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FEBRUARY, 1909

VOL. XXII, No. 11

THE OTTAWA NATURALIST

Published by The Ottawa Field-Naturalists' Club.

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ISSUED FEBRUARY 6, 1909.

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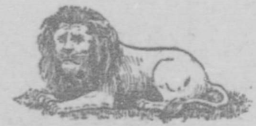

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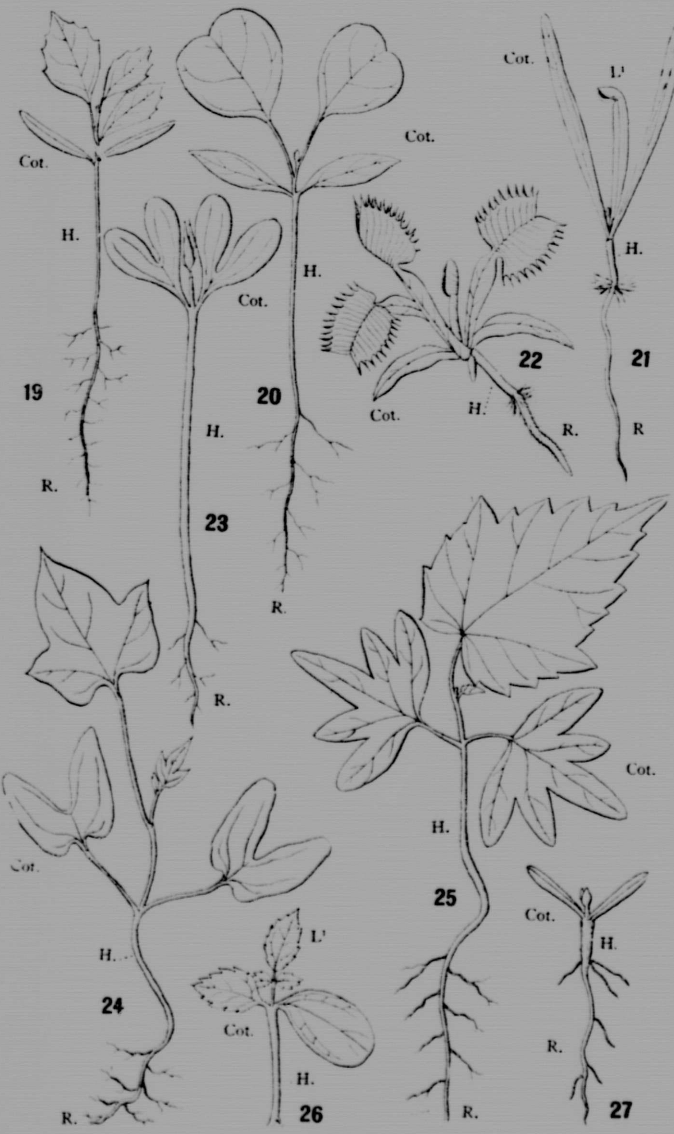

SEEDLINGS OF PHÆNOGAMOUS PLANTS

SEEDLINGS OF PHÆNOGAMOUS PLANTS.

THE OTTAWA NATURALIST

VOL. XXII. OTTAWA, FEBRUARY, 1909 No. 11

OBSERVATIONS ON SEEDLINGS OF NORTH AMERICAN PHÆNOGAMOUS PLANTS.

By Theo. Holm, Brookland, D.C.

(Continued from page 174).

In passing to describe some types of dicotyledonous seedlings, it might be stated at once that the majority of these possess epigeic cotyledons. There is, thus, a well marked distinction between the two classes *Monocotyledones* and *Dicotyledones*, consisting not only in the number of cotyledons, but also in the structure of these depending upon the different function which they have to perform. We have seen that in very many, really in most of the *Monocotyledones* the cotyledon has acquired a certain shape and internal structure for absorbing the endosperm, for instance the scutellum in *Gramineæ*, and the club-shaped organ in *Smilaceæ*, *Commelinaceæ*, *Scitamineæ*, etc., instead of being developed as a free, assimilating leaf as in *Alisma*, *Agave*, *Sisyrinchium*, etc. Such peculiar modifications of the cotyledonary leaves are not known from the *Dicotyledones*; in these they generally have the same function to perform as the proper leaves, to assimilate, or, sometimes, they are also the bearers of reserve food-substances, and are then either epigeic or hypogeic, especially the latter. Another striking contrast between these two classes is the usually much stronger development of the primary root, and of the hypocotyl in the *Dicotyledones*. Moreover, these two organs have, in the *Dicotyledones*, very often acquired a certain structure in accordance with their functions; for instance the primary root may be developed as a storage root, and the hypocotyl may, sometimes, attain quite a considerable increase in thickness and contain abundant deposits of food material, or its function may simply be to raise the cotyledons above the ground, thus liberating them from the seed-coat. In the *Monocotyledones*, on the other hand, the primary root seldom persists, and hardly ever as a storage root, and the hypocotyl is seldom developed to any great extent, and shows no modification to be compared with the one so frequently observed in the *Dicotyledones*. One of the most striking peculiarities noticeable in the seedlings of the *Dicotyledones* is the remarkable contrast between the shape of the cotyledons, especially the epigeic, and the final leaves, and it seems almost impossible to bring these into actual correlation. The diversity of form in the cotyledons is quite considerable, even if their shape be usually much simpler than that of the ultimate leaves, a simplification which may have been produced by arrest, rather than being an indication of leaf-forms that characterized the species in by-gone years, as suggested by some authors. Considered by themselves the epigeic cotyledons represent a multitude of forms, of which the following may be enumerated: "linear" in *Claytonia megarrhiza* Parry, *Menispermum Canadense* L., *Negundo aceroides* Moench, *Acer saccharinum* Wang; "narrow lanceolate" in *Platanus occidentalis* L.; "ovate" in *Vitis riparia* Michx., *V. æstivalis* Michx., *Ampelopsis quinquefolia* Michx., *Clitoria Mariana* L.; "obovate" in *Rhus copallina* L.; "obovate with auriculate base" in *Carpinus Caroliniana* Walt.; "oblong" in *Cornus florida* L., *Celastrus scandens* L., *Liquidambar Styraciflua* L.; "elliptic" in *Diospyros Virginiana* L., *Liriodendron Tulipifera* L., *Sanicula Marylandica* L., *Thaspium barbinode* Nutt.; "spathulate" in *Ambrosia trifida* L.; "oval" in *Rhus Toxicodendron* L.; "reniform" in *Hedeoma pulegioides* Pers., *Geranium maculatum* L.; "rotund" in *Cassia chamæcrista* L.; "bifid" with diverging broad globes in *Ipomæa leptophylla* Torr., *I. hederacea* Jacq.; "bifid" with diverging linear lobes in *Eschscholtzia Californica* Cham.; "palmately five-lobed" in *Tilia Americana* L., and finally "bipartite with diverging rounded lobes", making the leaf almost obcordate as in *Catalpa bignonioides* Walt. (Fig. 23); in *Aralia spinosa* L. (Fig. 26) the cotyledons are very unequal, the one being obovate, and entire, the other ovate with the margins serrate, thus imitating the outline of the leaflets of the mature tree; such distinction in structure is, otherwise, very seldom met with, while some modification in size, but not in outline, has been observed in cotyledons of several herbs. We have, thus, in the epigeic cotyledons a number of leaf-types which correspond with those of mature plants, herbs and trees, with the only exception, so far as I know, of the decompound. If we, on the other hand, examine the hypogeic cotyledons we notice in these hardly any variation worth speaking of, since these mostly remain enclosed by the seed; they are usually fleshy, entire, and vary only in length and width, from linear to oblong, etc.

To classify the dicotyledonous seedlings is a most difficult task, difficult to the same extent as it is to classify the mature plants within the frame of biologic types, where the organs of vegetative reproduction, and especially the subterranean, play such an important role. We might classify the seedlings in accordance with the position of the cotyledons, epigeic or hypogeic, and in accordance with the function of the hypocotyl; when the hypocotyl persists, the primary root generally stays active, but when it dies off, the root becomes replaced by secondary, which may develop from the node of the hypocotyl. Another modification may be noticed in the relative development of the primary root as an organ for storing nutritive matters for instance, sometimes accompanied by the more or less complete suppression of one of the cotyledons. Finally, the singular formation of a cotyledonary tube deserves, also, attention from a biologic point of view; besides that it has been made the subject of a most interesting treatise by Miss Ethel Sargant for defining the comparative antiquity of *Monocotyledones* and *Dicotyledones*.

The most simple type of dicotyledonous seedlings is undoubtedly the one in which the primary root persists, and stays as a nutritive root, and in which the main function of the hypocotyl is to raise the cotyledons above the ground, thus exposing them to the full effect of the sunlight. In this type the hypocotyl is straight and attains often a considerable length, much exceeding that of the subsequent internodes of the seedling; moreover, the hypocotyl does not increase in thickness beyond the continuous growth of the stele, the parenchymatic tissues remaining mostly unchanged. This type is exhibited by the majority of our trees and shrubs, furthermore by most of our herbs, and is evidently the most common. Some examples illustrating this type of seedlings may be seen in the accompanying plate, where *Platanus occidentalis* (Fig. 19), *Liriodendron* (Fig. 20), *Catalpa* (Fig. 23), *Ipomœa hederacea* (Fig. 24), and *Tilia Americana* (Fig. 25) have been drawn. These seedlings show, also, another point of interest, namely, the peculiar shape of the cotyledons, and the diversity in foliage when compared with the leaves of the mature plants.

As the second type, may be mentioned *Claytonia megarrhiza* (Fig. 27). In this the seedling is very small, and has the cotyledons raised above ground by a short hypocotyl; the primary root is long, and at first slender with a few ramifications, which are very hairy. At this stage two leaves, succeeding the cotyledons, are already visible, and the seedling is now ready to winter over. At the end of the first season the hypocotyl shows a distinct wrinkling by which the apical bud becomes pulled down beneath the surface of the ground, while the root continues its growth vertically and to a very considerable depth. In the following spring the leaves develop, forming a small rosette, while the hypocotyl, and the base of the root commence to increase in thickness, resulting finally in the formation of the very large root which characterizes the species. The plumule develops only a very short axis, and a few leaves, which winter over, and these become then succeeded by a small rosette surrounding the terminal bud, which is purely vegetative, the axis being a monopodium. A similar structure of the hypocotyl and primary axis may be observed in *Geranium maculatum* L. In this the hypocotyl increases in thickness so as to form a roundish tuber, and the apex of the axis is, also, here vegetative, developing a few leaves during the first season; the primary root persists, but does not increase in thickness to such an extent as in *Claytonia*. The seedling of *Baptisia tinctoria* R. Br., shows the same contraction of the hypocotyl and root as observed in *Claytonia*, but the primary shoot dies down to the cotyledons, and the vegetative reproduction is secured by the development of two overwintering buds, located in the axils of the cotyledons. In *Gillenia trifoliata* Moench (Figs. 36-37), in *Ceanothus Americanus* L., and *C. ovatus* Desf., the hypocotyl simply makes a bend toward the surface of the ground, and cotyledonary buds are, also, developed in these species, one in *Gillenia*, but two in *Ceanothus*, which replace the primary axis above the cotyledons; in these the hypocotyl and primary root persist for several years. We have, thus, in this type a hypocotyl whose function is first to raise the cotyledons and plumule above the ground, and afterwards either by contraction or simply by a bend to bring the overwintering bud or buds nearer to the ground for protection against the cold.

A third type is represented by *Ranunculus abortivus* L. (Figs. 34 and 35); in this the hypocotyl raises the cotyledons above ground, but soon afterwards it bends downward (Fig. 35) and dies off, together with the primary root. However, just before the hypocotyl and primary root cease to be active, a new root-system becomes developed from the cotyledonary nodus, and these secondary roots soon attach the seedling to the ground and nourish it. A mature specimen of this species, thus, lacks a tap-root; this manner of germinating was, also, observed in *R. recurvatus* Poir., and is undoubtedly common to several other species of the genus. The same is, furthermore, the case with *Sanicula Marylandica* L., while in several other Umbelliferæ, e.g. *Thaspium barbinode* Nutt., *Osmorhiza longistylis* DC., etc., the primary root develops as a persistent taproot with rapid increase in thickness. Somewhat different from this type is the germination of *Sarracenia purpurea* L., in which a very distinct tuft of long hairs develop at the base of the hypocotyl where the primary root begins; but also here the hypocotyl and primary root are of short duration as in *Ranunculus*. *Dionæa muscipula* Ellis (Fig. 22) belongs to the same type, and differs from most of the other Droseraceæ by the presence of a distinct primary root, which aborts in most of these. It is interesting to notice that the first leaf succeeding the cotyledons already shows the peculiar structure so very characteristic of *Sarracenia* and *Dionæa*.

In these types, mentioned above, I have shown some of the most striking modifications observable in the hypocotyl and the primary root, while the cotyledons themselves merely differ in respect to their shape. In the subsequent types, on the other hand, we shall see that some modification may, also, be noticed in these. Let us begin with *Dentaria laciniata* Muehl. (Fig. 30). Of the two cotyledons only one becomes raised above ground by means of its long petiole, while the other one is short-petioled with the blade enclosed by the seed*; the blade of the green cotyledon is obovate, large in proportion to the size of the seedling. We notice, furthermore, the short, slender primary root, which persists only through the first season. The hypocotyl is very short, and the plumule soon develops into a small, conical tuber, of which the first leaf generally pushes out during the first season as a long-petioled leaf with a green, mostly bicleft blade. In regard to the secondary roots, these show a very rare position since they break out from the axils of the cotyledons, one from each. In this way *Dentaria laciniata* represents a very interesting type of seedling, dicotyledonous, it is true, but with the normal development of only one of these. The European species of *Dentaria* are, also, interesting, since both cotyledons are hypogeic in *D. pinnata* Lam., but epigeic in *D. bulbifera* L., and *D. digitata* Lam. From this we learn that the structure of cotyledons may be very distinct even among closely related species.

A still more remarkable type is exhibited by *Podophyllum peltatum* L. (Fig. 31) in which the long petioles of the two cotyledons form a tube at the base of which the plumule is located; the primary root is well developed, and persists for several years. During the first season the seed-leaves are the only ones of the plant that are visible, the plumule staying dormant until next spring. This type is known from several other plants, and Miss Sargant has given quite a comprehensive list of these, from which the following may be enumerated: Several species of *Anemone*, *Trollius*, *Eranthis*, *Delphinium*

* A similar case has been observed and described by Hill in geophilous species of *Peperomia*.

nudicaule, *Aconitum Anthora*, *Leontice vesicaria*, tuberous species of *Oxalis*, *Megarrhiza Californica*, species of *Smyrnium*, *Bunium luteum*, *Chærophyllum bulbosum* (but not *Ch. procumbens*), *Dodecatheon*, species of *Polygonum*, and *Rheum*, and one of the *Compositæ*, namely *Serratula radiata*. However, as stated by Miss Sargant, short petiolar tubes are not uncommon among the seedlings of species allied to those enumerated above, for instance: *Ranunculus millefoliatus*, *Ferula fœtida*, *Serratula tinctoria*, *Rheum officinale*, etc.; these link the numerous species, in which the cotyledons are merely connate at the base, with those in which the cotyledonary tube is fully developed, and their existence is a strong argument for the derivation of such tubes from the fusion of two cotyledons.

As the last type of seedlings with epigeic cotyledons may be mentioned the so-called *Pseudo-monocotyledones*. Characteristic of these is the development of only one of the two cotyledons, the other one being completely suppressed. Members of this type are *Claytonia Virginica* L. (Fig. 33), *Erigenia bulbosa* Nutt. (Fig. 32) and *Dicentra Cucullaria* D.C. To these may be added, according to Miss Sargant: *Corydalis solida*, *C. cava*, *C. fabacea*, *Carum bulbocastanum*, *Cyclamen persicum* and *Pinguicula vulgaris*. In *Erigenia* the primary root soon commences to increase in thickness so as to form a round, tuberous body, and the single cotyledon,which consists of a long petiole and a simple, green blade is the only leaf that appears above ground during the first year. *Claytonia Virginica* germinates in the same way, but in this a leaf may appear in the first season, alternating with the cotyledon, and with the base partly surrounded by the sheath of this. *Dicentra Cucullaria* is described by Irmisch, and the cotyledon of this species possesses a blade with three very distinct divisions, a structure which otherwise is very seldom met with in cotyledons; it is the more peculiar since the blade of the cotyledon in the species of *Corydalis* is entire. It seems to be characteristic of these *Pseudo-monocotyledones*, with the exception of *Pinguicula*, that the subterranean organs (base of petiole, hypocotyl, or root) are more or less tuberous.

In passing now to describe some types of seedlings in which the cotyledons are hypogeic, I wish to state that even if this manner of germinating be very distinct from the one in which these leaves are epigeic, there are, nevertheless, some plants which exhibit a kind of transition between both. For instance, if we compare the cotyledons of *Phaseolus vulgaris*, which at first are hypogeic, but later on become epigeic and green, with those of *Phaseolus multiflorus*, which are hypogeic and pale, but turn green, when artificially exposed to the sunlight.

Very remarkable is the seedling of *Jatropha multifida* L., of which the cotyledons are distinctly petioled and by a long hypocotyl raised above ground, but of which the cotyledonary blades remain enclosed by the seed. In certain species of *Clematis* (*C. recta*) the cotyledons are normally hypogeic, but at times become epigeic.

Hypogeic cotyledons may remain enclosed by the seed all the time, or they might become freed from this and appear then as a pair of small, fleshy, pale leaves. Herbs as well as trees exhibit this manner of germinating, and characteristic of all is that the function of the cotyledons is only to be the bearers of reserve food-substances. The relative development of the primary root is somewhat different; furthermore, the hypocotyl, and the petioles of the cotyledons.

An interesting type is represented by *Megarrhiza Californica* Torr. In this plant the primary root does not commence to grow until the cotyledonary petioles have buried themselves deep in the ground, and these petioles are not only very long, but they are, furthermore, united so as to form a long tube, clothed with hairs which perform the same function as root-hairs.

Another type is characteristic of certain aquatics, e.g. *Nuphar*, *Nymphæa* and *Victoria*, in which the primary root increases but very little in length during the first stages of germination, its function becoming performed by a wreath of very long root-hairs developing from the base of the root as soon as the seed germinates. In *Nelumbium*, on the other hand, the root stays rudimentary, and does not even produce the wreath of hairs, so very characteristic of the others.

Sometimes the hypocotyl is well differentiated as in *Sanguinaria Canadensis* L. (Fig. 29), and we have here an interesting type with a persisting primary root (at least for some years), and a hypocotyl which by growing in thickness becomes the first joint of the large, horizontally creeping rhizome; the fleshy cotyledons soon leave the seed, but without being raised above ground. Furthermore, in this type the first leaf succeeding the cotyledons develops already during the first year, and shows the outline of the blade broadly cordate, and entire, instead of being prominently lobed as the final leaves. In *Phryma Leptostachya* L. the cotyledons do not leave the seed, and the hypocotyl is very short; the primary root develops as a long, somewhat fleshy root, which persists for some years. *Phryma* lacks a proper rhizome in the stricter sense of the word, since the vegetative reproduction is simply secured by cotyledonary buds in the first year, and later on by buds, which develop in the axils of the basal, scale-like leaves of the aerial shoot; it is a kind of rhizome which has been called a "pseudo-rhizome," and is known from many plants, especially with epigeic cotyledons, *Galium* for instance. To this type belongs, also, *Aristolochia Serpentaria* L. (Fig. 28), where the cotyledons remain enclosed within the seed; where the primary root is well developed, but where there is no hypocotyl, and finally where the vegetative reproduction is effected by only one bud arising from the axil of one of the cotyledons. *Aristolochia* differs from *Phryma* in another respect, by the first leaf succeeding the cotyledons being scale-like, instead of showing approximately the same structure of the final leaves as in *Phryma*.

The most frequent type is, however, the one in which the cotyledons may or may not remain within the seed, and where the primary root develops as a strong persisting root supporting the aerial, woody stem, as in many trees of various genera. *Sassafras*, *Lindera*, *Quercus*, *Aesculus*, *Prunus*, etc. In these the primary shoot remains as the only one, no cotyledonary buds being developed, and the earliest leaves may possess a distinct blade, or they may be developed merely as small, scale-like organs as in *Carya*, *Juglans*, *Sassafras* and others.

Finally may be mentioned the very singular seedlings of *Persea gratissima* Gärtn., and *Garcinia Cochinchinensis* Choisy. In the former the cotyledons are very large, and remain enclosed, each subtending an axillary bud, ready to develop, if the plumule should become injured. The plumule bears in this species two pairs of opposite leaves with petioles and small blades, while the succeeding five or six leaves are almost scale-like, and very different from the ultimate. *Persea* thus demonstrates the fact that in seedlings with enclosed hypogeic cotyledons, there may be an alternation of various forms of leaves, while in *Juglans* and *Carya*, for instance, all the first leaves are scale-like.

Still more remarkable is the seedling of various members of the *Guttiferæ*, especially of *Garcinia Cochinchinensis* Choisy. No cotyledons are developed, and the primary root soon dies off being replaced by a few very strong secondary roots, developing from the apex of the very large, bean-shaped hypocotyl. In this type the hypocotyl contains a broad parenchyma traversed by numerous resiniferous ducts, and filled with deposits of starch.

These dicotyledonous seedlings, thus, illustrate no small variation in respect to the development of cotyledons, hypocotyl, and root; furthermore, in regard to the young foliage succeeding the cotyledons. We have seen that in many trees, for instance *Carya*, *Sassafras*, *Quercus*, etc., the earliest foliage consists merely of scale-like leaves, while in *Liriodendron*, *Catalpa* *Platanus*

Tilia, etc., the leaves possess petioles and blades, but frequently of an outline very distinct from that of the final leaves. In *Liriodendron* for instance, the earliest leaves are very different from those of the mature tree; they are roundish to obovate, or even obcordate, and in the mature tree this simple type of leaf occurs only at the very apex or base of the branches. The study of this, frequently very striking, variation in foliage affords much of interest, not only from a morphological point of view, but also, and quite especially, because many of these seedling-leaves may be looked upon as still representing the foliage of ancestral types.

In the present paper I wished only to call attention to some of the most salient points observable in the seedlings, so far as concerns the external structure of their organs, and it is readily to be seen that even if the number of types is not very large, these seedlings nevertheless illustrate several interesting characteristics, indicating to some extent the future growth of the species. The study of mature rhizomes is often very difficult, when the seedling stage is not known; for instance, when the reproduction depends upon the cotyledonary buds; when the hypocotyl or the primary root, or both, actually become the first visible indication of the rhizome in its many, and highly differentiated modifications. It is, therefore, necessary to study our plants from this point of view, and I hope the few types which I have described may prove helpful in this respect. The literature upon the subject is very extensive, but there are some works in which very complete lists of papers have been compiled, and among these may be mentioned: Beiträge zur Morphologie und Biologie der Keimung by Klebs (1), and, A theory of the origin of Monocotyledons by Miss Sargant (2). In regard to the Grass-embryo there is a very comprehensive paper by Aug. Schlickum: Morphologischer und anatomischer Vergleich der Kotyledonen und ersten Laubblätter der Keimpflanzen der Monokotylen (3), in which the reader will find a well drawn comparison between the various theories that have been expressed in regard to this very complicated structure.

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(1). Untersuch. Bot. Institut, Tubingen, 1881-1885, p. 536.

(2). Ann. of Botany, Vol. 17, 1903, p. 1.

(3). Bibliotheca Botanica Stuttgart, 1896.

See also: B. Jönsson in Lund's Univ. Arsskr. Vol. 38, 1902; Arthur W. Hill in Ann. of Bot. Vol. 19 and 21, 1905-1907, and Sir John Lubbock, Contributions to the knowledge of seedlings, 1892.

EXPLANATION OF THE LETTERS USED IN THE PLATES.

Cot. = cotyledon; H. = hypocotyl; R. = primary root; L[1] = first leaf succeeding cotyledon; PL. = plumule; B. = bud; S. = scutellum; E. = epiblast.

EXPLANATION OF FIGURES.

Plate VII.

Fig. 19.	Seedling of	*Platanus occidentalis* L.		Natural size.
" 20.	"	*Liriodendron Tulipifera* L.		" "
" 21.	"	*Sarracenia purpurea* L.	6 x	" "
" 22.	"	*Dionæa muscipula* Ellis.	6 x	" "
" 23.	"	*Catalpa bignonioides* Walt.		" "
" 24.	"	*Ipomœa hederacea* Jacq.	⅔ of	" "
" 25.	"	*Tilia Americana* L.	⅔ of	" "
" 26.	"	*Aralia spinosa* L.	3 x	" "
" 27.	"	*Claytonia megarrhiza* Parry.		" "

Plate VIII.

Fig. 28.	Seedling of	*Aristolochia Serpentaria* L.		Natural size.
" 29.	"	*Sanguinaria Canadensis* L.		" "
" 30.	"	*Dentaria laciniata* Muehl.		" "
" 31.	"	*Podophyllum peltatum* L.		" "
" 32.	"	*Erigenia bulbosa* Nutt.		" "
" 33.	"	*Claytonia Virginica* L.		" "
" 34 and 35.		*Ranunculus abortivus* L.	3 x	" "
" 36 and 37.		*Gillenia trifoliata* Moench.		" "

GALL MIDGES OF THE GOLDENROD.

By E. P. Felt, State Entomologist, Albany, N.Y.

Goldenrod or Solidago, a dominant characteristic American genus, represented by numerous species and varieties, supports an extensive fauna. This is particularly true of the Cecidomyiidae or gall midges dependent for sustenance upon members of this extensive genus. Every portion of the plant is subject to levy, including the blossom and leaf buds, the leaves, the young branches, the larger stems and even the subterranean rootstock, some species producing galls on several portions of the plant. This is particularly true of *Asphondylia monacha* which may breed in apparently unaffected florets, inhabits the small apical rosette galls on the branches of *Solidago graminifolia* and may also be found in peculiar oval cells formed between two adherent leaves on several species of Solidago. These latter galls are evidently caused by the parent depositing eggs between the loosely apposed leaves of unfolding apical buds. The activity of the larva causes the leaf tissues to fuse around the point of injury and, as a result, the affected leaves adhere even after the natural growth of the plant separates their bases and causes them to assume an approximately horizontal position. The peculiar, long, fusiform galls of *Rhopalomyia fusiformis* and *Rhopalomyia pedicellata* may occur among the flower buds, arise from the leaves or even from portions of the stem, indicating that these two species in all probability have a somewhat extended breeding period. Goldenrod is a marked favorite with the genus *Rhopalomyia*, some 17 species existing at its expense and producing galls on all portions of the plant. Nine species of *Baldratia* may be reared from members of this genus all producing characteristic blister-like, apparently fungous affected, variously colored spots in the leaf tissues. The four species of *Lasioptera* reared from this genus live for the most part in goldenrod stems, while the peculiar *Camptoneuromyia adhesa* has been reared from the oval gall between adherent leaves noticed above, in connection with *Asphondylia monacha.* It is probable that further rearings would result in the discovery of additional species living upon goldenrod.

The following table of galls supplemented by extremely brief descriptions of the insects bred therefrom, will doubtless prove of service to any one interested in this subject. Members of the genus *Rhopalomyia* are usually rather large, reddish or reddish brown insects, easily recognized by the simple claws, the uni- or biarticulate palps and the stemmed antennal segments (in the male at least) bearing distinct whorls of hairs. The fraction following the number of antennal segments indicates the relative length of the stem of the fifth antennal segment, the length of the basal enlargement being the unit of length in every instance. Members of the genus *Lasioptera* and *Baldratia* are easily distinguished by the usually fuscous and white markings, and the dark scales along the anterior border of the wings, the first and second veins being very close to costa. The two genera are readily separated by the fact that *Lasioptera* has quadriarticulate palpi, while *Baldratia* has these organs uni- or biarticulate. Members of the latter genus breed almost exclusively in blister galls though a few may be found emerging from under the epidermis of nearly normal leaves. The genus *Camptoneuromyia* is allied to *Lasioptera* and easily distinguished therefrom by the strongly curved third vein which unites with costa near the distal third. The heavy bodied *Asphondylia* has long, cylindric antennal segments and a needle-like ovipositor.

Flower galls.

Gall greenish or reddish, subglobular, bud-like, 2 mm in diameter. Male, length 2.5 mm, yellowish red, 18-20 antennal segments, stem $\frac{1}{4}$.

Rhopalomyia racemicola O.S.

Gall green, cylindric, densely pubescent, 6 mm long. Male, length 2.5 mm, abdomen dark brown, 18-20 antennal segments, stem ¼. *Rhopalomyia anthophila* O. S.

Bred from an undescribed flower gall. Male, length 1.5 mm, abdomen light brown, 17 antennal segments, stem ¼. The female with 15 sessile antennal segments. *Rhopalomyia cruziana* Felt.

Bred from apparently unaffected florets. Adult, length 4-5 mm, dark brown, the tarsi broadly white banded. *Asphondylia monacha* O. S.

Bred presumably from apparently unaffected florets. Adult, length 4 mm, reddish brown, the tarsi fuscous yellowish. *Asphondylia johnsoni* Felt.

Leaf galls.

Apical bud galls.

Gall green, composed of loose, convolute developing leaves. Female, length 1 mm, abdomen dark brown, mid and posterior tarsi yellowish, 17 antennal segments. *Baldratia convoluta* Felt.

Gall a loose pod of adherent leaves. Female, length 1.25 mm; abdomen dark red, 15 antennal segments. *Dasyneura folliculi* Felt.

Apical rosette galls.

On *Solidago canadensis.*

Female, length 6 mm, abdomen dark brown, 24-25 antennal segments. *Rhopalomyia carolina* Felt.

Male, length 4 mm, abdomen fuscous yellowish, 21 antennal segments, stem ¾. Female 5 mm long. *Rhopalomyia albipennis* Felt.

Male, length 3 mm, abdomen fuscous yellowish, 16 antennal segments, stem 1¼. *Oligotrophus inquilinus* Felt.

On *Solidago canadensis* and *S. serotina.*

Male, length 2.5 mm, abdomen fuscous yellowish, 20 antennal segments, stem 1¼. Female, length 3-4 mm, abdomen fuscous red, 21 antennal segments, subsessile. *Rhopalomyia capitata* Felt.

Male, length 1.5 mm, abdomen fuscous yellowish, 20 antennal segments, stem 1¼. Female, length 2 mm, 19 antennal segments, stem ¾. *Rhopalomyia inquisitor* Felt.

On *Solidago graminifolia.*

Gall green, closely resembling that of *Oedaspis polita.* Adult, length 4 mm, dark brown, the tarsi white banded. *Asphondylia monacha* O. S.

Presumably bred from same gall. Female, length 1 mm, abdomen light yellowish, 16 antennal segments.
Lasioptera flavescens Felt.

A subapical or lateral oval gall. Male, length 2.5 mm, abdomen light yellowish, 17 antennal segments, stem $\frac{3}{4}$. Female, 15 antennal segments.
Rhopalomyia lanceolata Felt.

On *Solidago sempervirens*.
Asphondylia monacha O. S.

Galls attached to one, or at most, two leaves.

On *Solidago graminifolia*.

Gall greenish, red marked, ribbed, fusiform, sessile, length 6 mm. Male, length 2 mm, abdomen dark fuscous, 19 antennal segments, stem $\frac{2}{3}$. Female, length 3 mm, 18 antennal segments.
Rhopalomyia fusiformis Felt.

Gall green, red marked, fusiform, stemmed, length 13-14 mm. Male, length 2 mm, abdomen fuscous yellowish, 19 antennal segments, stem $\frac{1}{3}$. Female, length 3 mm, abdomen dark red, 18-19 antennal segments. *Rhopalomyia pedicellata* Felt.

On *Solidago rugosa*.

Gall green, red marked, fusiform, length 1.6 mm. Female, length 2 mm, abdomen dull red, 17 antennal segments. *Rhopalomyia clarkei* Felt.

On *Solidago canadensis* and *S. serotina*.

Oval galls between adherent leaves. Adult, length 1 mm, abdomen dark brown, 20-22 antennal segments.
Camptoneuromyia adhesa Felt.

Bred from similar galls. *Asphondylia monacha* O. S.

Bred from similar gall. Female, length 2 mm, abdomen silvery, 22 antennal segments.
Lasioptera argentisquamae Felt.

Blister-like galls occuring in leaf tissues.

Gall oval, black, on *Solidago graminifolia*. Male, length 1.5 mm, abdominal segments white margined posteriorly, tarsi banded, 16 antennal segments.
Baldratia carbonifera Felt.

Gall grayish brown, blue margined, on *Solidago squarrosa*. Male, length 1.5 mm, abdominal segments white spotted, 19 antennal segments.
Baldratia squarrosae Felt.

Gall rosy, on *Solidago rugosa*. Female, length 2 mm, abdominal segments white margined, posterior tars

narrowly annulate, 22 antennal segments.
Baldratia rosea Felt.

Gall oval, yellowish. Male, length 1.25 mm, abdomen light fuscous yellowish, 13 antennal segments.
Baldratia socialis Felt.

Female, length 1.5 mm, abdominal segments white margined, 16 antennal segments.
Baldratia fuscoannulata Felt.

Male, length 1.25 mm, abdomen reddish brown, 14-15 antennal segments. *Baldratia rubra* Felt.

Gall lunate, yellowish. Female, length 2.5 mm, abdomen dark brown, 21 antennal segments.
Baldratia flavolunata Felt.

Probably from blister gall. Female, length 1.25 mm, abdomen deep carmine,12 sessile antennal segments.
Dasyneura carbonaria Felt.

Elongate, brown leaf spot, possibly reared therefrom. Male, length 1 mm, pale yellowish, slender.
Lestodiplosis solidaginis Felt.

Male, length 1 mm, bright yellowish, slender.
Lestodiplosis triangularis Felt.

Stem galls.

On *Solidago graminifolia.*

Gall and adult described above.
Rhopalomyia fusiformis Felt.

Gall and adult described above.
Rhopalomyia pedicellata Felt.

Gall green, subglobular, near tip, 1.5 cm in diameter. Female, length 3 mm, abdomen dark brown, 19 antennal segments. *Rhopalomyia lobata* Felt.

On *Solidago*, various species.

Gall a long, uniform swelling of the stem, near the tip of the stem. Male, length 2 mm, abdomen white spotted, 15-17 antennal segments. Female, 21-22 antennal segments. *Lasioptera cylindrigallae* Felt.

Gall irregular, eccentric, usually near the base of stem. Adult similar to above.
Lasioptera tumifica Beutm.

Gall large, suboval, near the ground. Male, length 1.5 mm, abdomen reddish, 23 antennal segments, stem $\frac{2}{3}$. Female, length 4 mm. *Rhopalomyia hirtipes* O. S.

Galls bulb-like, at base of stem. Male, length 2.5 mm, fuscous yellowish, 18 antennal segments, stem $\frac{3}{4}$. Female, length 3 mm, abdomen pale yellowish.
Rhopalomyia bulbula Felt.

Gall stout, cylindric, on rootstock. Male, length 2.5 mm, abdomen brick red, 19 antennal segments, stem ¾. Female, length 4 mm, abdomen dark brown, 18 antennal segments. *Rhopalomyia thompsoni* Felt.

NEW MEMBERS.

The following have been elected ordinary members of the Club at recent meetings of the Council:—

Mrs. Oakeley, Ottawa.
Miss L. E. Hunt, Ottawa.
Mr. J. E. Smyth, Ottawa.
Miss M. Haldane, Ottawa.
Miss A. E. Johnston, Ottawa.
Mr. A. S. Cram, Ottawa.
Mr. H. R. MacMillan, Ottawa.

MEETING OF BOTANICAL BRANCH.

Meeting held at the home of Mr. A. E. Attwood, January 4th, 1909. Present: Mr. A. E. Attwood, Prof. John Macoun, Rev. G. Eifrig, Messrs. R. B. White, G. H. Clark, W. C. Ewing, H. R. MacMillan, F. H. Reed, D. A. Campbell, T. E. Clarke, J. W. Gibson, Jas. M. Macoun, W. Bond, H. Groh, and L. H. Newman.

The subject forming the basis for the evening's discussion was as follows:—"The Meaning of some Common Plant Names." Mr. Attwood introduced the subject by explaining how he had come to question the significance of certain names by which some plants had come to be popularly known. The first case cited was that of the word "acorn." This was shown to have come from "oak-corn," or "oak-grain," corn coming from the Latin "cornu," a horn—something hard and horny. "Corn" is also the term by which the most important grain of any country is known. Some of the more striking illustrations of the unique and interesting derivations of certain names are found in the following:—

POMEGRANATE, from *L. pomum*, an apple; *granatus*, having many grains or seeds.

CATKIN, after the domestic cat, and *kin*, meaning little; thus, a little cat or pussy, hence, pussy willow.

CABBAGE, from the Latin *caput*, a head.

CAULIFLOWER, cabbage flower, or possibly a corruption of the French *choufleur*.

NINEBARK, meaning a shrub with many layers of bark, the word "nine" being commonly used to express an unlimited number, as "nine-days' wonder."

SNAKEROOT, derived from the supposed efficacy of the plant to which the name is applied in curing snake bites.

BUCKWHEAT, or "beech" wheat, the grain resembling a beechnut.

SPEARMINT may be a corruption of spiremint, so named on account of the spire-like inflorescence of this plant; or it may have been suggested on account of the spear-shaped leaves which it produces.

STRAWBERRY is a corruption of strayberry, applied to this plant on account of its straggling habit of growth.

Altogether about 150 plant names were examined into and some exceedingly interesting revelations were brought to light respecting their derivation and meaning. Since Mr. Attwood has agreed to deal with this matter in a special article at a later date, we shall not refer to it at greater length at present.

Before the meeting adjourned Mr. H. R. MacMillan of the Forestry Branch was asked to speak briefly on some subject of scientific interest to foresters. The subject chosen was "Why a Forester should be a Botanist." It was pointed out that it was necessary for a forester to be acquainted with all branches of botany—systematic, physiological, histological and ecological. "A knowledge of systematic botany," continued the speaker, "is necessary because in making hasty examination of the resources of any locality, the forester must depend upon the development of the flora and the species represented for suggestions as to the possibilities of the region. A forester's crop is trees. In order to understand thoroughly their processes of growth, the phenomena of their reproduction and the development of their different organs, a detailed knowledge of plant physiology is necessary. Plant histology is another branch of botany which plays an important role in forestry, especially in the study of the utilization of woods. During past years attempts have been made to manufacture wood pulp from inferior species of timber, notably balsam and the cheaper resinous pines. That processes have been discovered that make the use of these trees suitable for the manufacture of paper is due to the close study that has been made of the structure of such woods, the discovery of the differences in their inner anatomy which stands in the way of their utilization, and the invention of processes to overcome the difficulties."

"That division of botany known as plant ecology is simply forestry minus the commercial element. Forests are great plant societies and it is the forester's business to learn what are the natural conditions which combine to form the habitat in which may always be found certain forest types. Having ascertained this, the forester decides upon the most important tree in that society and studies how best it can be reproduced. Forestry has for its object the reproduction of the most valuable species of timber on forest lands. Timber is reproduced by natural means wherever possible, by producing the conditions of light, soil and moisture upon which the plant, or tree in this case, thrives best. The problem is rendered more difficult by the fact that the conditions must be produced over large areas and without expense to the lumberman. For instance, spruce requires for natural reproduction shade, mineral soil and moisture. This tree is reproduced by so managing the lumbering operations that only the large trees are taken. The trees remaining furnish the shade and the seed; the logging operation tears up the ground, exposes mineral soil and a natural reproduction of young spruce is the result. If the reproduction is successful, it presupposes good botany; if it has not cost too much it has been good forestry."

After a short discussion on the remarks made by Mr. MacMillan,a number of very interesting botanical specimens were shown by different members of the Club. Some of these had been collected between 30 and 40 years ago from points around Ottawa at that time, but now covered by large public and private buildings. Mr. Eifrig showed specimens of charred apples and wheat, probably 3,000 years old, which he collected during the past summer at Lake Pfaffikon, Switzerland, near the ruins of the homes of the pile dwellers. These people built their homes and storehouses on piles over the water, presumably for the sake of protection. Some of these were burned in course of time, and the charred remains precipitated into the water, where they sank, and, being beyond the reach of air and also protected through being charred, have been preserved all these years.

L. H. N.

REVIEW.

FISHES OF ONTARIO.

Check List of Vertebrates of Ontario Fishes. By C. W. Nash (Lecturer on Biology, Ontario Dept. of Agric.); Education Department, Toronto, 1908.

A new work on fishes by a Canadian author is a rare event, and doubly welcome on that account. As far as this work goes it will be very useful, and there will be a great demand for it. Probably few persons are like the late J. A. Froude, the historian, who declared that, owing to their cold clammy character, fishes were repulsive to him. Most people find the finny tribes attractive whether gliding gracefully about in an aquarium, or tugging at the end of a baited line, or smoking hot on a dinner plate. Hence a book on fishes, especially if their metallic and varied forms be artistically depicted in illustrative plates, is coveted by everybody. It is surprising how deficient our Canadian literature is in this respect. We have almost unrivalled fish and fisheries, yet how few Canadian books to tell us about them. The issue of this handsome, well-illustrated work by the Board of Education, as one of the Series of Vertebrate Lists issued with the *imprimatur* of the Minister of Education, Toronto, is on every account notable.

Professor Ramsay Wright long ago prepared, as an appendix to the Ontario Game and Fish Commission Report, a description of economic fishes with plates, and it has been of high utility and value. The Fisheries Department of Ontario has also published more or less popular descriptions and plates of fishes in its annual reports. The most of the plates in these works have been reproductions of the well-known United States Fishery Bureau figures, which have been most widely and generously loaned by the Washington authorities. The late Mr. Montpetit, of Montreal, issued a book on our fresh-water fishes, but it had little scientific value.

Mr. Nash's book is very beautifully printed and contains 40 original drawings of fish, 32 being full-page plates and 8 small drawings in the text. The author has long been known for his skill as an artist and readers of the *Canadian Magazine* have been delighted with his sketches of birds and fishes. The present work shows him not only as an artist working *con amore*, but an accurate student of nature. The text is thoroughly scientific, and owes much, as all works on North American fishes must do, to the classic volumes of Jordan and Evermann. Had Mr. Nash relied more upon his own descriptive powers, as an ardent naturalist, his work would have had increased value. The technical descriptions by the famous American authors often hide rather than reveal the characters of the fish described. Mr. Nash might himself have described the common eel, for example, as "serpent-like in form, tail portion laterally flattened" but in this list the description of the genus runs "body elongate, sub-terete, compressed posteriorly, covered with embedded scales which are linear in form and placed obliquely, some of them at right angles to the others." The common bow-fin or lake dog-fish (*Amia*) has the "body oblong, compressed behind, terete anteriorly, head subconical anteriorly bluntish, slightly depressed, its superficial bones corrugated and very hard, scarcely covered by skin, etc., but these features apply to many other genera. Most of the existing works on American fishes have this grave fault that the descriptions of genera and species are overloaded with details not sufficiently diagnostic and of no aid in distinguishing a fish from its allies. They might as well include the further information that each respective genus and species is "permanently aquatic in habit." Now for one or two detailed suggestions. In the general definition of the Pisces (p. 7) the word "vertical" should be added to describe the plane in which the unpaired dorsal and anal fins stand. "The median line of the body with one or more fins" is not sufficient. The fine old Canadian name "Maskinonge" should have been used in this book rather than the United States Mascalonge, which is a non-descript term invented by tourist anglers who were ignorant of the origin of the word "Maskinonge" a *voyageur's* form of the Indian Mas, "great," and Kenosha, "fish." Hence the short form "lunge" is wholly misleading and arose from confusion with the French term for the great lake trout, viz., lunge (i.e. 'longe,' the long fish). As to the Gizzard Shad (*Dorosoma*), which Mr. Nash states has worked its way into Ontario from the Ohio and Mississippi valleys, through the canals, it is a native Canadian fish, and was recorded by the late Edward Jack on the St. John River, at Fredericton, N.B., and no doubt occurs in the St. Lawrence and doubtless also in the Ottawa River, where it appears to be called "whitefish" and is caught by anglers at the foot of the Chaudiere Falls. The Mooneye (*Hiodon*) also occurs in the Ottawa River, and ranges, as Mr. Nash states, from the St. Lawrence to Lake Superior. The author speaks of the Green Pike (*Lucius reticulatus*) as not apparently common; but probably more widespread than appears. This prettily marked species is found as far east as the Kennebeccasis River, N.B., and is scattered generally over eastern Canada.

The omission of some interesting species is to be regretted (such as Dr. H. M. Smith's *Coregonus osmeriformis*), especially as an introduced Pacific species, the Steelhead is described (p. 63) and twenty pounds specified as its maximum size. Jordan and Evermann name that weight, but specimens are plentiful in the Fraser River of twenty-seven up to thirty-six pounds weight.

The book is a catalogue of specimens in the Biological Section of the Provinical Museum and this limitation accounts for the exclusion of many species that should be found in a list of fishes of Ontario. Mr. Nash has found space not only for much faunistic information which the working naturalist will appreciate, but he includes notes on habit, food and distribution. He holds that the salmon feeds in fresh water, and the Ontario *Salmo salar* must have done so, though the salmon migrating from the sea ceases to feed, there can be no doubt. In British Columbia rivers there is not food for the vast schools of ascending fish, and in all no doubt as spawning time approaches they fast and the stomach is clogged with dense tenacious mucus, a result of a kind of catarrh as described by Dr. Noel Paton in the Scottish salmon, and familiar too in the lake whitefish. Tastes differ and Mr. Nash, in stating that the lake ling or burbot is considered worthless as food, cannot be aware of the opinion of many fishermen that there is no better food fish, the meat being white and of good flavour like the cod or haddock, its nearest relatives. The fall-fish (*Semotilus corporalis*) is served up as whitefish at some Ontario Fishing Clubs notwithstanding Mr. Nash's view that as a food fish it does not take high rank. It has good table qualities however.

It is plain that Mr. Nash's work is full of interest, but fishermen will dispute many points until the end of time. If a second edition is called for, as will certainly soon be the case, the value of the plates would be increased by clearly outlining in each figure the three or four gill-cover elements, and by indicating as correctly as possible the exact number of rays in the unpaired fins. The author is to be congratulated on the very few misprints; but on p. 9 *Icthyomyzon* should be *Ichthyomyzon*, on p. 63 *Cristimover* in two places should be *Cristivomer*, and on p. 118 *saggitatc* should *be sagittate*. The name of the authority should also be appended to each scientific name. Finally, the occurrence of other examples of *Polyodon* (the paddle fish) in Canada than the two mentioned, was noted in an article in the OTTAWA NATURALIST in 1899, p. 153, and the addition of an index would be an improvement. It is a most useful, indeed valuable, and creditable publication, and all interested in Ontario fishes will feel indebted to its author.

C.

PURE WHITE CALYPSO BOREALIS.

It may be of interest that a pure white Calypso was obtained by me at Thetis Lake last spring. I am not aware that such a specimen has previously been reported. I transplanted the bulb with the object of ascertaining whether the habit was constant but I fear that the hordes of robins which insisted upon scratching up the moss covering have destroyed the bulb.

J. R. ANDERSON, Victoria, B.C.

The Ottawa Field-Naturalists' Club, 1908-1909

Membership Fee to O.F.N.C., with "Ottawa Naturalist," $1.00 per annum