DECEMBER, 1903.
VOL. XVII, No. 9

THE OTTAWA NATURALIST.

Published by the Ottawa Field-Naturalists' Club.

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(ISSUED DECEMBER 5, 1903.)

OTTAWA, CANADA.
OTTAWA PRINTING COMPANY (LIMITED).
3 & 5 MOSGROVE ST.

Entered at the Ottawa Post Office as second class matter.

THE OTTAWA NATURALIST.

VOL. XVII. OTTAWA, DECEMBER, 1903. No. 9

BIOLOGICAL NOTES ON CANADIAN SPECIES OF VIOLA.

By THEO. HOLM.

(With two plates, drawn from nature by the author.)

In recent years North American, and especially Canadian, violets have attracted considerable attention on account of their very liberal contributions to the number of "undescribed species"; but it so happens that we have gained no further knowledge of the life-history of the genus than we already possessed from the time when the *Violaceæ* were studied from a thoroughly scientific point of view, when species were studied and treated as living beings with some power to adapt themselves to their environment and to vary, instead of as mere unnamed herbarium material. It really seems as if the species of *Viola* fared better at the time of Linnæus than they do now, for at that time they were at least classified in such a way as to become readily determinable, while in recent years the accumulation of supposed new species has gone on so rapidly as to leave the enumeration of these in anything but a systematic arrangement, with the omission of important morphological characters and regardless of natural affinities.

We naturally arrive at the conclusion that it would be more desirable and more beneficial to the study of natural science if we contented ourselves with a smaller number of species but well-defined and better appreciable from a biological view-point. The mere leaf-outline, the presence or absence of pubescence, the relative size and color of the perfect flower are deceptive characters, and even the position of the so-called "apetalous" flowers: aerial or underground, is far from constant. Systematic works, even of a very recent date, seldom contain anything new in the line of biology or morphology, since the authors generally content them-

selves with reproducing diagnoses that have been published long ago, instead of submitting the plants to a renewed study, whereby surely some new characters would be discovered; the only thing "new" to be found in such systematic works seems to consist in nomenclatorial changes: new combinations and new genera, based on specific rather than generic characters.

It is therefore to be hoped that Canadian botanists will undertake the work of studying such plants of their own, which need a revision, and, for instance, the *Violaceæ* would no doubt prove to be interesting from a biological view-point, besides that a close study of the various organs might reveal new characters of importance to the distinction of several critical species.[1] Some of these characters may be sought in the structure of both the perfect and cleistogamic flowers, in the leaf-variation, the structure of the rhizome and in the development of root-shoots. Having studied the genus from time to time, the writer thought that the publication of some observations upon the structure of these organs might be of some interest to Canadian botanists, besides that these notes might indicate the line of work to be pursued. We might begin with

THE FLOWERS.

Two kinds of flowers are known to occur in the genus *Viola*: the perfect, which we know is to be found in all the species, and the cleistogamic, which is far from uncommon, but which, nevertheless, seems characteristic of certain species, or perhaps better of certain sections of the genus; it is absent in *Viola pedata* and *tricolor* for instance. The perfect flower is, as we remember, hermaphrodite and zygomorphic, *i.e.*, symmetry in one plane; the sepals are prolonged backwards beyond their point of insertion, they are glabrous or hairy, often ciliate, and we have noticed much variation in their shape and in the length of their appendages; the corolla is polypetalous with the anterior petal larger and, sometimes, of a different outline from the others,

[1] The very work suggested by Dr. Holm is now being carried on at the Central Experimental Farm by Dr. James Fletcher, who has under cultivation there all the Ottawa species and many from other parts of Canada. The results of Dr. Fletcher's studies will doubtless be given to the Club when they have been completed.—EDITOR.

besides that it bears a spur of variable length. The five stamens are closely applied to the ovary; they have short filaments, and at their summit generally a membranaceous appendage formed by the prolongation of the connective; the two anterior stamens are provided with a spur-like nectary, which protrudes a considerable distance into the petaloid spur; this nectary shows several modifications in North American species and ought to be studied and described in the diagnoses. Finally, the ovary has a club-shaped style and bears the stigma in a groove on the anterior side.

These perfect flowers are, however, far from being always fertile, and it appears, from our own observations, as if they are sterile in a number of the acaulescent, purple-flowered species, at least in the vicinity of Washington, but whether these same species behave in the same way further north would be worth while determining. The other kind of flower, the cleistogamic, is often, but very incorrectly described as "apetalous," evidently from the fact that it has not hitherto been carefully examined in this country. The term "cleistogamic" is thus designated to such flowers as remain closed, in which the petals are merely present as rudiments or, sometimes, totally absent, and in which the stamens are reduced in number, besides that their anthers are small and contain but a few pollen-grains, which generally emit their tubes while still enclosed in the anther-cell. The pistil is in these flowers smaller than in the perfect ones, and the stigma is often scarcely developed. These flowers nevertheless produce a larger quantity of seeds than the perfect, and they have, in a number of cases, the power of burying themselves in the ground, where the seeds thus become ripened, or they are borne on erect, aerial peduncles like the perfect flowers.

Cleistogamic flowers are known from very nearly sixty genera, especially among the *Papilionaceæ*, *Acanthaceæ*, *Malpighiaceæ*, in certain species of *Oxalis*, *Lamium*, *Linaria*, *Drosera*, *Viola*, etc., while they are rare among the *Monocotyledones*: *Juncus*, *Hordeum*, *Leersia*, *Amphicarpum*, *Commelina*, etc.[1]

In the genus *Viola* these flowers were known already to Dillenius and Linnæus, which is readily to be seen from their

[1] Compare Darwin: Different forms of flowers, p. 310.

diagnoses of *V. mirabilis:* "*Viola* mo[illegible]a latifolia, flores ex radice, semina in cacumine ferens Dill.," and "*Viola* floribus radicalibus abortientibus, caulinis apetalis seminiferis Linn." But besides *V. mirabilis* a few other old world species of the genus are known to produce cleistogamic flowers as, for instance, *V. odorata*, *silvatica*, *canina* and *persiæfolia*, some of which have been described and figured by Professor Warming in his Manual of General Botany (1895. p 546.). The structure of the cleistogamic flowers is not, however, identical in all the species, and in regard to the North American species we have noticed some peculiarities, which may prove useful in the distinguishing of certain species.

The cleistogamic flowers remain constantly closed in the species which we have examined, and the general aspect is like that of *V. Macounii*, figured on our Plate IV, fig. 1, and the flower is nodding like the perfect. The sepals are normally developed and show a very prominent ciliation, but the petals are merely present in the shape of small warts; only two stamens are developed, (fig. 2) and in their natural position they are closely applied to the pistil. These stamens have large connectives, prominently denticulate along the margins, and the anthers are small and contain as usually only a few pollen-grains. The pistil has a short curved style, but no proper stigma is developed. These cleistogamic flowers of *V. Macounii* are sometimes buried in the ground, but at other times they are raised above the surface, borne on almost erect peduncles. It seems as if this varied position is due to atmospheric conditions; we have at least noticed that in several other species these flowers are only buried in the ground when the season is very warm and dry, while they develop above ground when the atmosphere is damp and cool. In *Viola papilionacea* the cleistogamic flowers are, thus, not always underground, and they differ from those of *V. Macounii* by having larger appendages on the sepals (fig. 5) and by these being glabrous. In this species there are, also, only rudimentary petals and only two stamens, which are somewhat larger than those of the former species. But in *V. sagittata* the cleistogamic flower is very much different. The appendages of the sepals (fig. 8) are long and narrow; the anterior petal is plainly developed

(fig. 9), and there are three stamens (fig. 12), of which, however, only two have both anther-cells developed. One of these stamens has always, as in the preceding two species, the connective folded around the style and stigma, as shown in figure 10, and the structure of the anthers and the connective is identical. The cleistogamic flowers are in this species, *V. sagittata*, constantly raised above ground on erect peduncles of quite considerable length, and it appears as if the position of these peculiar little flowers might constitute, if not a specific, then at least a sectional character. And in looking over the several species in which cleistogamic flowers occur, we notice that some of the acaulescent, woodland types: *V. papilionacea*, *Macounii*, and *villosa* show a tendency of burying the flowers in the ground, while the bog plants: *V. sagittata*, *blanda*, *lanceolata*, *primulæfolia*, *affinis* and *cucullata* always bear the cleistogamic flowers on erect peduncles; on the other hand, *V. emarginata* and *ovata*, both inhabitants of sandy, gravelly hill-sides, bear the flowers raised above the ground. This varied position observed in the cleistogamic flowers depends evidently upon the character of the substrate: humus, wet boggy ground or gravelly soil, besides that, the atmospheric conditions may not be excluded. If the flowers and fruits of the bog species were buried in the wet moss, they would, no doubt, be exposed to decaying, and it seems very natural that *V. affinis* always bears these flowers raised above ground, when it occurs in swamps or wet meadows, while it partly buries them in the ground, when growing in thickets, border of woods, etc.

Very peculiar is the mode of growth observed in *V. rotundifolia*. The perfect flowers are in this species plainly developed from the axils of the basal leaves: acaulescent, while the cleistogamic are borne in the axils of cauline leaves: caulescent; it appears as if the stems which bear the cleistogamic flowers in this species are mostly subterranean, but we have seen one instance, however, where a stem bore a few green leaves instead of merely scale-like. In *Viola orbiculata* it is interesting to see that two sets of aerial stems with green leaves and flowers develop in the same season, and that the flowers of the first set are perfect and very showy, though sterile, while the later developed are all cleistogamic and closed, but produce seeds.

While thus cleistogamic flowers appear to be common to a number of species of *Viola*, there are certain North American species in which they are absent, for instance, *V. pedata* and *rostrata*. In *V. striata*, *Canadensis*, *pubescens* and *glabella* we have observed a few instances where the last developed flower was merely rudimentary, but with no signs of producing any seeds, while such were produced by all the perfect ones on the same stem. And in *V. sarmentosa* we have not succeeded in detecting a single cleistogamic flower in our herbarium specimens, and not in *V. Langsdorfii* either. We hope, however, that Canadian botanists will re-examine these species in the field, more especially the two last mentioned, since it is very important to learn something about the structure of the cleistogamic flowers in general in others than those described above

VARIATION IN LEAF-OUTLINE.

When numerous leaves develop from the same bud as in the monopodial, acaulescent violets, certain variation becomes always more or less noticeable in the leaves. Those that develop first, before the flowers, are frequently different from the later ones, and in certain species, *V. papilionacea* and *palmata*, for instance, the first of these are generally cordate or reniform, but entire, while the later ones, sometimes, are more or less deeply lobed. In *V. sagittata* the variation in leaf-outline is quite considerable, and we have, sometimes, noticed a number of forms upon the same individual during one season, from the oblong-ovate to the lanceolate, with the base hastate, or from the deltoid, entire to the deeply lobed, the latter being characteristic of the so-called *V. emarginata*. Such variation seems largely due to the position of the leaves in the bud, but there are also, cases where the nature of the surroundings seems to affect the leaf-shape. *Viola emarginata*, for instance, does not develop the deeply cut leaves except when it grows in rich soil and in shade; in open places and in sandy soil the leaves become entire and often quite narrow like those of *V. sagittata*. *V. palmata* has always the later leaves deeply lobed, when growing in woods, while *V. papilionacea* shows a pronounced lobation, when observed in damp, shaded places, along creeks, etc.

The caulescent violets show but a slight variation, which m restricted to the mere serration or crenulation of the leaf margin. But the most conspicuous variation is to be observed in *V. pedata*, if we compare the leaves of the mature plant with those of the rootshoots. Some of these types of leaves are figured on our plate (Plate V, figs. 13-16), and we notice the great divergence between the normal leaf (fig. 13) and the smaller one (fig. 14), which was taken from a one year old specimen. In the rootshoots (figs. 15-16) the leaves show a tendency to becoming almost entire, and one would hardly have suspected them to belong to this species, if it were not for the fact that we succeeded in preventing them from breaking off when the mother-plant was lifted.

Considering these few but well marked cases of leaf-variation in *Viola*, we might suppose that several of the recently described new species, in which the outline of the leaf constitutes an important part of the diagnosis, may be referred to some single type with ability to adapt itself to the surroundings, and to exhibit a certain amount of variation. And we must remember that besides varying in leaf-outline these same species do, also, vary in respect to the pubescence, which is still more influenced by the conditions of the surroundings, character of the soil, light and shade, etc., and it can, of course, only be ascertained through prolonged study in the field whether such plants are sufficiently constant in their mode of growth so as to be considered as valid species.

THE RHIZOME.

Few organs are as constant in their structure as those which constitute the rhizome, the under-ground stem-portion, with its leaves and roots; yet it is very seldom that recent authors pay much attention to this part of the plant, when they describe new species; in regard to *Viola* it is generally passed by in silence. The following types of rhizome are observable in the Canadian perennial species of *Viola*:

A. Rhizome vertical, monopodial, leaves all basal with axillary flowers:

V. pedata.

B. Rhizome horizontal, otherwise as in A :

V. sagittata, affinis, Macounii, cucullata, palmata, papilionacea.

C. Rhizome horizontal or ascending, monopodial, with basal leaves from the axils of which aerial stems develop with leaves and flowers, but no stolons :

V. pubescens, glabella, orbiculata.

D. Rhizome a sympodial pseudorhizome with basal leaves, etc., as in C :

V. Canadensis, striata, rostrata.

E. Rhizome horizontal, monopodial, leaves all basal with axillary flowers and stolons with scale-like leaves :

V. Leconteana, primulæfolia, Selkirkii, blanda, lanceolata.

As may be readily seen from this table, the monopodial ramification seems the most characteristic, while the sympodial occurs only in a few species. Of these two kinds of branching, the monopodial is in *Viola* recognized by its continuous growth in one direction and by its terminal bud developing only leaves with axillary shoots : floral or vegetative, of which the latter continue the same development of leaves and without being terminated by a floral axis. These lateral shoots, however, do not attain the same length or the same strength as the mother axis, unless in cases where this becomes injured and dies off. It is thus characteristic of the monopodium that the terminal bud remains vegetative and for an indefinite period.

The sympodial rhizome is in *Viola* but sparingly represented, and as a matter of fact it does not occur as a true rhizome in the stricter sense of the word. We have called it a pseudorhizome, because the under-ground stem-portion is here (in *V. Canadensis*. etc.) only represented by the bases of the aerial shoots, from the lowermost leaf-axils of which buds develop, which in the following season grow out into above-ground shoots. But there is no under-ground mother-axis in these species, and, moreover, each bud becomes terminated by a floral shoot with cauline leaves and axillary flowers. And it is seen without much difficulty when we examine *V. Canadensis* that the fresh, flowering shoots are, always, borne upon the base of an old, withered stem from the previous year. One might suppose that *V.*

pubescens, *glabella* and *orbiculata* ought to be reckoned of the same group as *V. Canadensis*, but in these species as well as in the more southern *V. hastata*, the above-ground stems are readily seen to have developed directly from the rhizome and in the axils of leaves, pertaining to the terminal bud. In other words, their rhizome represents a monopodium just as typical as the one described above, with the only difference that in the one case only flowers develop, while flower-bearing stems develop in the other. These flower-bearing stems die down to the ground without leaving any basal buds for reproduction; this is secured by the terminal bud of the under-ground main-axis.

In *V. pedata* the rhizome is constantly vertical; it is rather short, but quite thick, and the primary root persists for about two years. In *V. papilionacea*, *affinis*, etc., the rhizome is horizontal, somewhat longer, but the internodes are barely visible. The thickness of the rhizome is in these species (B) as well as in *V. pedata* due to the swollen bases of the petioles, as we have described in a previously published paper.[1] In *V. primulæfolia* and its allies (E) the rhizome is quite slender, and these species are characterized by their more or less profuse development of long, very slender, subterranean stolons, each of which becomes terminated by a rosette of leaves like the mother-shoot, and in which the same monopodial branching takes place.

The peculiar instance of both caulescent and acaulescent flowers developed upon the same rhizome is illustrated by *V. rotundifolia*, as described above. However, our material was rather scant of this species, thus we were unable to make out whether the cleistogamic flowers are borne on stems that are aerial or subterranean under normal conditions.

In *V. sarmentosa* we have a type which is very different from all the others on account of its sarmentose habit. The stolons are, as it appears from our dried material, always above ground, inasmuch as they all bear typical stem-leaves, but scattered, not forming a rosette as in the monopodial species. None of our specimens showed any rhizome, but they were all developed from stolons, which had rooted and become separated from the mother

[1] Memoirs of the Torrey Botanical Club. Vol. 2, No. 3, p. 66.

plant. Canadian botanists are urgently requested to study this species in order to explain its mode of growth from young to adult stage, and especially to demonstrate the structure of the rhizome and of the cleistogamic flowers, if such are present.

In comparing the rhizomes of these Canadian violets with European species, it is interesting to notice that there is only one, *V. mirabilis*, which exhibits the same growth as *V. rotundifolia*, and that these two species are not to be considered as near allies, since the former has the flowers light purple, the latter, on the contrary, yellow. In *V. odorata* the rhizome is monopodial and the flowers as in our acaulescent species, but there are also runners, which stay above ground and which develop rosettes of leaves at their apex, thus repeating the growth of the mother-rhizome. The caulescent *V. sylvatica* and *V. Riviniana* agree in all respects with *V. pubescens* and its allies, while the pseudo-rhizome of *V. Canadensis* is readily recognized in the European *V. canina*, *stagnina*, *elatior* and a few others, which have been described by Professor Hjalmar Nilsson.[1]

THE ROOTS.

The primary root persists for about one season in these perennial species of *Viola*, but is soon replaced by adventitious, which in the monopodial types develop from the base of the petioles from four to five together, or scattered along the internodes of the stolons, as in *V. primulæfolia*, etc. These roots are usually of two kinds: nutritive and storage, of which the latter are quite common in the monopodial species of the groups A, B and C; they are not very thick, however, but possess, nevertheless, a large parenchymatic tissue of the cortex with an abundance of starch, and correspond well with this type of root as described by Dr. Rimbach.[2] No contractile roots were observed.

THE ROOTSHOOTS.

This form of shoot has only been observed in *V. pedata*, as described above, and we might state here, that the shoots develop at the tips of the roots and that they remain in connection with

[1] Acta Universitatis Lundensis. Vol. 19. 1882-83, p. 205.

[2] Berichte deutsch. botan. Gesellsch. Vol. 17. 1899, p. 18.

the mother-plant for at least two seasons; they commence to bloom in their second year. But in no other American violet have we, so far, detected rootshoots, and they are not very well known among the old world species either. Wydler and Irmisch noticed them in *V. sylvatica, Riviniana* and *canina*, and Professor Warming found them in *V. elatior*.[1] It would seem that they might be found among the corresponding American homologues, viz: *V Canadensis, striata* and *rostrata*, and perhaps also in the species of the group C.

In considering the means of propagation, floral and vegetative, as possessed by these Canadian species of *Viola*, it seems as if those of the group E (*V. primulæfolia*, etc.) are the best equipped, since they produce stolons and develop seed-producing flowers besides; these species are, thus, able to wander and spread themselves over a larger area than the others, in which stolons do not occur. *Viola pedata*, with its short and plump, vertical rhizome, is, nevertheless, possessed of some power to wander by means of the rootshoots. But in all the other groups (B, C and D) the structure of the rhizome does not enable the individual to spread over any large area, and the principal distribution is in these species secured by the seeds, which are ejected with much violence and thrown to a great distance by a peculiar mechanism of the carpels. This manner of dispersing the seeds becomes, of course, much impeded when the cleistogamic flowers bury themselves; it may be for this same reason that the bog-species have their pods raised high above the wet, mossy substrate, by which the dispersion of the seeds become better secured than otherwise.

Brookland, D.C., September, 1903.

EXPLANATION OF PLATES.

PLATE IV.

Fig. 1—*Viola Macounii*. A cleistogamic flower, magnified.

Fig. 2—Same species. A cleistogamic flower laid open, showing five sepals, rudimentary wart-like petals, two stamens and the pistil, magnified.

Fig. 3—Same species. The pistil and the two stamens in their natural position, magnified.

[1] Botan. Tidsskr. Ser. 3. Vol. 2. Copenhagen, 1877-79, p. 63, and Botan. Notiser. Lund., 1884, p. 32.

Fig. 4—Same species. The apex of the pistil with the style and stigma, magnified.

Fig. 5—*Viola papilionacea*. A cleistogamic flower, with the sepals, excepting the appendages, removed ; the petals are represented by small, wart-like organs, and the stamens are closely applied to the pistil, magnified.

Fig. 6—Same species. A stamen showing the two anther cells and very large, ciliate connective, magnified.

Fig. 7—Same species. The pistil, magnified.

Fig. 8—*Viola sagittata*. A cleistogamic flower showing only the long appendages of the sepals and the pistil, magnified.

Fig. 9—Same species, showing a small petal, the anterior, two stamens and the pistil, magnified.

Fig. 10—Same species. The pistil and a stamen, magnified.

Fig. 11—Same species. A stamen with the anthers very irregularly opened, magnified.

Fig. 12—Same species. The three stamens of the flower, magnified.

PLATE V.

Fig. 13—*Viola pedata*. A typical leaf, of an old specimen collected in the month of August. Natural size.

Fig. 14—Same species. A leaf, one of the earliest developed, of a young specimen, one year old, collected in the month of April. Natural size.

Fig. 15—Same species. A rootshoot, collected in the month of June. Natural size.

Fig. 16—Same species. A rootshoot, collected in the month of June, showing various forms of leaves. Natural size.

ADDITIONAL NOTES ON SOME CANADIAN SPECIMENS OF "*LITUITES UNDATUS.*"

J. F. WHITEAVES.

Since the publication of a previous paper on this subject, in the October number of this journal, additional information has been obtained in regard to some of the questions discussed in it.

In the first place, Dr. W. Y. M. Woodworth, curator of the Museum of Comparative Zoology at Cambridge, Mass., has kindly lent the writer the types of Hyatt's *Plectoceras obscurum*, so that it has now become possible to make a direct comparison between them and a large series of presumably authentic specimens of *Plectoceras Halli* (Foord). Such a comparison has resulted in the conviction that, although *P. obscurum* may be, and doubtless is, quite distinct from the *Inachus undatus* of Emmons, which Hyatt calls *Eurystomites undatus*, there is no appreciable difference, either in external form, in the surface markings, or in the shape and position of the siphuncle, between *P. obscurum* and *P. Halli*. The types of *P. obscurum* are three in number, one a comparatively perfect specimen from the Black River limestone at Watertown N.Y., marked 2077; and the others, two fragments from the Birdseye limestone at Watertown, each marked 2078. The specimen marked 2077 has nearly the whole of one side worn away, but the other side shows the general shape of the shell and its surface markings very well. It is about three inches and a half in its maximum diameter and consists of two entire whorls. The inner whorls, if there were any, are not preserved. Both sides of the specimen show that the whorls are at first so closely coiled that the inner half of the outer whorl is in close contact with the one that immediately precedes it, but that its outer half is free and slightly uncoiled. At the anterior end of the shell, the outer whorl is about twelve millimetres apart from that which immediately precedes it. And it would seem to be the body chamber, which occupies rather less than one-half of the outer whorl, that is free and separate. The surface markings are precisely similar to those of the fine specimens of *P. Halli* collected by Mr. Weston at Lorette. On the worn side all the septa but the last are obliterated, and the shape and position

of the siphuncle are not at all clearly shown. A label, in Hyatt's hand-writing, however, which accompanies the specimen, states that the siphuncle is "marginal and ventral" as it is known to be in *P. Halli*. The two fragments marked 2078 show neither the external form of the shell, the outline of the transverse section, nor any of the surface markings. One of these is a little more than about one-third of the outer whorl of a specimen which has been worn down in such a manner as to show a longitudinal section of the body chamber and of the last five septa, which average from five to five and a half millimetres in their greatest distance apart. The other shows scarcely anything, except that the venter is much flattened.

In the second place, *Plectoceras Halli*, which seems to be a very characteristic fossil of the Black River limestone, has now been found at two localities near Ottawa city. The first of these is Lot 4, Concession 3, Rideau front, Gloucester, where the specimen referred to in a former paper was found by Mr. Walter R. Billings. The second is Mechanicsville, on the Ontario side of the Ottawa River at La Petite Chaudière rapids, where a specimen which shows both the surface ornamentation and the position of the siphuncle remarkably well, was found by Mr. J. E. Narraway in October last.

In the third and last place, on a tablet in the Museum of the Geological Survey there are four fossils from the Black River limestone at St. Ambroise, P.Q., collected by Sir W. E. Logan in 1852, that are still labelled "*Lituites undatus*." Three of these are apparently small specimens of *Plectoceras Halli*. The fourth is clearly neither that species nor *Eurystomites* (or *Plectoceras*) *undatus*. It is unfortunately not more than an inch and a quarter in its maximum diameter and does not show the position of the siphuncle, so that it is quite uncertain to what genus it should be referred. A similar but rather larger specimen, which also does not show the position of the siphuncle, has quite recently been found by Mr. Narraway in the Black River limestone at Tetreauville. Both of these specimens are apparently gyroceraconic, with laterally compressed whorls, and their surface markings consist of thin sharp ribs, with shallowly concave spaces between

them. These ribs curve concavely and rather widely forward on each side, and narrowly and convexly forward on the venter.

It would therefore appear that in Canada the true *Inachus undatus* of Emmons, which Hyatt refers to *Eurystomites* but which may be a *Plectoceras*, has only been found near Kingston, in the Black River limestone. Also, that all the specimens from that formation in the Province of Quebec which have been called *Lituites undatus*, and similar specimens from the Black River limestone near Ottawa, are either *Plectoceras Halli* (Foord) or an at present undetermined and possibly undescribed species, whose generic relations have yet to be ascertained. And that *Plectoceras obscurum* is a synonym of *P. Halli*.

ERRATA IN PREVIOUS PAPER.

On page 119, line 11 from bottom, for "losely" read loosely.
,, 120, line 9 from bottom, for "1861" read 1891.
,, 121, line 2 from top, for "*P. Foordi*" read *P. Halli*.
,, 121, line 7 from top, for "sipuncle" read siphuncle.
,, 121, line 8 from top, for "specimen" read species.
,, 121, line 9 from bottom, for "surtural" read sutural.

Ottawa, Oct. 20th, 1903.

BIRD NOTES.

CANADIAN RUFFED GROUSE (*Bonasa umbellus togata*).—An incident illustrating the velocity of flight of the ordinary so-called Birch Partridge of this district, occurred in the middle of September last. As I was sitting at my office desk, I was startled by a loud crash of glass close above my head, accompanied by a shower of fragments. Upon examination, I found that one of the above-named birds had flown through the window. The pane broken was of thick double diamond glass, 3 ft. 4 in. long by 1 ft. 7 in. wide. The bird had been raised by a dog, about fifty yards from the building, and had flown straight at the window, possibly thinking it was an opening through which it could escape. The velocity was so great that the bird was killed almost instantly, and the breast bone and furcula or wish-bone were crushed.

PINE GROSBEAK (*Pinicola enucleata*).—On October 30th, on a lawn at the Central Experimental Farm, I saw and watched closely for some time a small flock of about a dozen Pine Grosbeaks, which were busily engaged eating the seeds of the small

Asiatic maple (*Acer Ginnala*), the fruit of the Berry-bearing Crab (*Pirus baccata*), and the berries of the Mountain Ash. None of these birds had the rich plumage of the adult male. I cannot remember in previous years noticing any of these birds so early in the autumn. Mr. Harrington, however, tells me that he saw about a hundred of them on the ground and in the trees along Meech Lake, Que., on the previous Sunday, October 18th. Mr. W. E. Saunders also saw them at Rat Portage in October, but this last named locality is of course much nearer to their breeding grounds than we are.

The chief object of this note is not, however, so much to record the occurrence of these birds as to urge the members of the Field-Naturalists' Club to try and prevent the senseless destruction by thoughtless boys of these beautiful and delightfully tame winter visitors. They are so tame and confiding that without the slightest difficulty they can be approached within six or eight feet. We have far too few of our bird friends which visit us in the winter, and all should do their utmost to protect those few which do come to us, as our guests, for food and shelter, in winter time.

Very few boys are really cruel ; but nearly all are ill-informed concerning the common objects of the country. Pointing out that a thing is wrong seldom has the effect of preventing boys from doing it; but might we not appeal to them by pointing out the cowardice of killing such beautiful and gentle creatures as these little birds, which do not make an effort to protect themselves and trust us so much, as hardly to get out of our way when we come within a few feet of them? Catching these wild birds and putting them in a cage is practically destroying them, because very few of those caught will live in a cage, and they are perhaps the least suited of all of our wild birds to be kept in captivity. Although the soft notes are charming when heard in a state of nature, the song is not such as would justify anyone for keeping the Pine Grosbeak in captivity. As cage-birds, they are large clumsy birds which scatter their food and make a great mess, and they soon become uninteresting to their captors. Lastly, they are Arctic birds which only come south in the winter, and, although with great care they may be kept through a summer, with the exception of perhaps one in a thousand, all die as soon as the hot weather comes.

JAMES FLETCHER.

NATURE STUDY—No. VIII.

THE PROPOSED COURSE IN NATURE STUDY FOR PUBLIC SCHOOLS.

S. B. SINCLAIR, Ph.D.

At the annual meeting of the Ontario Education Association in Toronto last Easter, a draft of "proposed changes in the Public and High School Courses of Study" was submitted for consideration, and in all probability these changes (with minor modifications) will come into effect at an early date.

In this scheme it is proposed to make a somewhat definite course of Nature Study compulsory for all classes in Public Schools, and to insist that all Public School teachers take an extended course of training in Natural Science before entering the Normal School. This forward movement cannot fail to be of interest to every reader of THE NATURALIST, and in future discussions it may be of value to know something of the content and sequence of the Nature Study material which is to be dealt with in the Public School.

The following is a brief outline of the proposed Course of Study for the first four classes :

FORM I.

NOTE.—From the character of Nature Study, the course therein must be more or less elastic, and a selection should be made therefrom subject to the approval of the Inspector. The acquisition of knowledge should be secondary to the awakening and preserving the pupil's interest in nature, and to training him to habits of personal observation and investigation. The topics are suggested as suitable ones from which a course which will meet the conditions of the school may be selected ; but the treatment must be suited to circumstances, age, and experience of learners, and to the seasons of the year, accessibility of materials, etc.

Animal Life : Habits of pet animals, their care and food ; domestic animals on the farm, their care, habits and uses ; birds, their nesting, song, food, migrations in the autumn ; metamorphosis of a few conspicuous butterflies or moths.

Plant life : Work in school garden ; study of a plant, as a geranium or pansy, from slip or seed to flower; caring for plants in pots ; buds, their preparation for winter, their development ; autumn leaves, collection, forms, tints; economic fruits, collection, forms, how stored for winter, fruit as seed holders, dissemination

of seeds ; roots and stems, comparison of fleshy forms, uses, how stored for water.

Life on the Farm : Harvesting, primitive and modern methods compared ; preparation for winter ; the barn and its uses ; activities of the farm during winter ; winter sports and social life on the farm ; the varied operations of spring time.

Observations of rain, snow, and frost ; spring time as awakening to new life, effects of sun and moisture on the soil.

FORM II.

Course of Form I. continued. Animal Life. Life history and habits of domestic animals and familiar wild animals, as squirrel ; earth-worm, habits, structure, uses ; toad, habits, structure, uses ; observation of live insects and their activities, comparison of young and adult stages.

Plant Life : Cooperative and individual work in school garden ; cultivation of plants in pots with observation of the development of leaves and flowers ; parts of leaves and flowers ; change of flower to fruit and fruit to seed ; functions of the parts of flowers ; the forms and uses of trees ; activities connected with forestry and lumbering, connect with study of pioneer life and present conditions on the prairie.

Different kinds of soil, as sand, gravel, loam, leaf-mould, and clay ; experiments to ascertain how soils are composed, whether of mineral or of decayed organic material, and which best retains water ; additional phenomena of spring in the vicinity of the school, cause of melting snow, floating ice, etc. ; how nature prepares the soil for growth of plants.

Observation of farm, garden and household operations.

FORM III.

Course of Form II. continued. Animal Life : Adaptation of different kinds of animals to their respective habits ; birds, life history of types, habits of wild fowl in different seasons ; fish, forms and uses of different parts of the body, food and how obtained ; life histories of moths, butterflies, beetles and grasshoppers ; useful insects, as ladybird and dragon-fly ; harmful insects and methods of destroying them.

Plant Life : Germination of seeds under controllable condi-

tions and in the school garden ; more particular study of the forms and functions of the parts of plants, and variations in these forms and functions in different plants ; observations on the culture of farm and garden crops and orchard and shade trees ; the observing and the distinguishing of the common forest trees.

Observing local minerals and rocks, their properties and uses ; experiments on different kinds of soil ; distinction between hard and soft, pure and impure water, test and methods of purification of water.

Sources of Heat : Experiments to show the effect of heat in the expansion of solids, liquids and gases ; practical applications. Temperature ; thermometer, construction and graduation. Methods of transmission of heat, conduction, convection and radiation ; causes of winds and ocean currents ; ventilation.

FORM IV.

Course of Form III. continued. Animal Life : Relation of fishes, birds and wild animals to man ; life histories of conspicuous and economic insects ; organ and functions.

Plant Life : Study of organs of plants and their functions ; study of economic and wild plants from seed to fruit in the school garden, home garden, farm and forest ; weeds injurious to crops and methods of destroying them ; buds and twigs ; wood, rings, grain, and bark, uses, etc. Experiments to show composition of soils and their relation to drainage, temperature, etc. ; varieties of soils adapted to different crops ; fertilizers, etc.

Implements and tools used on the farm and in the household, mechanical principles applied in their construction.

The atmosphere, its composition. Combustion : simple experiments, study of candle flame products. Changes produced in the air by respiration. Reciprocal relation of plants and animals as regards the atmosphere ; impurities in air. Gravity : air and liquid pressure ; the barometer. Cohesion and adhesion, the nature of these forces ; phenomenon of solution and diffusion ; amorphous and crystalline forms of matter. Practical use of heat, steam and electricity in connection with the study of industries.

FORM V. AND CONTINUATION CLASSES.

The work outlined for this class is too extended to allow of reproduction here. It includes definite courses in Botany,

Zoology, Physics and Chemistry, based upon work taken in previous classes and treated by a more purely scientific experimental method.

THE TEACHER'S PREPARATION.

The courses of study in the High Schools are to be taken up in three main divisions :

(*a.*) Lower school, covering from two to three years ;

(*b.*) Middle school, from one to two years, and

(*c.*) Upper school, two years.

Teachers seeking Junior Non Professional standing are to be examined on the Experimental Science of the Lower school course and the Physics and Chemistry of the Middle school course.

Physics and Chemistry are to be taken during four years instead of during one or two, as is now the case. These subjects are to be taken only during the winter months, in the Lower school course, Botany and Zoology being taken during the fall and spring months.

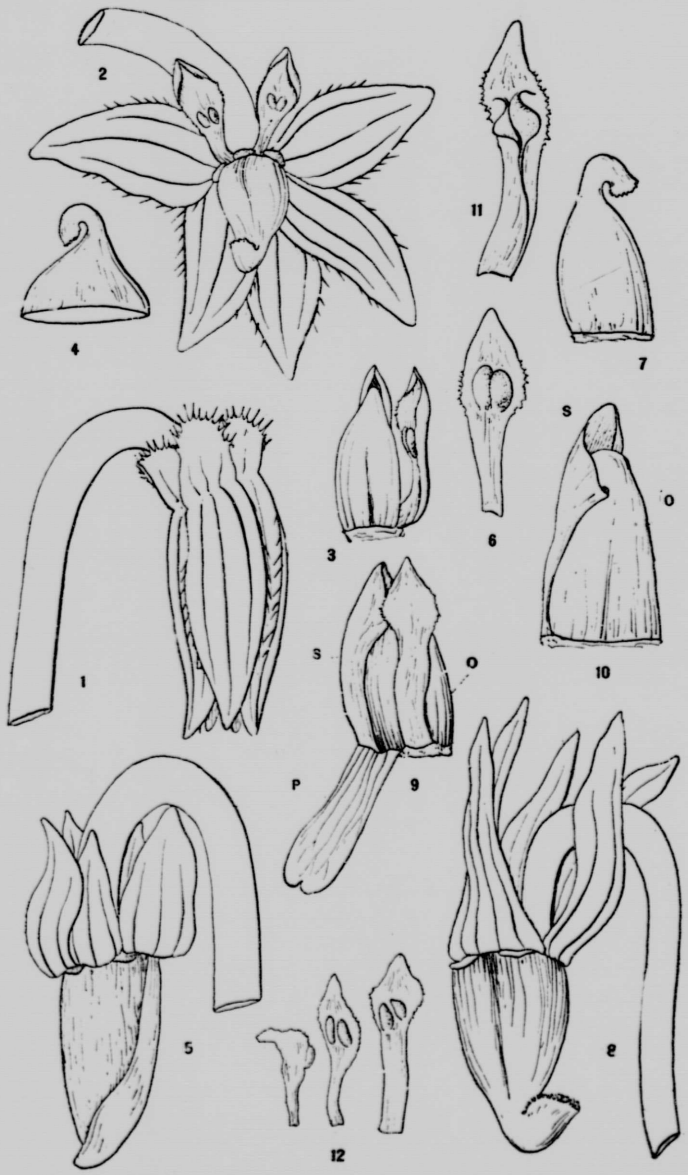
The course in Botany includes a study of representatives, such as flowering plants, ferns, fungi, etc., and deals with structure, life-relations, plant societies, plant physiology, etc.

The course in Zoology is designed to include representatives of the animal world. Special attention is directed to insects and birds, life-history, habits, adaptation to climate, etc.

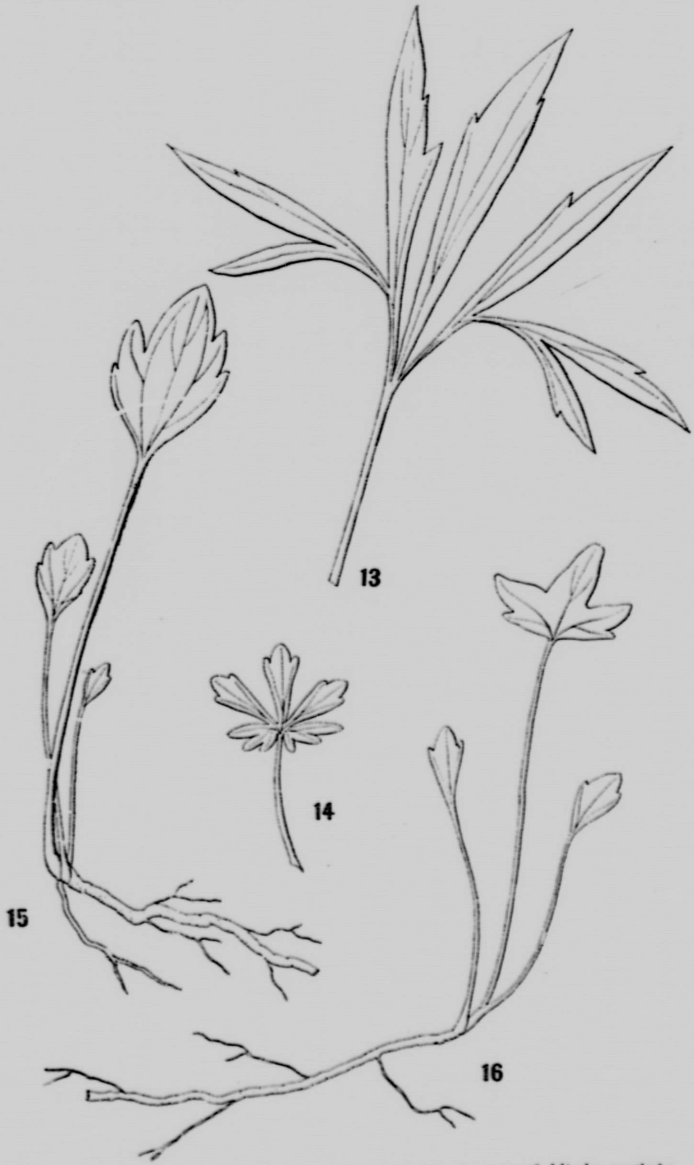
In both courses the work is intended to be practical, and, to ensure this, class text-books are not to be allowed.

Speaking generally, the proposed course in Natural Science (compulsory for teachers in training before entering the Normal School) will extend over from three to four years and occupy one lesson period per day.

During the Normal term the teacher in training will review the work done in the High School, and reconstruct it from the standpoint of the learning process. On the psychological side, he will study the subject in its logical sequence and in its relation to the needs and powers of the developing mind, with a view to the proper selection and arrangement of material and to the best methods of presentation. On the historical side, he will familiarize himself with the best of what has been done and is being done elsewhere, in order that he may avoid errors and avail himself of the advantages of past experiment. With such an equipment by way of preparation, the teacher who possesses growing power and enthusiasm, should be able to render efficient service, and this is an important consideration ; for, after all, the success of the movement must rest very largely in the hands of the teacher.



Holm: Notes on Violets. Cleistogamic flowers.



Holm : Notes on Violets. Leaves and root-shoots of Viola pedata.

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