregular groups, furnished with a peridium; uredospores subglobose to elliptical, echinulate, 15 by 18–27 μ ; teleutosori scattered, often numerous. column long, cylindrical, usually curved; teleutospores oblong or cylindrical, yellowish-brown, smooth, about 11 μ in diameter.

On *Comandra umbellata*: McHenry, Aug. 20, 1157, Aug. 23, 1245; Boone, Sept. 2, 1428; LaSalle, Sept. 13, 1498, Sept. 16, 1552; Ogle, Sept. 26, 6199.

The determination of the variety was made by comparison with the specimens in Ellis' North American Fungi, No. 1082.

This is *Cronartium comandrie*, Peck (Bot. Gaz. IV. p. 128).

MELAMPSORA, CAST.

Teleutospores one or more celled, when divided the septa mostly vertical (sometimes horizontal or oblique), sessile, densely compacted in a firm, flat or slightly convex layer; uredospores single celled, sessile upon the hymenium, the sori usually covered by a membrane, which is finally irregularly ruptured.

This genus, as here defined, includes not only what has been uniformly assigned to it, but the species which have been

by different authors assigned to *Calyptospora*, *Melampsorella*, *Phragmospora* and *Thekopsora*. Admitting all these as genera of equal rank, the characteristics may be given as follows:

Teleutospores produced beneath the cells of the epidermis:

Teleutospores one-celled.....MELAMPSORA.

Teleutospores divided.....PHRAGMOSPORAE.

Teleutospores produced *in* the cells of the epidermis.

Teleutospores one-celled, colorless.MELAMPSORELLA.

Teleutospores divided, colored:

Sori small, with uredoTHEKOPSORA.

Sori broadly confluent or effused, without uredo,

CALYPTOSPORA.

With the single exception of *Melampsora Gæppertiana* (*Calyptospora Gæppertiana*, Kühn) on various species of *Vaccinium*, no supposed æcidium form has been found; in this case the almost universal association of the teleutoform on *Vaccinium*, and one or more species of *Peridermium* on *Pinus* and *Abies*, seems to strongly indicate their genetic relation. Other observations corroborate the supposed connection, so that, in Europe at least, we may accept the matter as a fact that this species of *Melampsora* and *Æcidium* (*Peridermium*) *columnare*, Alb. & Schw., are alternate forms. In America, *Peridermium balsameum*, Peck, seems to be associated with the teleutoform, but whether *P. balsameum* and *P. columnare* are specifically identical has not been determined. See Farlow, Appalachia, Vol. III. (1884) p. 241 *et seq.*

M. epilobii, (Pers.) Fkl.

II., III. Hypogenous. Uredosori scattered, minute, hemispherical, then opening by a circular stoma; uredospores obovate, sometimes varying to subglobose and oblong, episporium thin, sharply echinulate, each produced on a pedicel, orange-yellow, 12-15 by 14-18 μ ; teleutosori irregular, scattered, often confluent in irregular crust-like areas, becoming chestnut-brown, or at length darker; teleutospores mostly one-celled, often divided by a septum which is horizontal, oblique, or vertical, cuboidal or elongated, episporium thin, smooth, 21-39 μ long.

Uredo pustulata, var. *Epilobii*: subrotund, flavescent, minute, little prominent, closed, collected in little clusters.—Pers. Syn. Fung. p. 219.

Melampsora epilobii, Fckl. F. rh. 300, I., II.—I. Fungus stylosporiferus. *Uredo Epilobii* DC. Fl. Fr. II. p. 226. On leaves of *Epilobium montanum*, *roseum* and *angustifolium*, plentiful in summer. II. Fungus teleutosporiferus. Sori plane, confluent, black-fuscous; teleutospores obovate-clavate, fuscous. On the under surface of withered leaves of *Epilobium angustifolium*; rare in autumn.—Fuckel, Symb. Myc. p. 44.

On *Epilobium coloratum*: JoDavies, Sept. 20, 6019, II.

Persoon described (Syn. Fung. p. 219) *Uredo pustulata* var. *epilobii*, and DeCandolle wrote *Uredo epilobii* (Flora Franc. II. p. 226), and Fuckel described the teleutoform and referred the uredo to same species. The name *Uredo pustulata*, Pers., has been used for various species.

M. crotonis, Burrill.

II., III. Amphigenous. Uredosori scattered, rather prominent, circular, cinnamon-colored; uredospores obovate, sharply echinulate, produced on pedicels, 15–21 by 18–27 μ ; teleutosori irregular, scattered or somewhat confluent, slightly elevated, reddish brown; teleutospores irregular, mostly elliptical or oblong, one, two, or more celled, arranged in an irregular layer composed of variously imbricated spores, smooth, cell-contents granular, pale to dark brown, 11–15 by 30–42 μ .

Trichobasis crotonis, Cooke. Amphigenous; sori minute, subrotund, surrounded by the ruptured epidermis, fuscous: pseudospores globose or ovate, finely warty (28–30 μ diam.). On leaves of *Croton procumbens*, California.—Cooke, Grevillea, VI., p. 137.

On leaves of *Croton capitatum*: Marion, Oct. 20, 1900, II., III. *C. monanthogynus*: Johnson, May 12, 4649, II.; Jersey, Oct. 12, 6282, Oct. 14, 6322; Jackson, Oct. 22, 1945, II., III.; Nov. 5, 2266; Union, Oct. 25, 2010, II., III., Oct. 31, 2157, II., III., Nov. 1, 2211. *Crotonopsis linearis*: LaSalle, Sept. 28, 6226.

The uredo is *Trichobasis crotonis*, Cke. The teleutoform seems to belong to the group separated by Magnus under the generic name of *Phragmospora*, but it is not easy to make out the relation of the spores to the cells of the host in dried specimens.

M. salicina, Lév.

II., III. Amphigenous, the uredo mostly hypophyllous, and the teleutoform more often epiphyllous. Uredosori small, circular, often thickly spread over the leaf surface, surrounded by a thick row of paraphyses, which are strongly enlarged and rounded above; uredospores subglobose or elliptical, finely echinulate, 12-15 by 14-18 μ ; teleutosori various in size, usually flat, irregular, often thickly associated or confluent, crust-like, becoming reddish brown or dark brown; teleutospores oblong, in transverse section polygonal, about 10 by 30-37 μ .

On leaves of *Salix cordata*: McHenry, Aug. 23, 1242, II., Aug. 24, 1276 and 1271. *S. longifolia*: McHenry, Aug. 24, 1254, II., Aug. 31, 1396, II., III.; Lake, Aug. 27, 1350, II., III.; Lee, Sept. 11, 5780, II.; LaSalle, Sept. 14, 2500, II., III.; Henry, Sept. 28, 1707, II. *Salix* sps.: McLean, July 18, 2498, II., July 20, 2497, II., Aug. 4, 2499, II.; Piatt, Aug. 17, 1096, II.; McHenry, Aug. 24, 1278, II., 1288, II.; Lake, Aug. 27, 1351, II., III.; Kane, Aug. 30, 1375, II., III.; LaSalle, Sept. 20, 1599, II., III.; Rock Island, Sept. 21, 1618, II.; Jersey, Oct. 14, 6315, II., III.; Union, Oct. 24, 1977, II.; Pulaski, Nov. 4, 2228, II., III.

Thümen thinks what is included in the above should be separated into the following species, for which he has given descriptions: *M. Biglowii*, *M. capreanum*, *M. Hartigii*, *M. medusæ*, *M. vitellinæ*, (Hedwigia XVIII. [1879] p. 77, and Bulletin Torrey Botanical Club, VI. p. 216).

M. populina, Lév.

II., III. Amphigenous. Uredosori small, scattered over the surfaces of the leaves, usually more numerous below, circular, surrounded by a dense row of paraphyses, which are clavate or strongly enlarged and rounded above, powdery, orange-yellow; uredospores varying from subglobose to oblong or clavate, echinulate, 13-20 by 21-30 μ ; teleutosori scattered, mostly thickly studding both surfaces of the leaf, flat, compact, crust-like, often confluent, reddish brown; teleutospores oblong, prismatic, epispore thin, smooth, one-celled, 15 by 36-45 μ .

On leaves of *Populus tremuloides*: McHenry, Aug. 20, 1196. *P. monilifera*: Tazewell, July 22, 2509, II.; McLean,

July 25, 2508, II., Aug. 28, 5642, Oct. 6, 1809, III., Oct. 18, 1884, III.; Piatt, Aug. 10, 1003, II.; Champaign, Aug. 41, 1019, II., Oct. 31, 6376; Lee, Sept. 9, 5751, II.; LaSalle, Sept. 13, 1508, III., Sept. 17, 1586, II.; JoDavie, Sept. 15, 5909, II., III.; Henry, Sept. 28; 1722, II., III.; Fulton, Oct. 1, 1784, III.; Jackson, Nov. 5, 2261, III.

COLEOSPORIUM, LÉV.

Teleutosori divided by horizontal septa (about three) so as to form unbranched vertical rows of closely connected cells, each of which emits, on germination, a promycelium bearing a single sporidium, compacted in a dense flat or convex somewhat waxy stratum; uredospores produced in chains, which soon break up into a powdery mass; sorus naked.

The species of this genus are difficult to determine morphologically one from another, and comparatively little has been done towards elucidating life histories through cultures. It is supposed that *Coleosporium senecionis* and *Peridermium pini* are alternate forms of one species, but other æcidial states are unknown. The so-called uredospores are produced in chains, and according to the classification adopted here would, by themselves, fall in the genus *Cæoma*. The query arises as to whether this should be looked upon as the æcidium or uredo stage. So far as observed this form grows on the same leaf, and usually just before the teleutoform, characteristics of the latter rather than the former. If, indeed, *Peridermium pini* is the æcidium form of *Coleosporium senecionis*, then the pulverulent spores on *Senecio*, one would say, must be the uredo form, and these are very similar to the first-formed spores of the other species.

C. sonchi-arvensis, (Pers.) Lév.

II., III. Hypogenous, rarely epiphyllous. Uredosori scattered or united in groups, often very numerous and sometimes crowded or confluent, elliptical or irregular, powdery; uredospores elliptical, often irregular, thickly studded with little obtuse tubercles, orange-yellow, but soon fading, 15-21 by

19–24 μ ; teleutospores scattered or united in groups, often very numerous and sometimes confluent, low, at first orange-yellow, changing to pale reddish brown; teleutospores about four-celled, cylindrical or enlarged above, epispore thin, smooth.

Uredo sonchi-arvensis. Crowded, subconfluent, fulvous, sori nearly plane, irregular. Hab.: frequent in autumn on leaves of *Sonchus arvensis* in fields after harvest.—Persoon, Syn. Fung., p. 217.

On leaves of *Vernonia fasciculata*: Tazewell, July 22, 2491, II.; Champaign, Aug. 11, 1023, II., III.; Piatt, Aug. 15, 1070, II., III. Aug. 17, 1111, II., III.; McLean, Sept. 6, 5671, II., III., Oct. 6, 1810, II., III., Oct. 13, 1862, II., III.; LaSalle, Sept. 14, 1545, II., III., Sept. 29, 6240, III.; JoDaviess, Sept. 15, 5911, II.; Jersey, Oct. 13, 6296, II., III.; Jackson, Oct. 22, 1955, II., III.; Union, Oct. 24, 1970, 1984, II., III., 1985, II., III., 1986, II., III., Oct. 26, 2034, Oct. 27, 2067, II. III.; Pulaski, Nov. 4, 2233. *Elephantopus Carolinianus*: Union, Oct. 26, 2033, II., III. *Aster sagittifolius*: Jackson, April 21, 4213, II.; Pulaski, May 5, 4508, II., 4509, II., May 6, 4532, II., May 10, 4592, II.; McLean, July 12, 2488, II., July 15, 2486, II., July 29, 2487, II., Aug. 1, 2463, II., III., Aug. 6, 2485, II., 2489, II., Oct. 18, 1885, II., III.; McHenry, Aug. 20, 1162, II.; LaSalle, Sept. 13, 1507, II.; Stephenson, Sept. 13, 5823, II., Sept. 14, 5881, II., III., JoDaviess, Sept. 16, 5950, II.; Rock Island, Sept. 27, 1685, II.; Fulton, Oct. 3, 1741, II. *Aster* spp.: Jackson, April 25, 4292, II.; Johnson, May 12, 4650, II.; Adams, July 11, 5499, II., 5500, II.; McLean, Aug. 1, 2490, II.; Piatt, Aug. 10, 1008, II.; McHenry, Aug. 24, 1283, II.; Cook, Sept. 6, 1452, II.; JoDaviess, Sept. 19, 5998, II.; Fulton, Oct. 3, 1736, II., III.; Union, Oct. 21, 1906, II., III. *Solidago latifolia*: McLean, Aug. 1, 2481, II., Aug. 6, 2483, II., 2484, II., Oct. 12, 1853, II., III. *S. altissima*: Adams, July 1, 5378, II., July 3, 5386, II., July 7, 5448, II.; Lee, Sept. 9, 5752, II. *S. ulmifolia*: McLean, Aug. 6, 2482, II.; LaSalle, Sept. 17, 1570. *S. Canadensis*: Adams, July 11, 5498, II.; McLean, July 12, 2479, II., July 15, 2478, II., 2480, II., III., July 16, 2477, II., Aug. 6, 2476, II., Oct. 18, 1879, II.; McHenry, Aug. 20, 1178, II., Aug. 24, 1279, II.; Stephenson, Sept. 13, 5817, II.; Rock Island, Sept. 24, 1619, II., III., Sept. 27, 1684, II., III.; Fulton, Oct. 3, 1743, II.; Union, Oct. 25, 2006, II., III., Oct. 27, 2060, II.,

2066, II., Nov. 1, 2205, II., Nov. 4, 2273, II. *S. gigantea*: McLean, Sept. 6, 5672, II. *Solidago* sps.: Union, April 26, 4312, II., April 29, 4393, II.; Pulaski, May 3, 4466, II.; Adams, June 26, 5289, II., July 5, 5418, II.; Piatt, Aug. 15, 1077, II., Aug. 17, 1112, II.; Ogle, Sept. 26, 6187, II.; Union, Oct. 21, 1912, II. *Silphium integrifolium*: Union, Sept. 22, II., III., (Earle.) *S. terebinthinaceum*: Jersey, Oct. 13, 6298. *Helianthus*: Piatt, Aug. 17, 1130; Jersey, Oct. 13, 6297, II., III., Oct. 14, 6311; McLean, Oct. 12, 1847, II., III., Oct. 18, 1878.

Nos. 1912, 2006, 2060, 2205, 2481, 5817, 5881, 5950 and 6187 are accompanied by pycnidia of *Dothidea solidaginis*.

The name adopted is from *Uredo sonchi-arvensis*, Persoon. For the fungi here included many names have been proposed under the idea of specific distinctness. But whatever differences exist seem to be so connected by intermediate forms that those upon the host-plants named are considered specifically identical. There are, therefore, included such as have been named *Uredo Solidaginis*, Schw., *U. terebinthini*, Schw., *Coleosporium compositarum*, Lév., *Uredo* or *Cæoma elephantopodis*, Schw., *Coleosporium Vernoniæ*, B.&C., and *C. Solidaginis*, Thüm. Perhaps the form on *Vernonia* differs more than others from the type on account of the uredospores being smaller, and the teleutospores being more enlarged above. On *Elephantopus* the teleutosori are grouped in circles.

C. ipomœæ, (Schw.)

II., III. Hypophyllous. Spots yellowish or none; sori minute, scattered or irregularly clustered, circular. II. Spores irregularly oval, strongly echinulate, 18 by 26 μ . III. Sori convex, deep reddish orange; spores (chains) oblong or slightly clavate, conspicuously 4-6-septate, about 10 by 26 μ , segments widest transversely.

On leaves of *Ipomœa Nil*: Union, Oct. 31, 2133, II., III.; Jackson, Nov. 5, 2265, II., III. *I. lacunosa*: Union, Oct. 31, 2134, II., III. *I. pandurata*: Tazewell, July 22, 2462, II., III.; McLean, July 29, 2292, II., III., Oct. 13, 1861, II., III.; Piatt, Aug. 15, 1068, II., III., Aug. 17, 1108, II., III., 1136, II., III.; Jersey, Oct. 12, 6271, II., III.

This is evidently the plant named *Uredo ipomœæ* by

Schweinitz, and as such distributed by Ravenel in his *Fungi Caroliniani* IV. No. 99, and *Fungi Americani*, No. 488. In both of those specimens the Coleosporium form is found. Our specimens on *Ipomœa Nil* have the spore-chains somewhat more slender, and the color of those examined is not quite so deep as that of those on *I. pandurata*.

CHRYSOMYXA, UNGER.

Teleutospores composed of several cylindrical cells in simple or branched vertical rows, the lower cells sterile, each of the upper producing a several-celled promycelium bearing about four sporidia, sorus naked, compact, flat or convex, red or orange-yellow; uredospores in vertical rows, soon pulverulent, sorus naked.

It is understood that *Peridermium abietinum*, (Alb. & Schw.) is genetically related to one or more species of this genus as the æcidium-stage.

Not so far observed in Illinois.

UREDIO, LÉV.

Spores one-celled, produced singly on pedicels from which they readily separate at maturity, forming a powdery mass; sorus without pseudoperidium, without spermagonia.

Many, perhaps all, are forms of plants belonging to other genera classified by the teleutospores, as *Uromyces*, *Puccinia*, etc., and constitute what is known as the second stage of the *Uredineæ*; but some of the so-called species have not yet been connected even in supposition with any teleutosporic forms. The spores germinate at maturity, and soon lose their vitality; the germ tube produces the mycelium directly, without the intervention of sporidia. The sorus is in some cases surrounded by paraphyses, usually club-shaped and incurved, a characteristic of the so-called genus *Lecythea*.

For the comparison between *Uredo* and *Cæoma*, see the latter.

U. hydrangeæ, B. & C.

Hypogenous. Spots small, yellowish, more or less confluent. Sori minute, scattered, few; spores obovate, produced on pedicels, minutely tuberculate, 12-18 by 16-24 μ .

On *Hydrangea arborescens*.

This name is attached to specimens in the Curtis herbarium, and published in Curtis' Cat. Plts. N. C., p. 122, without description. The specimens from which the description is taken were collected by Mr. F. S. Earle, Cobden, Oct. 13, 1879. There is no evidence of the occurrence of the fungus elsewhere in the State.

CÆOMA, TUL.

Spores one-celled, produced in vertical chains, soon separating in a powdery mass, sorus without pseudoperidium, but sometimes covered by a thin adherent membrane, often with spermagonia, and with or without paraphyses.

The term Cæoma has been used with several and very different significations. As here limited it does duty, probably temporary, as a genus of so-called species of which teleutospore forms are still unknown. As defined the genus differs from *Uredo* in the manner of the production of the spores, and from *Æcidium* in the absence of a peridium. According to some authors the presence of spermagonia is taken as the special characteristic of *Cæoma* as against *Uredo*, so that with these writers the forms having spores in chains, but without spermagonia, are arranged under the latter, as, for example, the so-called *Uredo agrimonia*,—herein found as *Cæoma agrimonia*, Schw. It, however, seems pretty evident that, with or without spermagonia, those forms having spores in chains represent rather the æcidial than the uredo stage, and as some species of *Æcidium* have no spermagonia, the absence of the latter in *Cæoma* ought not to be unlooked for.

Some of the so-called *Cæomæ* have been identified as the æcidial forms of *Phragmidium*, which see. Compare also *Coleosporium*.

C. agrimonix, Schw.

Hypogenous. Spots yellowish, often confluent and more or less spreading over the surface. Sori small, irregularly, mostly thickly, associated in patches, or over the whole surface, orange; spores subglobose or elliptical, epispore rather thin, finely echinulate, 14-16 by 15-20 μ .

Cuoma (Uredo) agrimonix, Schw. Spots lutescent; sori minute, confluent; spores delicate red-orange, at length faded. Often covering the whole under surface of the leaves.—Schweinitz, N. Am. Fungi, No. 2835, p. 291.

On leaves of *Agrimonia Eupatoria*: Johnson, May 11, 4617; McLean, July 7, 2511, July 15, 2513, 5560. July 27, 2514, Aug. 6, 2510, Oct. 6, 1812. Oct. 18, 1877; Tazewell, July 22, 2512; Piatt, Aug. 17. 1118; Lee, Sept. 8, 5710; LaSalle, Sept. 13, 1505, Sept. 17, 1569; Stephenson, Sept. 14, 5880; Ogle. Sept. 22, 6106; Henry. Sept. 28. 1728; Jersey, Oct. 12, 6272. *A. parviflora*: McLean, Sept. 6, 5673.

This has been named *Uredo agrimonix*; it was placed by Schweinitz in the *Uredo* section of *Cuoma*, the latter including, according to him, all allied species. But the spores are produced in chains, not borne singly upon a stalk. On this account probably, Bonorden (Beitr. z. Kent. d. Coniomyc, p. 20) assigned it to the genus *Coleosporium*, hence it is known as *Coleosporium ochraceum*. Without question, however, the form is not the teleuto stage. Until the latter is known it must therefore be *Cuoma*, and the specific name should, at all events, stand as above.

C. nitens, Schw.

Hypophyllous. Sori irregular. flat, usually thickly associated and confluent, more or less covering the surface, bright orange-yellow; spores subglobose, elliptical or oblong, epispore thin, finely tuberculate, 12-24 by 18-32 μ ; spermagonia scattered, numerous, yellow, mostly on upper side of leaf.

On *Rubus occidentalis*: McLean, May 20, 4722, May 25, 4777, May 26, 4792; LaSalle, June 15, 4993. *R. villosus*: Union, April 16, 5016, April 17, 4140, April 24, 4258, April 26, 4310, April 27, 4332, April 28. 4375, April 29, 4391; Jackson,

April 19, 4176, April 28, 4367; Pulaski, May 1, 4403, May 6, 4531, May 9, 4578; Johnson, May 13, 4670; McLean, May 23, 4749, May 26, 4791; Champaign, June 8, 4903; LaSalle, June 16, 5208; Adams, July 3, 5387.

Schweinitz (Syn. Car. 458) calls this *Æcidium nitens*, and afterwards (Syn. N. A. Fungi) *Cæonia* (sub-genus *Æcidium*) *luminatum*. The last name has been most often used, but without proper authority.

This is the well known orange rust of the blackberry, and more rarely of the black-cap raspberry, occurring for the most part in May and June. It is unquestionably a first form or undeveloped state of some teleutosporic species, and this has been thought to be a *Phragmidium*. Some recent observation, however, tends to show that it belongs to *Puccinia Peckiana*, Howe, which is found on the same host-plants, and matures in September.

ÆCIDIDIUM, PERSOON.

Spores one-celled, in chains or vertical rows, without pedicels; sorus inclosed in a short, beaker-like pseudoperidium, which protrudes through the ruptured epidermis of the host, and opens regularly at the vertex, the border soon becoming more or less toothed or lobed, and usually recurved; with spermatogonia.

This was supposed to be a true genus of automatus species, but it is now believed that all the supposed species belong to *Uromyces* and *Puccinia*, and constitute what is known as their first or æcidial stage in the alternations of development. Before, however, anything like exact knowledge as to genetic relations can be ascertained, carefully made artificial cultures must be made by competent investigators. Where there is now good reason for accepting the demonstrations as satisfactorily made, the forms have been included in their proper places with the teleutospores; otherwise they follow here under the designation of species.

Æ. ranunculacearum, DC.

Hypophyllous. Spots distinct, yellowish, mostly small; æcidia irregularly and densely clustered, short, erect, or at

length more or less recurved and many times divided, becoming pulverulent, pale yellowish; spores subglobose or elliptical, epispore rather thick, finely but conspicuously tuberculate, 18 by 21-24 μ ; spermagonia minute, honey-yellow, mostly scattered on the upper surface of the affected area.

On *Anemone Pennsylvanica*: Champaign, June 9, 4934, June 10, 4956.

Æ. ranunculi, Schw.

Mostly hypogenous. Equally usually densely associated over the whole surface of the leaf, or over definite patches; æcidia recurved, border narrow and many times split; spores subglobose or elliptical, finely echinulate, 15-21 by 18-24 μ ; spermagonia numerous, scattered among the æcidia on same side of leaf, minute.

On *Ranunculus abortivus*: Union, April 12, 4030, April 13, 4066, April 14, 4097, April 15, 4106½, April 17, 4131; Jackson, April 18, 4165, April 28, 4363; Pulaski, May 5, 4507; McLean, May 23, 4751, May 29, 4805, May 30, 4840.

Æ. punctatum, Pers.

Hypophyllous. Spots effused, yellowish; æcidia uniformly scattered over large portions or the whole of the leaf-surface, not usually crowded, rather large, deeply divided into few (about four) widely spreading recurved lobes, thin but firm; spores subglobose to oblong, almost smooth, brown, about 18-21 μ , or 15-18 by 21-27 μ ; spermagonia uniformly and remotely scattered on both surfaces, conspicuous, reddish brown.

Simple, scattered, peridia subimmersed, mouth subcontinuous, powder compact, fuscous.—Persoon, Syn. Fung., p. 212.

On *Hepatica triloba*: Champaign, May 1. *Anemone nemorosa*: Riverside, near Chicago, June 2. J. C. Arthur.

This is *Æcidium quadrifidum*, DC. There is on *Anemone nemorosa* a species supposed to be different (not so far found in Illinois) known as *Æ. anemones*, Pers., or *Æ. leucospermum*, DC. In this last the pseudoperidium is more often, but less deeply, divided, and the border more distinctly rolled, and the spermagonia are very much less conspicuous, produced, how-

ever, in the same way. The spores have thinner walls, are lighter colored, and are said to be more elongated. In the latter respect, however, the specimens collected by Arthur have spores commonly quadrangular, and considerably longer than wide. A Massachusetts specimen agrees with the typical *Æ. punctatum* except that the spermagonia are confined to the lower side of the leaf. That on *Hepatica triloba* is distinctively *Æ. punctatum*.

Æ. actææ, (Opiz.) Wallr.

Æcidia orderless or in circular groups, on pale spots which later are blackish in the centre; pseudoperidia short-cylindrical, with a white tube and many times split and recurved border; spores polygonal, pale yellow, fine-warty, 16–26 μ in diameter by 30 μ .—Winter, *Die Pilze*, p. 268.

On *Actæa*: Jackson, April 25, 4288.

The description is taken from European specimens; those from Illinois are not fully developed, but seem to be the same.

Æ. dicentræ, Trelease.

Hypophyllous. *Æcidia* uniformly and remotely scattered over the entire surface, rather large, prominent, border regularly segmented and quite uniformly and abruptly rolled, firm; spores subglobose or elliptical, epispore thin, minutely tuberculate, 10–13 by 11–16 μ ; spermagonia large, disk-like, rather distant in a single row on the margin of the leaf, reddish brown.

On *Dicentra cucullaria*: Jackson, April 20, 4195, April 21, 4211, April 25, 4289, April 27, 4345, April 28, 4360; Union, April 24, 4252; McLean, May 22, 4731, May 23, 4753.

Æ. Mariæ-Wilsoni, Peck.

Hypogenous. Spots small, definite, not thickened, yellowish; *æcidia* small, short-cylindrical, border narrow, many times split and recurved, subcircinating; spores subglobose or somewhat angular, epispore thin, minutely tuberculate, 11–15 μ ; spermagonia preceding and, with the *æcidia*, mostly on the upper side of the leaf.

Spots orbicular, yellow; subiculum not thickened nor excavated; peridia small, slightly elevated, subcircinating, numerous, the margin distinctly scalloped and reflexed; spores subglobose, orange, becoming pale, .00056-.00062 in. in diameter.—Peck, Rep. N. Y. State Mus., XXIV., p. 92.

On leaves of *Viola cucullata*: Union, April 24, 4246.

This seems to differ from *Æ. violæ* in the leaf-spots not being thickened, in the æcidia and spores, and in the presence of spermagonia. Specimens from Professor Trelease, labelled *Æ. Petersii*, B. & C., on *Viola delphinifolium*, cannot be distinguished from the species described above and earlier named by Peck.

Æ. hibisciatum, Schw.

Hypophyllous. Spots usually few, large, thickened, definite, brown with a yellow border; peridia mostly densely crowded, sometimes irregularly circinate, subimmersed; spores broadly oval, about 18 by 37 μ .

Spots orbicular, yellowish, confluent; peridia irregularly but densely scattered, slender, yellow; spores not compact but loose, yellowish.—Schweinitz, N. Am. Fungi, No. 2877.

On leaves of *Hibiscus militaris*: McLean, July 7, 2429, July 15, 5559.

Æ. geranii, DC.

Hypophyllous. Spots definite, not large, purplish or yellow, scarcely thickened; æcidia circinating, small, short, deeply and rather finely split and much recurved; spores subglobose, epispore thin, thickly tuberculate, 18-21 μ ; spermagonia clustered in the center of the spots, on both sides of leaf.

On *Geranium maculatum*: McLean, May 23, 4752, May 29, 4806, May 30, 4833, May 31, 4866, June 1, 4881; Piatt, May 28; LaSalle, June 16, 5205.

Æ. impatientis, Schw.

Hypogenous. Spots sometimes definite, purple, yellow-bordered, more often effused, on the leaves scarcely thickened, on the petioles and stems swollen; æcidia subcircinate or irreg-

ularly scattered, short, deeply and rather coarsely split and much recurved; spores subglobose or elliptical (vertical diameter shorter), epispore thin, apparently smooth, contents finely granular, 15-18 by 18-20 μ ; spermagonia clustered above in the centre of the definite spots, otherwise sparsely scattered on both sides of leaf.

On *Impatiens*: Union, April 29, 4396; Pulaski, May 4, 4483, May 8, 4559; McLean, May 31, 4864, June 24, 5280, July 2, 2425, July 5, 2434, July 7, 2436, July 15, 5557; LaSalle, June 16, 5206; Adams, July 3, 5388, 5389, July 7, 5451.

Æ. pteleæ, B. & C.

Mostly hypophyllous. Spots distinct, yellow, thickened; æcidia irregularly clustered, cylindrical, rather long, becoming numerous and deeply split and much recurved; spores subglobose or elliptical, large, conspicuously tuberculate, 21-25 by 24-30 μ ; spermagonia not found.

Spots pallid, in a hollow on the under side of the leaves; pseudopodia crowded, short, radiated.—Berkeley, Grev., Vol. III, p. 61.

On leaves of *Ptelea trifoliata*: Adams, June 22, coll. C. A. Hart; Peoria, July 10, 6516.

There is scarcely any doubt but that the plant described above is the *Æcidium pteleæ* of Berkeley and Curtis, though the description in Grevillea is insufficient, and the original specimen in the Curtis collection is so poor that its characters cannot be made out.

Æ. onobrychidis, Burrill.

Hypophyllous. Spots distinct or confluent, somewhat effused, yellowish brown; æcidia subcircinate, crowded, short, border abruptly recurved, rather coarsely dissected; spores subglobose or elliptical, epispore rather thin, studded with low, obtuse tubercles, sometimes united in ridges, 19-24 μ ; spermagonia clustered in the center of spots mostly on the upper surface, minute, reddish brown.

On *Psoralea Onobrychis*: LaSalle, June 20, 5249.

Æ. psoraleæ, Peck.

Hypophyllous. *Æcidia* uniformly distributed over the

leaf, short, soon deeply split and recurved; spores elliptical, epispore rather thick, densely tuberculate, 15-18 by 18-24 μ ; spermagonia numerous, uniformly scattered among the æcidia, honey-yellow.

Spots none; peridia abundant, generally occupying all the lower surface of the leaf, rarely a few on the upper surface, short, margin crenulate; spores subglobose and subelliptical, brownish yellow when fresh, yellowish when dry, .0007-.0008 in. long.—Peck, *Am. Nat.*, Vol. VIII., p. 215.

On *Psoralea floribunda*: LaSalle, June 20, 5248.

Æ. leucostictum, B. & C.

Hypophyllous. Spots very small, scarcely evident, not discolored; æcidia very small, irregularly clustered in little groups, short, border narrow, recurved and many times split; spores subglobose, minutely tuberculate, 11-12 by 12-16 μ .

Minute, scattered or collected into small patches.—Berkeley, *Grev.*, Vol. III., p. 61.

On *Lespedeza procumbens*: Johnson, May 11, 4616.

This is named as above in Curtis' Catalogue of the Plants of North Carolina, and described in Grevillea (III. p. 61) as a variety of *Æ. orobi*, Pers. The specific distinction is preferred on account of the difference in size of æcidia and spores as well as the appearance of the former.

Æ. orobi, Pers.

Hypophyllous. Spots usually conspicuous, yellow, not thickened; æcidia scattered or collected in orderless groups, small or medium size, short, border many times split and recurved; spores subglobose, usually somewhat angular, epispore rather thick, studded with low obtuse tubercles, often appearing smooth, 18-21 by 21-24 μ ; spermagonia few, mostly on the upper side of leaf, in the center of affected spots.

On leaves of *Amphicarpaea monoica*: LaSalle, June 15, 4989.

This is referred to the above named species with some doubt as to the identification. The æcidia are collected in more definite groups than are found in typical specimens of the species.

Æ. grossulariæ, DC.

Hypogenous. Spots distinct, swollen, yellow; æcidia densely clustered, medium size, edge entire and erect or often many times split and recurved; spores subglobose, epispore very thin, obscurely roughened.

On leaves and fruit of *Ribes rotundifolium*: McLean, May 22, 4730, May 23, 4758, May 29, 4814, May 30, 4836. *Cultivated gooseberry*: McLean, May 31, 4847, coll. C. A. Hart; Champaign, coll. T. J. Burrill.

Æ. epilobii, DC.

Amphigenous. Æcidia scattered rather uniformly over the surfaces of the leaves, sometimes more abundant beneath, short, rather coarsely and deeply split and much recurved; spores subglobose, epispore thin, smooth or nearly so, 15–18 μ ; spermagonia honey-yellow, appearing before the æcidia, scattered over both surfaces, more numerous above.

On *Ænothera biennis*: Union, April 29, 5019.

There is much reason to suppose that this is *Uromyces ænotheræ*, Burrill. The specimens on *Ænothera linifolia*, from Jackson county, are, if not identical, exceedingly similar, as may be learned by comparing the descriptions. Moreover, Mr. C. A. Hart collected May 27th, 1883, in McLean county, on the radical leaves of what is supposed to be *Ænothera biennis*, a *Uredo*, which is undistinguishable from the uredo form of this *Uromyces*. The sori of Mr. Hart's specimens are developed on both surfaces of the leaves, but the greater number open on the under side — the only point of difference noted.

Æ. ænotheræ, Peck.

Hypophyllous, or very sparingly produced above. Spots conspicuous, usually purple, scarcely thickened; æcidia crowded in a somewhat definite circle, with a small central vacant area, short, deeply and rather coarsely split and much recurved; spores subglobose, epispore thin, very minutely tuberculate, 15–18 μ ; spermagonia few, very inconspicuous, on the upper side of the leaf in the center of the spots, honey-yellow.

Spots orbicular, scarcely thickened, reddish purple, sometimes stained with yellow; peridia short, crowded, generally with a small free central space; spores orange, subglobose, small, .0005 in. in diameter. Not unfrequently a reddish purple dash extends from the spot to the margin of the leaf. The cups sometimes occur sparingly on the upper surface of the leaf. The free central space appears umbilicus-like, and, when present, is a noticeable feature.—Peck, Rep. N. Y. State Mus., XXIII. p. 60.

On *Enothera biennis*: Union, April 27, 4334; Pulaski, May 8, 4566; McLean, May 20, 4721, May 23, 4757, May 25, 4780, May 29, 4802, May 30, 4824, May 31, 4848, June 1, 4883, June 14, 4975, June 19, 5270; Champaign, June 8, 4892; La-Salle, June 15, 4998; Adams, July 3, 5390.

Æ. sambuci, Schw.

Hypogenous. Spots conspicuous, yellow, swollen; æcidia circinate or more often densely and irregularly crowded, short, deeply split and recurved; spores subglobose, epispore thin, minutely tuberculate, 18–21 μ ; spermagonia very few, in the center of the spots on both sides of the leaf.

On *Sambucus Canadensis*: Pulaski, May 5, 4493, 4497; May 8, 4560; McLean, May 31, 4859 (undeveloped), June 1, 4890 (undeveloped).

On the young stems the æcidia often occur in large dense clusters with much distortion of the host.

Æ. diodiæ, Burrill.

Hypophyllous, on the cotyledons and rarely lower leaves. Spots distinct, small, greenish brown; æcidia few, in little irregular clusters, small, short, border little or not at all recurved; spores subglobose or elliptical, epispore rather thin, tuberculate, 17–21 by 21–30 μ ; spermagonia rather numerous, scattered, above, not found on many of the spots.

On *Diodia teres*: Johnson, May 13, 4661, May 16, 4700.

This may be the æcidium of *Uromyces spermacoces*, which grows on the same host.

Æ. cephalanthi, Seymour.

Hypogenous. Spots distinct, brown, scarcely thickened; æcidia numerous, irregularly crowded, short, the strongly re-

curved narrow border abrupt, finely divided; spores large, subglobose or elliptical, episore very thick, very conspicuously reticulately roughened, 28-36 by 33-43 μ ; spermagonia scattered over the upper side of infected area, minute, reddish brown.

On *Cephalanthus occidentalis*: Ravenswood, near Chicago, June (A.D. 1883), coll. J. C. Arthur; Quincy, July 12 (A.D. 1883), coll. C. A. Hart.

***Æ. houstoniatum*, Schw.**

Hypophyllous. *Æcidia* scattered over the entire leaf, small, very short, recurved border narrow, many times split; spores globose or elliptical, often angular, minutely tuberculate, 12-15 by 15-18 μ ; spermagonia numerous, conspicuous, appearing before the *æcidia*, scattered over the entire under surface, occasionally above, purple.

Without distinct spots. Pseudoperidia elevated, pallid, subconical, contracted at the apex, and somewhat excavated. Spores orange. The infected plant, though degenerated, yet flowers.—Schweinitz, N. Am. Fung., No. 2891, p. 293.

On *Houstonia carulea*: Union, April 16, 5010 (Earle), April 17, 4133, April 26, 4307; Jackson, April 27, 4344, April 28, 4362; Johnson, May 13, 4663.

The infected plants are easily recognized, as the fungus causes them to grow more slender and more strictly erect, often taller, and gives them a yellowish appearance.

***Æ. erigeronatum*, Schw.**

Hypophyllous. Spots usually distinct, large, swollen, yellow; *æcidia* subcircinate or irregularly crowded, short, soon many times divided and much recurved; fragile, soon becoming pulverulent; spores subglobose, episore thin, tuberculate, 12-15 μ ; spermagonia indistinct, few, usually centrally crowded, mostly on upper side of leaf, yellow.

Spots large, yellowish, somewhat swollen, pseudoperidia densely distributed, without order, elevated, spores yellowish.—Schweinitz, N. Am. Fungi, No. 2869, p. 292.

On *Erigeron Canadense*: Adams, June 27, 5306, July 6, 5434. *E. bellidifolium*: Johnson, May 13, 4664, May 16, 4699.

E. Philadelphicum: Union, April 17, 4136; Champaign, June 8, 4916. *E. annuum*: Johnson, May 12, 4634, May 13, 4666; Champaign, June 8, 4893, June 10, 4953; Adams, June 27, 5305, July 6, 5433.

Æ. asterum, Schw.

Hypophyllous. Spots usually distinct, somewhat swollen, yellow or purple; æcidia subcircinate or irregularly crowded, short, deeply divided and recurved, soon becoming pulverulent; spores subglobose, epispore thin, tuberculate, 12–17 μ ; spermagonia rather indistinct, few, mostly on upper side, yellow.

On *Aster sagittifolius*: Jackson, April 21, 4212, 4214, April 25, 4282; Union, April 24, 4253, April 28, 4382; Pulaski, May 1, 4402, May 5, 4501, May 10, 4588; Johnson, May 11, 4613; McLean, May 20, 4723. *Aster* spp.: Jackson, April 25, 4285; Pulaski, May 5, 4510; Johnson, May 12, 4646; McLean, July 7, 2423, July 15, 5558. On *Solidago latifolia*: 4248, 4284, 4732, 4994. On *S. cæsia*: 4249, 4485, 4574, 4506, 4614, 5556. *S. rigida*: 4837 (only spermagonia). *S. altissima*: 4250, 4575, 4587, 4615, 4665, 4688, 4809, 5253. *Solidago* spp.: 4050, 4137, 4166, 4175, 4197, 4283, 4308, 4401, 4425, 4426, 4484, 4528, 4647, 4687, 4733.

Schweinitz at first separated those on *Solidago* under the name *Æ. solidaginis*, but subsequently united them with the *Aster* forms. His change in the form of the specific name to *asteratum* is not followed.

There seems to be a different *Æcidium* on *Solidago*. See Ellis' North American Fungi, No. 1018.

Æ. compositarum.

Under this head are united all the *Æcidia* on *Compositæ* except the two foregoing, whose teleutoforms are doubtful. It is impossible to satisfactorily determine them until full life histories are worked out. It is even impossible to give in this place a description of the species properly known as *Æcidium compositarum*, Mart., neither is it deemed wise to try to refer anything to the Schweinitzian species, *Æ. helianthi-mollis* and *Æ. tracheliifoliatum*. Taking the host plants as guide to a considerable extent, the following forms are noted:

On *Eupatorium*. Hypophyllous. Spots distinct, usually few, conspicuous, yellow; æcidia irregularly clustered or somewhat circinate, short, irregularly split and moderately recurved, soon pulverulent; spores subglobose, epispore rather thin, minutely tuberculate, 18–20 μ ; spermagonia several, scattered, above, honey-yellow. On *Eupatorium perfoliatum*: McLean, July 11, 2424.

On *Silphium*: Hypophyllous, and often also epiphyllous. Spots distinct, usually widely scattered, not large, yellow, æcidia irregularly associated, scarcely crowded, deeply immersed, and but slightly projecting above the raised epidermal border, margin many times split or pulverulent, little excurved; spores subglobose, often angular, 11–15 μ ; spermagonia rather few, conspicuous, reddish brown, central, on both sides of leaf. On *Silphium integrifolium*: McLean, May 3, 4852. *S. terebinthinaceum*: McLean, May 30, 4825, June 23, 5274, July 2, 2420, July 11, 2421. *S. laciniatum*: McLean, June, coll. C. A. Hart.

On *Ambrosia*: Hypophyllous. Spots large, often confluent, scarcely thickened, yellow or purplish brown; æcidia not closely crowded, irregularly distributed over the spot, with, however, a free central area, short, but not deeply immersed, firm, the coarsely divided border widely and elegantly excurved; spores subglobose, usually angular, epispore firm, smooth, 12–15 μ ; spermagonia few, central, on both leaf-surfaces, reddish brown. On *Ambrosia trifida*: Champaign, June.

On *Xanthium*: Hypophyllous, very rarely also epiphyllous. Spots not large, distant, scarcely thickened, yellowish, sometimes tinged purple; æcidia not densely crowded, irregularly distributed or subcircinate, mostly irregular in outline, deeply immersed and protruding little above the raised epidermal border, the margin pulverulent, rarely lobed and excurved; spores subglobose or elliptical, often angular, epispore rather thin, minutely tuberculate, about 15–18 μ ; spermagonia few, central, mostly above, minute, yellowish brown. On *Xanthium strumarium*: Champaign, June. This is much like the form on *Silphium*, and answers in some respects to *A. verbesinæ*, Schw., and also to *A. trachelifoliatum*, Schw., but it is probably neither. The *Æcidium* is often followed by *Puccinia xanthii*, Schw., and may be connected therewith.

On *Helianthus*: Hypophyllous, rarely also epiphyllous. Spots distinct or confluent, usually yellow, somewhat thickened; æcidia subcircinate, not usually densely crowded, short, not deeply immersed, deeply split and widely recurved, at first firm, but soon becoming pulverulent; spores subglobose or elliptical, epispore thin, minutely tuberculate; spermagonia few, central, mostly on upper side of leaf, inconspicuous, yellowish brown. On *Helianthus* *sps.*: Union, April 24, 4256, 4257, April 26, 4309; Jackson, April 28, 4369; Pulaski, May 9, 4573; Johnson, May 12, 4642, 4643, 4644, May 15, 4689.

There seem to be two species on *Helianthus*, and in No. 4644 on the same host. In one case the æcidia are in large clusters, with spores about 12–14 by 13–16 μ ; in the other case the clusters are small, and the spores measure about 15–21 by 20–24 μ .

On *Bidens*: Hypophyllous, very rarely also epiphyllous. Spots mostly rather large, effused, often confluent, purple, scarcely thickened; æcidia sparsely scattered, rather prominent, border abruptly and rather conspicuously recurved, firm; spores subglobose, epispore thin, minutely tuberculate, 15–17 μ ; spermagonia few and inconspicuous, mostly central, below, often altogether wanting. On *Bidens frondosa*: Adams, June 27, 5304; Champaign, midsummer.

On *Lactuca*: Hypophyllous. Spots definite, conspicuous, thickened, mostly widely separated, but sometimes numerous and somewhat confluent, purple, then brown; æcidia mostly crowded around a free central space, rather numerous, short, many times irregularly split and widely recurved or pulverulent; spores angular, irregularly subglobose or broadly oval, epispore thin, minutely tuberculate, 15–18 μ ; spermagonia rather numerous, scattered centrally above, large, simply convex, reddish brown. On *Lactuca Canadensis*: McLean, May 20, 4720, May 23, 4748, 4759, May 25, 4781, 4781½, May 26, 4798, May 29, 4803, May 30, 4826, May 31, 4849, 4865, June 1, 4884; Champaign, June 8, 4894.

Æ. plantaginis, Ces.

Amphigenous. Spots usually small, sometimes effused and large; æcidia collected in little groups or loosely scattered,

short-cylindrical, little or not at all recurved; spores subglobose or elliptical, tuberculate, 18-21 μ ; spermagonia seldom found, mostly preceding the æcidia, scattered over the spot on either side of leaf.

On *Plantago Virginica*: Union, April 15, 4106, 4126, April 17, 4134, April 26, 4305, April 27, 4333; Jackson, April 19, 4180, April 28, 4361; Johnson, May 13, 4667.

The determination of this species was made from the specimen in Ravenel's *Fungi Americani*, No. 483.

Æ. lysimachiae, (Schl.) Wallr.

Hypophyllous (also on the petioles). Spots distinct, yellowish, scarcely thickened; æcidia somewhat circinate, short, the recurved border very narrow; spores subglobose, epispore thick, conspicuously tuberculate, 21-24 by 22-27 μ ; spermagonia few, central, above.

On *Lysimachia ciliata*: McLean, June 1, 4882.

The above description is taken from specimens on *Lysimachia ciliata*, and agrees, save in the irregularly circinate arrangement of the æcidia, with the specimens in Rabenhorst's *Fungi Europæi*, No. 391. A specimen from Wisconsin on *L. lanceolata* is distinct, especially in the characteristics of the spores, but otherwise as well. It is not known what the Schweinitzian *Æcidium lysimachiae* is. If the same as Schlectendal's *Cœoma lysimachiae*, the second authority for the name should be Schweinitz; if different, the question arises as to which name shall be allowed to stand. At all events there does not seem to be good reason for writing, as is sometimes done, *Æcidium lysimachiae*, Lk.

Æ. pentstemonis, Schw.

Hypophyllous. Spots definite, purple, yellow-bordered, usually small, somewhat thickened; æcidia clustered, short, the deeply recurved border rather coarsely split; spores subglobose, inconspicuously tuberculate, 18-21 μ ; spermagonia few, central in the spots on both sides of leaf.

On *Pentstemon pubescens*: Union, April 16, 5014 (Earle), April 17, 4138; Johnson, May 12, 4645, May 16, 4698.

Æ. lycopi, Gerard.

Hypogenous. Spots circular, distinct, or more or less confluent, scarcely thickened, purplish brown; æcidia on the leaves mostly circinate, often in a single circular row, sometimes, by the confluence of the spots, loosely and irregularly scattered, on the petioles and stems irregularly crowded, short, recurved border abrupt and much torn; spores subglobose, epispore thin, tuberculate, 15–19 μ ; spermagonia few, centrally clustered above, reddish brown.

Spots yellow; subiculum more or less thickened; peridia short, scattered or crowded, margin crenate; spores pale yellow.—Peck, 26 Rep. N. Y. Mus., p. 78.

On *Lycopus Europæus*: Pulaski, May 2, 4424.

Differs from Gerard's description in the arrangement of the æcidia, and less swollen spots.

Æ. myosotidis, Burrill.

Hypogenous. Æcidia uniformly distributed over the leaf, mostly somewhat densely crowded, rather large, somewhat prominent, the recurved border wide and rather coarsely divided; spores subglobose or elliptical, epispore thick, conspicuously tuberculate, 15–18 by 18–22 μ ; spermagonia numerous, uniformly scattered over both surfaces of the leaf, reddish yellow.

On *Myosotis verna*: Union, April 12, 4026, 4029, April 13, 4067, April 17, 4132, April 26, 4306; Jackson, April 27, 4343, April 28, 4364.

The distribution of the æcidia is decidedly different from that of *Æcidium asperifolii*, Pers., as described, as well as from the specimens at hand, and similarly different from those named *Æcidium lycopsidis*, Desv., *Æ. lithospermi*, Thüm., and *Æ. symphyti*, Thüm. The three last are made synonyms of the first by Winter, and all are said to be the æcidia of *Puccinia rubigo-vera*. The latter is common in Illinois in wide areas where *Myosotis* does not occur, and no other species of *Borraginaceæ* has been observed infested with the *Æcidium*.

Æ. hydrophylli, Peck.

Hypophyllous. Spots conspicuous, distinct, yellowish; æcidia subcircinate, short, recurved border rather wide and

deeply divided; spores subglobose, epispore thin, smooth or nearly so, 18–21 μ ; spermagonia numerous, scattered over the central area of the spot above.

Spots small, few, yellow, with a pale greenish border; subiculum thickened, whitish, peridia few, generally crowded, short, the margin subrenate; spores bright yellow or orange; spermagonia central, on the opposite side.—Peck, 26 Rep. N. Y. Mus. p. 78.

On *Hydrophyllum appendiculatum*: McLean, July 20, 5600.

Æ. polemonii, Peck.

Hypophyllous. Spots usually distinct, yellowish brown, border effused; æcidia irregularly clustered, usually about a free central area, short, recurved border wide and rather coarsely divided; spores subglobose or elliptical, often angular, epispore thick, conspicuously tuberculate, 18–21 by 21–25 μ : spermagonia few, central, on both surfaces.

Spots suborbicular, pallid or greenish-yellow, sometimes confluent; peridia hypophyllous, crowded, short; spores globose or subelliptical, bright orange, .0008–.001 of an inch in diameter, minutely rough; spermagonia central on both sides of the leaf.—Peck, Bot. Gaz., Vol. IV. p. 230.

On *Polemonium reptans*: McLean, May 29, 4807. *Phlox pilosa*: McLean, May 31, 4851.

Æ. solani, Mont.

Hypogenous. Æcidia uniformly, usually densely, distributed in patches over the leaf-surface, short, friable, soon becoming pulverulent; spores subglobose or elliptical, often angular, epispore rather thick, obscurely tuberculate, 13–15 by 15–21 μ ; spermagonia very abundant, hypophyllous, scattered over extended patches with or without æcidia, comparatively large, honey-yellow.

On *Physalis viscosa*: Urbana, Ill., May 30 (A.D. 1879), T. J. Burrill.

There is a *Puccinia physalidis*, Peck, from Colorado, of which the above may be the æcidial form, but so far as known the *Puccinia* has not been collected east of the Mississippi.

Æ. apocyni, Schw.?

Undeveloped.

On *Apocynum cannabinum*: McLean, June 14, 4977.

Æ. Jamesianum, Peck.

Amphigenous, on the leaves more abundant beneath. Spots circular, distinct, or often confluent, on the leaves somewhat, and on the stems much swollen; æcidia subcircinate or irregularly crowded, short, pseudoperidium fragile, soon becoming pulverulent; spores subglobose or elliptical, epispore very thick, conspicuously and densely tuberculate, the tubercles often united in short irregular ridges, 21-36 by 24-45 μ , usually about 30 by 39 μ ; spermagonia numerous, scattered or centrally clustered above, nearly black.

On *Asclepias Cornuti*: McLean, May 26, 4799, June 1, 4886, June 19, 5264, June 23, 5277, July 14, 5535, July 17, 5582.

Occurs on stems, petioles and midribs, forming swellings, and on both sides of the leaf, being most plentiful on the lower surface. It is very destructive, eating holes in leaves and stems. The spores are very remarkable for size, marking and thickness (5 μ) of epispore.

There is a different *Æcidium* on *Asclepias Cornuti*, specimens of which were received from E. W. Holway, Decorah, Iowa, labeled *Æ. Jamesianum*.

Æ. fraxini, Schw.

Hypogenous, occurring especially along the veins and upon the leaf-stalks. Spots definite, swollen, often purple; æcidia more or less densely clustered, few or many, elongate, cylindrical, tardily lacerated, but ultimately deeply split and recurved; spores elliptical, epispore thin, tuberculate, 21-24 by 24-32 μ ; spermagonia rather numerous, scarcely elevated, on the upper side of leaf, scattered over central area of the spot.

On *Fraxinus viridis*: Champaign, June 8, 4915, June 10, 4954; LaSalle, June 21, 5252; McLean, June 24, 5379, July 5, 2427.

Æ. pustulatum, Curtis.

Hypogenous. Spots small, reddish yellow, thickened; æcidia rather densely crowded, often in a small circle with a vacant centre, short, rather finely split and recurved; spores subglobose, inconspicuously tuberculate, 16–21 μ ; spermagonia few, yellowish, epiphyllous, difficult to make out.

Spots small, yellowish, sometimes stained with red, thickened, often concave above, convex below; peridia short, subcrowded, often forming a circle about a free central space; spores pale orange, subglobose, .00066–.00083 in. in diameter.—Peck, 23 Rep. N. Y. State Mus., p. 60.

On *Comandra umbellata*: McLean, May 20, 4717, May 25, 4782, May 29, 4804, May 30, 4827, 4850; Champaign, June 10, 4955.

Æ. euphorbiæ, Gmel.

Hypophyllous. Æcidia uniformly scattered over the entire surface, short, the narrowly recurved border soon becoming pulverulent; spores subglobose to oblong, often irregular and angular, epispore rather thick, tuberculate, 12–15 by 15–24 μ ; spermagonia scattered among the æcidia or none, not found on the upper side of leaf.

On leaves of *Euphorbia polygonifolia*: Ravenswood, near Chicago, Oct. 11, 1883, J. C. Arthur. *E. hypericifolia*: Adams, June 29, 5350, July 6, 5430; McLean, July 7, 2432, July 27, 2431, Oct. 6, 1801; Tazewell, July 22, 2430; Piatt, Aug. 27, 1106. *E. maculata*: Kane, Aug. 30, 1374; McHenry, Sept. 1, 1414; Boone, Sept. 2, 1420; LaSalle, Sept. 16, 1548, 1549; Rock Island, Sept. 21, 1617, Sept. 24, 1651. *E. dentata*: Adams, July 6, 5428; Ogle, Sept. 26, 6182.

This occurs with *Uromyces euphorbiæ* in Nos. 1064, 1548, 1616, 2353, and 5428. The genetic connection has not been ascertained for our plants.

Persoon is often given as the authority for this name, but in his Syn. Fung., p. 211, he refers to Gmelin as the author. *Æ. Euphorbiæ-hypericifoliæ*, Schw., is probably a synonym.

Æ. crotonopsidis, Burrill.

Hypogenous, occurring upon the cotyledons, and less commonly on the caulicle and lower leaves. Spots distinct, dark-

colored, the affected cotyledons soon yellow; æcidia not numerous, irregularly clustered, short-cylindrical, becoming coarsely divided and widely spreading, pseudoperidium thin but firm; spores irregular, mostly elliptical, episore rather thick, tuberculate, 12-15 by 15-18 μ ; spermagonia very few, scattered, above.

On *Crotonopsis linearis*: Johnson, May 12, 4648, May 13, 4662, May 16, 4701.

Æ. urticæ, Schum.

Hypophyllous. Spots distinct, brown, border yellow; æcidia densely clustered, short, the narrow border abruptly turned, finely divided; spores subglobose, episore rather thin, sparsely tuberculate, 15-21 μ ; spermagonia minute, scattered, on the upper side of spot, reddish brown.

On *Urtica*: Warsaw, Ill., June 27, coll. C. A. Hart.

Æ. smilacis, Schw.

Hypophyllous. Spots large, circular, somewhat effused, pale yellowish, somewhat thickened; æcidia irregularly scattered or crowded, short, recurved border wide and rather coarsely divided; spores irregular, mostly angular, elliptical to oblong, episore thick, conspicuously tuberculate, 15-18 by 18-22 μ ; spermagonia rather numerous, scattered, mostly above, honey-yellow.

On *Smilax herbacea*: Ravenswood, near Chicago, June 29 (1883), J. C. Arthur.

Æ. trillii, Burrill.

Hypophyllous. Spots distinct or somewhat confluent, circular, effused, yellowish; æcidia densely aggregated around a free central circular space, sometimes with a more or less distinct outer circle later in development, short, pseudoperidium thin, fragile, soon after opening becoming pulverulent; spores subglobose, episore very thin, smooth, 19-24 μ ; spermagonia very numerous, rather prominent, scattered, central, on both sides of leaf.

On *Trillium recurvatum*: Union, April 24, 4251.

Differs from *Æ. convallariæ* in the more fragile and fugacious æcidia, and in the smooth, very much thinner episore.

Æ. convallariæ, Schum.

Hypophyllous. Spots distinct, or more or less confluent, lemon-yellow, scarcely thickened; æcidia loosely clustered, irregular or subcircinate, short-cylindrical, recurved border narrow and abruptly turned; spores subglobose or oval, sometimes angular, epispore thick, conspicuously tuberculate, 21-24 by 24-30 μ ; spermagonia numerous, scattered over the central area of the spot on both surfaces, dark reddish brown.

On *Smilacina*: McLean, May 26, 4797. *S. stellata*: McLean, June 1, 4885; LaSalle, June 19, 5224. *S. racemosa*: McLean, May 31, 4861, 4862.

RCESTELIA, REBENT.

Spores one-celled, in chains or vertical rows, without pedicels; sorus enclosed in an elongated, usually tapering, pseudo-peridium, which protrudes far through the ruptured epidermis of the host, and which becomes deeply split and fringed; with spermagonia. On species of *Pomeæ*.

Æcidia usually hypophyllous, lower part sunk in the swollen tissues of the leaves, forming above cylindrical, conical, or oblong projections, which are often split and fringed in the upper part, peridium composed of large colorless cells, spores brownish or orange-colored, subglobose when mature, formed in moniliform rows. Spermagonia punctiform, forming minute dark-colored pustules in discolored spots on the upper surface of the leaves. Mycelium infesting the leaves and stems of different *Pomeæ*.—Farlow, *Gymnosporangia* of the U. S. p. 24.

The forms included here are now supposed to be (like those of *Æcidium*) mere stages of development of other teleutosporous species, and perhaps all belong to *Gymnosporangium*. The genetic connection of the forms placed in these two genera was first shown by Oersted, of Denmark, in 1865, who satisfied himself, by artificially sowing the spores, of the relationship existing. His conclusions have since been confirmed by DeBary in Germany, Cornu in France, and Cramer in Switzerland; but nothing conclusive has been ascertained in our country save from the effects in nature of the proximity of the different hosts and their parasites. Professor Farlow's artificial cultures (The *Gymnosporangia* of the United States, p. 32, etc.) gave not only

negative results, but served to throw doubt upon previous conclusions. In Illinois one species only of *Gymnosporangium* has been collected (from *Juniperus Virginiana*), and wherever this has been observed near apple orchards the latter have been strikingly infested with *Ræstelia*. Unfortunately the specific type of the latter—from anatomical characteristics—cannot be confidently given at the time of this writing. It seems to be *R. lacerata*.

R. lacerata, (Sow.) Fr.

Æcidia hypophyllous, sometimes on the stems and young fruit, seated on the yellow pulvinate thickening of the leaves, slender, cylindrical or somewhat subulate, recurved, densely clustered, 5–30 together; peridia yellowish white, rather delicate, soon splitting and becoming fimbriate, the divisions not extending to the base of the peridium; cells of peridium narrow, 20 μ broad by 55–72 μ long; spores brownish, roundish-oblong, surface finely granulated, 19–24 μ in diameter. Spermagonia in yellowish spots on the upper surface of the leaves. (Farlow, *Gymnosporangia of the U. S.*, p. 30.)

On leaves of *Cratægus tomentosa*: Lee, Sept. 8, 5715; LaSalle, Sept. 13, 1509; Union, Oct. 31, 2141. *C. tomentosa*, var. *mollis*: Piatt, Aug. 17, 1122; LaSalle, Sept. 13, 1510, Sept. 13, 1528; JoDaviess, Sept. 18, 5980; Ogle, Sept. 26, 6193. *C. tomentosa*, var.: Piatt, Aug. 17, 1113; LaSalle, Sept. 12, 1472. *C. coccinea*: Kane, Aug. 30, 1385.

R. penicillata, (Sow.) Fr.

Same as *R. lacerata*, but *æcidia* smaller and frequently concentrically arranged, peridia splitting to the base, the divisions very numerous, revolute, fimbriate, formed of one or more rows of cells. (Farlow, *Gymnosporangia of the U. S.*, p. 30.)

On leaves of *Pyrus coronaria*: Tazewell, July 22, 2433, 2436; McLean, Aug. 1, 2435; Champaign, Aug. 13, 1042; Piatt, Aug. 16, 1082; McHenry, Aug. 20, 1161, Aug. 27, 1334; Lee, Sept. 8, 5714; Stephenson, Sept. 13, 5838; LaSalle, Sept. 14, 1522; JoDaviess, Sept. 15, 5910; Rock Island, Sept. 23, 1631.

PERIDERMIIUM, LINK.

Spores one-celled, in chains or vertical rows, without pedicels; sorus inclosed in a variously-shaped pseudoperidium, which protrudes through the ruptured substratum and bursts irregularly; with spermagonia. On *Coniferae*.

This so-called genus is composed of probable æcidioforms of *Melampsora*, *Chrysoomyxa* and *Coleosporium* species. The mycelium is, however, perennial in the bark and medullary rays of coniferous trees, from which the fruit-form may be annually produced during seventy or more years,—the parts of the host in the meantime becoming variously deformed, and the growth more or less seriously reduced.

Not yet observed in Illinois.

ENDOPHYLLUM, LÉVEILLÉ.

Spores one-celled, produced in chains or vertical rows, without pedicels, the sorus inclosed in a pseudoperidium immersed in the substratum; with spermagonia.

This genus was at first separated from *Æcidium* only on account of the immersed pseudoperidia, which, unlike those of the latter genus, do not protrude through the ruptured epidermis to form a separate cup-like organ; but later investigations have shown that the spores in germination emit a true promycelium bearing sporidia, altogether similar to the germination-development of the teleutospores of *Puccinia* and the other genera of *Uredineæ*. The mycelium in the newly affected plant survives the winter and fruits the next spring.

No species yet observed in Illinois. They may be looked for on various species of *Crassulaceæ*, and perhaps on those of *Euphorbiaceæ*.

G L O S S A R Y .

- Æcidioform*, *æcidiostage*, the first of the alternating fruit forms of numerous species of Uredineæ.
- Æcidiospores*, the spores of æcidia.
- Æcidium* (pl. *æcidia*), a generic name; also the cup-like organ characteristic of the genus.
- Amphigenous*, produced on various parts of a plant, especially on both sides of leaves.
- Apiculate*, furnished with an apiculus.
- Apiculus*, a short terminal point.
- Ascus* (pl. *asci*), a spore sack or case, formed of a single cell, from the protoplasm of which the spores are produced.
- Bullate*, puckered or crinkled; said of leaves in which the veins seem too short or too near together for the intervening substance.
- Capitate*, having a somewhat globular head.
- Cauline*, pertaining to the stem
- Circinate*, coiled like a watch spring, often used to indicate a circular arrangement.
- Clavate*, gradually thickened upward, club-shaped.
- Confluent*, united, running together.
- Constricted*, pinched or drawn in.
- Cotyledons*, the seed-leaves of plants.
- Cuneate*, *cuneiform*, wedge-shaped.
- Echinulate*, closely beset with little sharp-pointed prickles.
- Effused*, poured out, spreading.
- Epigenous*, produced upon or above, usually used synonymously with epiphyllous.
- Epiphyllous*, on the upper side of leaves.
- Erumpent*, breaking out, or bursting through.
- Excicati*, dried specimens.
- Ferments*, living organisms capable of changing, by their processes of nutrition, the chemical composition of organic substances.
- Ferruginous*, rust-colored.
- Fimbriated*, fringed.
- Flavescent*, growing yellow, yellowish.
- Fugacious*, early falling off.
- Fuscescent*, approaching fuscous or dark brown.
- Fuscous*, dark brown.
- Globose*, nearly spherical.

Grumulose, like clustered grains.

Host, the supporting plant, that upon which a parasite lives.

Hyaline, glass-like, transparent.

Hymenium, fruit producing surface.

Hypha (pl. *hyphæ*), a filament of a fungus. The vegetative hyphæ taken in quantity are called the mycelium.

Hypogenous, produced below.

Hypophyllous, growing from the under side of leaves.

Innate, growing inside or inclosed.

Laciniate, cut-fringed.

Lutescent, pale yellow.

Mucronate, abruptly pointed with a spine.

Mycelium, the vegetative filaments of fungi.

Nuclear, pertaining to a nucleus.

Nucleus, a differentiated portion of the protoplasm of a cell.

Pallescent, approaching pallid.

Pallid, of a pale undecided color.

Papilla, a small obtuse protuberance.

Papillate, covered with papillæ.

Paraphyses, sterile elongated organs bordering a sorus, or distributed among the spores.

Parasite, one living upon and drawing its sustenance from another.

Parasitic, having the characteristics of a parasite.

Parenchyma, a tissue of thin walled cells, mostly somewhat spherical.

Parenchymatous, composed of parenchyma.

Pathogenic, disease producing.

Pedicel, a foot stalk, the stem of a spore.

Peduncle, a stalk, sometimes used for the stem of a spore, but more commonly as the main stalk of a flower or flower cluster.

Peridium, a wrapper or covering. The membranous vessel inclosing the spores in *Acidium* is usually called a pseudoperidium, but for brevity the former is sometimes used.

Pilose, thinly covered with hairs which are long and weak.

Promycelium, the germinal filament of a teleutospore upon which sporidia are borne.

Pseudoperidium, a false peridium, the cup of *Acidium*.

Pseudopodia, false feet.

Pulverulent, powdery, covered with dust.

Pulvinate, cushion-like.

Punctate, dotted.

Recurved, bent backwards or outwards.

Reflexed, bent abruptly backwards or outwards.

Reticulately, in a net-like manner.

Rufous, red-brown.

Saprophyte, a plant living on dead organic matter.

Septate, divided by one or more partitions.

Septum (pl. *septa*), a partition wall.

- Sorus*, a spore cluster, or sometimes a cluster of spore cases.
- Spadiceous*, a bright clear brown.
- Spermagonia*, minute cysts or capsules containing spermatia.
- Spermatia*, exceedingly minute bodies produced like spores, and probably under certain circumstances capable of germination, produced in spermagonia.
- Spores*, a general term applied to the reproductive bodies of cryptogamous plants, differing from a seed in having no embryo.
- Sporidia*, reproductive bodies borne upon a promycelium, or as sometimes used, the spores produced in asci.
- Sterigma* (pl. *sterigmata*), foot-stalks of spores, usually applied to those of very minute size.
- Striæ*, longitudinal lines or marks.
- Striate*, having striæ.
- Subiculum*, the modified tissue of the host penetrated by the mycelium of a parasite.
- Subulate*, awl-shaped.
- Teleutoform*, the last or final fruit-form in the alternating generations of *Uredineæ*.
- Teleutospore*, the last spore of a series, the final spore.
- Testaceous*, brick-color, brownish yellow, orange yellow with much gray.
- Tubercle*, a small obtuse prominence.
- Turbinate*, top-shaped.
- Uredo*, a generic name, also one of the fruit-forms of *Uredineæ*, next before the teleutospore.
- Uredoform*, *uredospore*, see *Uredo*.
- Verrucose*, covered with little warts.
- Vertex*, the upper extremity, here applied to the whole top of a spore, while apex designates the point only.
- μ , one thousandth of a millimetre, about one twenty-five thousandth of an inch.
- I., II., III., the first, second and third forms of the fungus; or æcidium, uredo and teleutoform.

ERRATA.

Page 142, line 18 from bottom, for insidious read insidious.

Page 163, line 12, for **Rudbeckiæ** read **rudbeckiæ**.

Page 167, line 7, for 25–23 μ read 25–32 μ ; line 15, for **spharganii** read **sparganii**; line 5 from bottom, for **erytheronii** read **erythronii**.

Page 169, line 10, for **acuminatus** read **acuminata**.

Page 172, line 1, for *circeæ* read *circææ*; line 3, for Cda. read Car.; for *aculeata* read *podophylli*; line 4, after *flosculosorum* insert Roehl.

Page 173, lines 5 and 6 from bottom, for parenchymatous read parenchymatous.

Page 175, line 18 from bottom, for densey read densely.

Page 179, line 15 from bottom, for *Proserpinacea* read *Proserpinaca*; line 9 from bottom, for 24–66 μ read 24–36 μ .

Page 180, line 4, for marked read naked.

Page 181, line 5, for 23–45 μ read 30–45 μ ; line 18 from bottom, for *Æcidum* read *Æcidium*; line 3 from bottom, for **Kuhnæ** read **kuhnæ**.

Page 182, line 10, for *eupatoriodes* read *eupatorioides*.

Page 183, line 4 from bottom, for 25 read 24.

Page 184, line 9, for 169 read 180.

Page 198, line 9 from bottom, for **phragmites** read **phragmitis**.

INDEX TO HOST PLANTS.

<p>Abies 212</p> <p>Acorus calamus..... 167</p> <p>Actæa..... 223</p> <p>Agrimonia Eupatoria 220</p> <p style="padding-left: 2em;">parviflora 220</p> <p>Agrostis vulgaris..... 198</p> <p>Aletris farinosa..... 195</p> <p>Allium striatum 168</p> <p>Ambrosia 231</p> <p style="padding-left: 2em;">trifida185, 231</p> <p>Amorpha canescens..... 177</p> <p style="padding-left: 2em;">fruticosa 177</p> <p>Amphicarpæa monoica..... 226</p> <p>Andropogon199, 203</p> <p style="padding-left: 2em;">furcatus199, 203</p> <p style="padding-left: 2em;">scoparius199, 203</p> <p>Anemone cylindrica 172</p> <p style="padding-left: 2em;">nemorosa 222</p> <p style="padding-left: 2em;">Pennsylvanica..... 222</p> <p style="padding-left: 2em;">Virginiana 172</p> <p>Apocynum cannabinum..... 236</p> <p>Apple.....144, 145, 154</p> <p>Arisæma dracontium 166</p> <p style="padding-left: 2em;">triphyllum 166</p> <p>Asclepias cornuti.....163, 236</p> <p style="padding-left: 2em;">incarnata..... 164</p> <p style="padding-left: 2em;">tuberosa 164</p> <p>Aster..... 183, 216, 230</p> <p style="padding-left: 2em;">miser 183</p> <p style="padding-left: 2em;">Novæ-Angliæ..... 183</p> <p style="padding-left: 2em;">sagittifolius183, 216, 230</p> <p style="padding-left: 2em;">Shortii 183</p> <p>Barberry145, 154</p> <p>Bidens 232</p> <p style="padding-left: 2em;">frondosa 232</p> <p>Blephilia hirsuta..... 190, 191</p> <p>Borraginacæe 234</p> <p>Buckthorn 154</p>	<p>Calystegia sepium 193</p> <p>Carex 195</p> <p>Cephalanthus occidentalis..... 229</p> <p>Cereals 198</p> <p>Circæa alpina..... 180</p> <p style="padding-left: 2em;">Lutetiana.....179, 180</p> <p>Cirsium 187</p> <p style="padding-left: 2em;">discolor 187</p> <p style="padding-left: 2em;">lanceolatum 187</p> <p>Claytonia Virginica.....175</p> <p>Compositæ151, 130</p> <p>Comandra umbellata.....211, 237</p> <p>Coniferæ 241</p> <p>Conoclinium celestinum..... 182</p> <p>Crassulacæe 241</p> <p>Cratægus coccinea 240</p> <p style="padding-left: 2em;">tomentosa 240</p> <p style="padding-left: 4em;">var. mollis..... 240</p> <p style="padding-left: 4em;">var. 240</p> <p>Croton capitatum..... 213</p> <p style="padding-left: 2em;">monanthogynus 213</p> <p style="padding-left: 2em;">procumbens 213</p> <p>Crotonopsis linearis.....213, 238</p> <p>Cunila Mariana..... 190</p> <p>Cupressinæ..... 209</p> <p>Cynthia Virginica..... 188</p> <p>Desmodium 160</p> <p style="padding-left: 2em;">Canadense 160</p> <p style="padding-left: 2em;">cuspidatum 160</p> <p style="padding-left: 2em;">paniculatum..... 159</p> <p style="padding-left: 2em;">rotundifolium 160</p> <p>Dicentra cucullaria..... 223</p> <p>Diodia teres163, 228</p> <p>Dulichium spathaceum 196</p> <p>Elephantopus 217</p> <p style="padding-left: 2em;">Carolinianus 216</p> <p>Elodes Virginica157, 158</p> <p>Elymus Virginicus.....170, 200</p>
--	--

Epilobium angustifolium.....	213	Impatiens — (<i>continued</i>)	
coloratum	213	pallida	176
montanum	213	Ipomœa lacunosa.....	217
roseum.....	213	Nil	217, 218
Eragrostis pectinacea	201	pandurata	217, 218
Erigeron annuum	230	Juncus tenuis	168
bellidifolium	229	Juniperus Virginiana	210, 240
Canadense.....	229	Kuhnia eupatorioides.....	182
Philadelphicum	230	Lactuca	232
Erythronium	168	Canadensis	232
Eupatorium	231	Lathyrus ochroleucus.....	161
ageratoides	181	palustris	161
perfoliatum	231	venosus.....	161
Euphorbia	165	Leguminosæ	209
dentata	165, 237	Lespedeza capitata.....	161
heterophylla	165	hirta	161
hypericifolia	165, 237	procumbens	160, 226
maculata	165, 237	repens	160
polygonifolia	237	violacea	161
Euphorbiacæ	241	Lobelia puberula	188
Fraxinus viridis	236	syphilitica	188
Galium concinnum	181	Lophanthus nepetoides	191
triflorum	181	Lycopus Europæus	234
Gentiana puberula.....	193	Lysimachia ciliata	233
Geranium maculatum.....	224	lanceolata	233
Gilia	192	Mentha	190
Gooseberry, cultivated.....	227	Canadensis	190
Grasses.....	154, 169, 170, 198	Mitella diphylla	178
Hedysarum paniculatum.....	160	Monarda Bradburiana	190
Helianthus	185, 186, 217, 232	fistulosa	190
annuus	185	punctata	190
decapetalus.....	185	Muhlenbergia	197
mollis	185	Myosotis	234
rigidus	185	verna	234
Hepatica triloba	222, 223	Oats.....	154, 198, 200, 201
Hibiscus militaris.....	224	Oenothera biennis.....	227, 228
Hieraceum	187	linifolia.....	162, 227
Canadense	187	Osmorrhiza.....	180
Hordeum jubatum.....	198	brevistylis	180
Houstonia cœrulea.....	229	longistylis	180
Hydrangea arborescens	219	Panicum	201
Hydrophyllum appendicula- tum	235	capillare	201
Hypericum	157	crus-galli	202
mutilum	157, 158	pubescens	201
Impatiens	176, 225	virgatum	170, 201
fulva	176	Peltandra Virginica.....	166
		Pentstemon pubescens.....	233

Phænogams	152	Rubus — (continued,)	
Phaseolus diversifolius	162	strigosus	207
helvolus	162	villosus.....	178, 208, 220, 221
vulgaris	162	Rudbeckia laciniata.....	163
Phlox pilosa.....	235	Ruellia ciliosa	189
divaricata	192	strepens.....	189
Phragmites communis	199	Rye.....	200
Physalis viscosa	235	Sambucus canadensis	228
Pinus	212	Salix	214
Pistacea	159	cordata.....	214
Plantago Virginica.....	233	longifolia	214
Podophyllum peltatum	173	Scirpus atrovirens	197
Polemonium reptans.....	235	fluviatilis	169
Polygonum acre	194	validus	196
aviculare, var. erectum.....	164	Sedges	154
amphibium	194	Senecio	215
Pennsylvanicum.....	194	Seymeria macrophylla	189
ramosissimum	164	Sida spinosa.....	175
Virginianum	194	Silphium	231
Pomeæ	210, 239	integrifolium	184, 217, 231
Populus monilifera	214	laciniatum	231
tremuloides	214	perfoliatum	184
Potentilla	204	terebinthinaceum	184, 217, 231
Canadensis	205	Smilacina	239
Proserpinaca palustris	179	racemosa	239
Prunus Americana.....	177, 178	stellata	239
serotina	177, 178	Smilax herbacea.....	238
Virginiana	177	hispida	195
Psoralea floribunda	226	Solidago	217, 230
Onobrychis.....	225	altissima	216, 230
Ptelea trifoliata.....	225	cæsia.....	230
Pycnanthemum lanceolatum..	190	Canadensis	216
linifolium	190	gigantea	217
pilosum	190	latifolia	216, 230
Pyrus coronaria.....	240	rigida	230
Ranunculus abortivus.....	222	ulmifolia	216
repens	173	Sonchus arvensis	216
Red cedar.....	145, 154	Spartina cynosuroides.....	169, 199
Rhus.....	159	Sparganium eurycarpum	167
toxicodendron	158	Sunflower	151
Ribes rotundifolium.....	227	Taraxacum	187
Rosa	204, 207	dens-leonis	187
Rosaceæ.....	204	Tephrosia Virginiana	209
Rose	206	Tricuspis seslerioides.....	201
Rubus	204	Trillium recurvatum	238
occidentalis.....	220, 221	Urtica	238

Vaccinium	212	Viola — (<i>continued</i> ,)	
Vascular cryptogams.....	152	<i>striata</i>	174
Vernonia.....	217	Wheat.....	143, 145, 148, 154, 198, 199, 200
<i>fasciculata</i>	186, 216	Xanthium.....	231
Viola	174	<i>strumarium</i>	185, 231
<i>cucullata</i>	174, 224	Zea Mays	203
<i>delphinifolium</i>	224		
<i>pubescens</i>	174		

INDEX TO SPECIES.

ÆCIDIUM, 148, 155, 204, 219, 221, 230, 236, 239, 241	Æcidium — (<i>continued</i> ,)
<i>actææ</i>	<i>impatiens</i>
<i>anemones</i>	<i>Jamesianum</i>
<i>apocyni</i>	<i>leucospermum</i>
<i>asperifolii</i>	<i>leucostictum</i>
<i>asteratum</i>	<i>lithospermi</i>
<i>asterum</i>	<i>luminatum</i>
<i>calystegiæ</i>	<i>lycopi</i>
<i>cephalanthi</i>	<i>lycopsidis</i>
<i>Claytoniatum</i>	<i>lysimachiæ</i>
<i>columnare</i>	<i>Mariæ-Wiisoni</i>
<i>compositarum</i>	<i>myosotidis</i>
<i>convallariæ</i>	<i>nitens</i>
<i>crotonopsidis</i>	<i>œnotheræ</i>
<i>dicentræ</i>	<i>onobrychidis</i>
<i>diodiæ</i>	<i>orobi</i>
<i>dubium</i>	<i>pentstemonis</i>
<i>epilobii</i>	<i>Petersii</i>
<i>erigeronatum</i>	<i>plantaginis</i>
<i>euphorbiæ</i>	<i>podophylli</i>
<i>Euphorbiæ-hypericifoliæ</i> ...	<i>polemonii</i>
<i>fraxini</i>	<i>psoraleæ</i>
<i>geranii</i>	<i>pteleæ</i>
<i>graminis</i>	<i>punctatum</i>
<i>grossulariæ</i>	<i>pustulatum</i>
<i>helianthi-mollis</i>	<i>quadrifidum</i>
<i>hibisciatum</i>	<i>ranunculacearum</i>
<i>houstoniatum</i>	<i>ranunculi</i>
<i>hydrophylli</i>	<i>sambuci</i>
	<i>smilacis</i>

<i>Æcidium</i> — (continued,)	
<i>solani</i>	235
<i>solidaginis</i>	230
<i>symphyti</i>	234
<i>tenue</i>	181
<i>tracheliiifoliatum</i>	230, 231
<i>trillii</i>	238
<i>urticæ</i>	238
<i>verbesinæ</i>	231
<i>violæ</i>	174
<i>violæ</i>	224
<i>ASCOBOLUS furfuraceus</i>	158
<i>Autopuccinia</i>	171
<i>СЪОМА</i>155, 204, 215, 218, 219, 220	
<i>agrimonîæ</i>	219, 220
<i>Ari Virginici</i>	166
<i>Claytoniatum</i>	175
<i>elephantopodis</i>	217
<i>luminatum</i>	221
<i>lysimachîæ</i>	233
<i>miniata</i>	207
<i>nitens</i>	178, 120
<i>Calypptospora</i>	212
<i>Gœppertiana</i>	212
<i>CHRYSOMYXA</i>	156, 218, 241
<i>COLEOSPORIUM</i>156, 215, 219, 220,	
.....	241
<i>compositarum</i>	217
<i>ipomœæ</i>	217
<i>miniatum</i>	207
<i>ochraceum</i>	220
<i>senecionis</i>	215
<i>Solidaginis</i>	217
<i>sonchi-arvensis</i>	215
<i>Vernonia</i>	217
<i>CRONARTIUM</i>	156, 211
<i>asclepiadeum, var. thesii</i> ..	211
<i>comandræ</i>	211
<i>DARLUCA filum</i>	168
<i>Dicœoma</i>	178
<i>DOTHIDEA solidaginis</i>	217
<i>ENDOPHYLLUM</i>	154, 241
<i>Eupuccinia</i>	171
<i>GYMNOSPORANGIUM</i>155, 209, 239,	
.....	240
<i>macropus</i>	144, 210
<i>Hemipuccinia</i>	171
<i>Heteropuccinia</i>	171
<i>Lecythea</i>	177, 218
<i>Leptopuccinia</i>	171
<i>MELAMPSORA</i>156, 177, 211, 241	
<i>Biglowii</i>	214
<i>capreanum</i>	214
<i>crotonis</i>	213
<i>epilobii</i>	212
<i>Gœppertiana</i>	212
<i>Hartigii</i>	214
<i>medusæ</i>	214
<i>populina</i>	214
<i>salicina</i>	214
<i>vitellinæ</i>	214
<i>Melampsorella</i>	212
<i>Micropuccinia</i>	171
<i>PERIDERMIDIUM</i>155, 212, 241	
<i>abietinum</i>	218
<i>balsameum</i>	212
<i>columnare</i>	212
<i>pini</i>	215
<i>PHRAGMIDIUM</i> ...155, 171, 204, 206,	
.....	219, 221
<i>fragariæ</i>	204
<i>Hedysari</i>	160
<i>mucronatum</i>	205, 207
<i>rubi</i>	208
<i>rubi-idæi</i>	207
<i>speciosum</i>	206
<i>triarticulatum</i>	205
<i>Phragmospora</i>	212, 213
<i>Pileolaria</i>	158
<i>brevipes</i>	158, 159
<i>Podisma</i>	210
<i>PUCCINIA</i> ...148, 151, 153, 155, 157,	
.....	170, 176, 177, 178, 194,
.....	208, 218, 221, 241
<i>aculeata</i>	173
<i>aletridis</i>	194
<i>amorphæ</i>	176
<i>andropogi</i>	198, 202
<i>anemones-virginianæ</i>171, 172	
<i>angustata</i>	196
<i>arundinacea</i>	199
<i>arundinariæ</i>	199

Puccinia — (continued,)

asteris	163, 172, 182
caricina	196
caricis	172, 195
centaureæ	182
chærophylli	180
circææ	171, 179
cirsii	187
compositarum	187
conoclinii	182
convolvuli	192
coronata	170, 200
Ellisiana	203
emaculata	198, 201
flaccida	202
fiosculosorum	172, 186
galiorum	180
gentianæ	193
Gerardii	183, 184
glechomæ	191
glechomatis	191
graminis	145, 146, 148, 172, 197, 200
<i>Hedysari paniculati</i> ..	160
helianthi	151, 186
heterospora	175
hieracii	187
hyssopi	191
Kuhnii	181
lateripes	189
<i>Lespedezæ polystachyæ</i> ..	161
<i>Lespedezæ procumbentis</i> ..	161
lobeliæ	188
maculosa	188
Marie-Wilsoni	174
maydis	172, 203
menthæ	172, 189
<i>var. Americana</i>	191
microsperma	188
mucronata	206
<i>var. Rosæ</i>	206
myrrhis	180
nolitangeris	176
obecta	196
osmorrhizæ	180
Peckiana	178, 221

Puccinia — (continued,)

phragmites	198
physalidis	235
pimpinellæ	180
plumbaria	191
<i>var. phlogina</i>	192
podophylli	172, 173
<i>polygoni</i>	165
<i>polygoni-amphibii</i>	193
<i>Polygoni-Aviculariæ</i>	165
prenanthis	188
proserpinacæ	178
pruni-spinosæ	172, 177
ranunculi	172
rubigo-vera	199, 200, 234
scirpi	172
semeriæ	188
silphii	184
smilacis	195
solida	172
sorghii	203, 204
straminis	200
striæformis	200
tanacetii	151, 172, 185
<i>var. vernoniæ</i>	186
tenuis	181
tiarellæ	178
Tripolii	184
tripustulata	178
variabilis	187
Vernoniæ	186
veronicæ	189
violæ	174
<i>Wilcoxiana</i>	192
windsoriæ	197, 198
xanthii	184, 231
<i>Pucciniopsis</i>	171
RAVENELIA	155, 208
<i>glandulæformis</i>	209
<i>glandulosa</i>	209
<i>indica</i>	209
<i>stictica</i>	209
RÆSTELIA	155, 210, 239
<i>lacerata</i>	240
<i>penicillata</i>	240
<i>Thekopsora</i>	212

