

Orchids

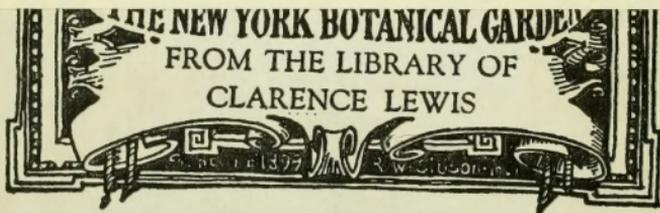
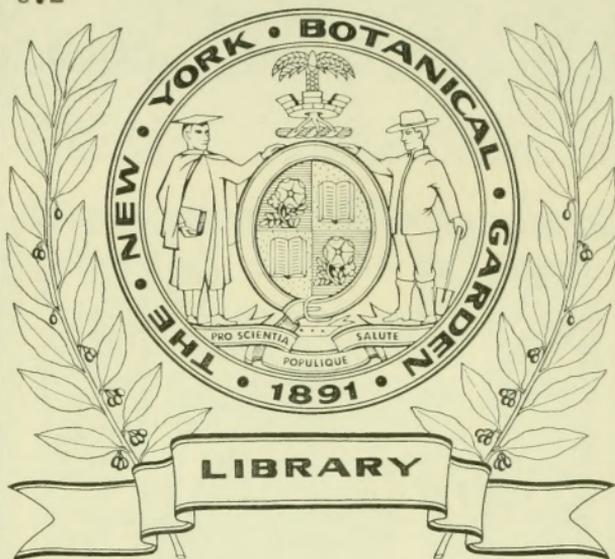


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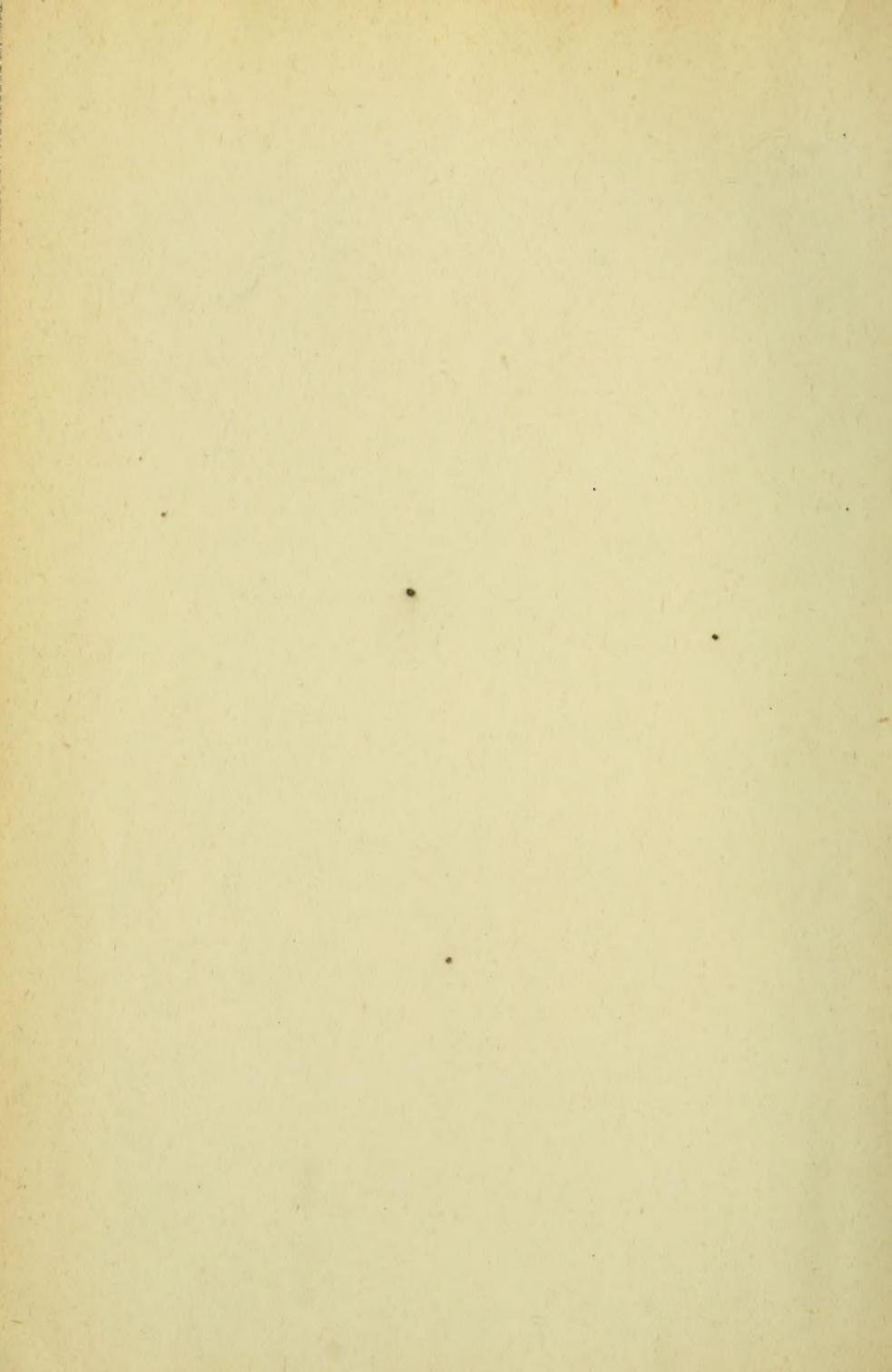




FIG. 1.—SHOWY LADY'S SLIPPER.
Cypripedium spectabile.

THE
ORCHIDS OF NEW ENGLAND.

A POPULAR MONOGRAPH.

BY
HENRY BALDWIN.

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INTRODUCTION.

THE name Orchid is with most persons associated with the heat and luxuriant vegetation of southern climates, and our North American species are, as a rule, known only to botanists. Few in number, terrestrial in their habits, often unobtrusive in color, almost valueless in trade, they make of themselves no claim to distinction in the vast floral tribe to which they belong; and the Rambler in wood or field is surprised when told that this or that flower he has brought home is related to the gorgeous and curious plants he has admired in some hot-house. When the Island of Java contains over three hundred species of Orchids, it is but a confession of poverty to state that the section of the United States lying east of the Mississippi and north of North Carolina and Tennessee produces fifty-nine species and varieties; but when this area is narrowed down to New England and forty-seven are found in the catalogue of her flora, the provincial pride that devotes a special treatise to this little group can be easily understood.

My own acquaintance with this rural family was for years what might be called a bowing one; a supposed ability to call its members by name when I saw them and an appreciation of their outward beauty or oddity forming a superficial knowledge with which I was quite content until I began to make a series of sketches of my charming friends. Then, as I observed them more closely in their homes, I realized how little one knows about his neighbors, after all; discovered that there were brothers and sisters, cousins once or twice removed and other relatives I had never seen, and that these apparently

guileless folk had tastes and passions deserving the closest study. They actually seem, now that I understand them better, more like human beings than forms of vegetation, and if we believe the marvellous tales of the wise men as to the dependence of Orchids upon insects; that each part of a flower has its share in the mutual labor; that the spots and fringes, silken curtains and waving banners, strong, or subtle odors, are not mere adornments, but necessary to the fertility of the plant and the perpetuation of its race; that there are changes in color and structure, plots and devices to gain their ends, we must confess, I think, that although the Orchids do not spin, they toil with a wisdom and foresight that Solomon might have envied.

It is well to enumerate at this point the leading characteristics of Orchids; that is, of the *Orchis* family, and I find that many are puzzled by the interchange of words. Our *Orchis spectabilis* is a species of the genus "*Orchis*," but the *Orchis* family has many other genera, and while it is proper to call an *Arethusa* or a *Lady's-Slipper* an Orchid, it is not proper to call either an *Orchis*, that final consonant being of decided importance in the botanist's view.

Quoting from both Gray and Darwin, let me explain that the flower of an Orchid has "3 inner divisions (petals) and 3 outer divisions (sepals) mostly of the same texture and petal-like appearance. One of the inner set differs more or less from the rest . . . and is called the *labellum* or lip," and this is often beautifully or grotesquely shaped, and whether furnished with a spur-like appendage or destitute of one, it is almost always a conspicuous feature. "It is by far the most important of the external envelopes of the flower. It not only secretes nectar, but is often modelled into variously shaped receptacles for holding this fluid, or is itself rendered attractive so as to be gnawed by insects. Unless the flowers were by some means rendered attractive, most of the species would be cursed

with perpetual sterility. It is often deeply channelled, or has guiding ridges," . . . often approaches the other divisions "closely enough to render the flower tubular." It is properly the upper petal, but a slight twist in the ovary or seed-vessel has turned the flower upside down, a change enabling insects to enter the flower more easily.

"In most flowers, the stamens, or male organs, surround in a ring the female organs, called the pistils. In all common Orchids there is only one well-developed stamen, which is confluent with the pistils and they form together the *column*. Ordinary stamens consist of a filament or supporting thread (not always seen in the Orchids) which carries the anther" and this is "a sort of case filled with a waxy or meal-like powder, called the pollen, which serves to fertilize the pistil." "The anther is divided into two cells, which are very distinct in

most Orchids, and appear in some species like two separate anthers."

"Orchids properly have three pistils united together, the upper and anterior surfaces of two of which form the two stigmas. But the two are often completely confluent so as to appear as one."

The grains of pollen, when deposited on the stigma, "emit long tubes," and these penetrating the surface, "carry the contents of the grains down to the young seeds in the ovary," which, when mature, is "a 1-celled, 3-valved pod, with innumerable minute seeds appearing like fine sawdust."

"The upper stigma is modified into an

extraordinary organ called the *rostellum*, which in many Orchids presents no resemblance to a true stigma. When mature, it either includes or is altogether formed of viscid matter."

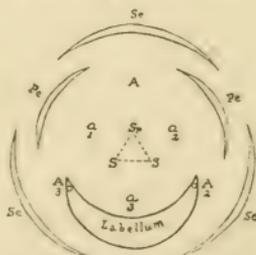


FIG. 2.—SECTION OF THE FLOWER OF AN ORCHID. (From Darwin.)

Pe, Pe, Petals; *Se, Se, Se*, Sepals; *S, S*, Stigmas; *Sr*, Stigma modified into the rostellum.

A, Fertile anther of the outer whorl; *A₂, A₃*, anthers of the same whorl combined with the lower petal, forming the labelum; *a₁, a₂*, rudimentary anthers of the inner whorl (fertile in *Cypripedium*), generally forming the clinandrium; *a₃*, third anther of the same whorl, when present, forming the front of the column.

Originally, Darwin tells us, the flower consisted of "fifteen organs, arranged alternately, three within three, in five whorls or circles; three sepals, three petals, six anthers in two circles (of which only one belonging to the outer circle is perfect in all the common forms) and three pistils, with one of them modified into the *rostellum*. Of the existence of three of the anthers in two of the whorls, R. Brown* offers no sufficient evidence, but believes that they are combined with the labellum whenever that organ presents crests or ridges. The amount of change these flowers have undergone from their parental or typical form is enormous. Organs are used for purposes widely different from their proper use,—other organs have been entirely suppressed or have left mere useless emblems of their former existence." Two stamens belonging to the outer circle, that were or became petal-like, have united with a real petal to form the lip. Seven organs have united to form the column," of which three alone perform their proper function, namely one anther and two generally confluent stigmas,—with the third stigma modified into the *rostellum* and incapable of being fertilized,—and with three of the anthers no longer functionally active, but serving either to protect the pollen of the fertile anther, or to strengthen the column, or existing as mere rudiments, or entirely suppressed. To trace the gradations perfectly between the several species and groups of species in this great and closely-connected order, all the extinct forms which have ever existed along many lines of descent converging to the common progenitor would have to be called into life." †

The flower of an Orchid may be solitary, or one of a cluster, and is furnished with a bract, a kind of little leaf that springs from the point where the flower stem joins the main stem. Sometimes petals and sepals unite to form a hood or roof over

* A noted authority on this special subject.

† "The Fertilization of Orchids."

the lip ; sometimes spread apart, giving the blossom the look of a winged insect. Who knows but nature intended to make the resemblance closer and then changed her mind? The blossom or blossoms may be borne on a scape, a stalk without normal leaves, like that of our Pink Lady's-Slipper, or on a leafy stem like that of the Yellow Lady's-Slipper; this scape, or stem, being sometimes covered with minute down; often ribbed or angled. The leaves are parallel veined, like those of the Lilies (indeed, as the Lily family follows the Orchis family pretty closely in botanical order and there are obvious points of resemblance, it is not strange that some Orchids are mistaken for Lilies), and coming to the roots, we have three or four kinds; clusters of fibres, clusters of tubers, branching, coral-like substances, and bulbs. Nearly all Orchids, wherever they may grow (in England, all but one species), depend so closely upon insects for their fertilization that the failure of a plant to attract the insects that would naturally visit it, or to produce the nectar for which they come, would work a two-fold mischief: the extinction of the one must be followed by the extinction of the other. To sum up, in the words of Hermann Müller: "The Orchis family is remarkable for the following characters, due to its wide distribution and to its enormous number of species: first, for great variety of habit and diversity of station; secondly, for its immense variety of peculiar and highly-specialized flowers; and thirdly, for the unusually large number of seeds produced in one capsule." *

Of our North American Orchids, ten species are identical with those found in Europe, and several are represented either directly or by allied forms in Darwin's "Fertilization of Orchids." This writer, in his descriptions, and Professor Gray, in his observations on American species,† have told their fascinating stories so clearly that it would not be necessary for

* "The Fertilization of Flowers."

† See appended Bibliography.

me sometimes, in quoting from both authorities, to strip the paragraphs I have interwoven still further of their technical language, if it were not partly my aim to attract those well disposed readers who are ordinarily discouraged by the sight of a long array of mysterious words. I hope that enough descriptive terms have been taken from Gray's *Botany*, to furnish what would not be obvious from an inspection of the illustrations, and that the abridgment of quoted passages and the rejection of details has not been carried too far. It should be added that terms such as "front," "outside," "lower," etc., are not always used in the strict sense in which they are employed in the botanies.

How well worthy of minute examination this single family is, is proved by Darwin's modest confession after twenty years study, that he doubted if he thoroughly understood the contrivances in any one flower. This has a discouraging sound, at first; for the possibility of discovering anything that eluded his eyes, keen as those of the hero of a German legend, may well be questioned; but the field is a tempting one to glean, and as few investigations have been made in America, judging by the scarcity of printed matter relating to the subject, our humblest species still mocks us with its secrets.

In speaking of the Orchids found in New England I shall arrange them in the order in which they blossom in the vicinity of Burlington, Vermont, where most of my own observations have been made, and shall hope to make my calendar serviceable elsewhere, as my arrangement agrees pretty well with lists sent me from other sections. Specific dates are worth considering, it seems to me, although one cannot rely on them, but as a safer guide, especially for those who travel during the period when these plants are in flower, let me say that so far as I can learn, a plant blossoming in Southern Connecticut about the first of any given month would be due in Western Vermont, or the upper Connecticut valley between the 10th

and 15th, and in the White Mountains, two weeks later still; that is, in low or moderately elevated land. Between Portland, Maine, and Moosehead Lake, there is thought to be a difference of at least two weeks in plants that bloom in spring; "this difference lessening as the hot weather comes on." The amateur collector will find that it makes a good deal of difference in point of time, whether his search is made on the north or south side of an elevation; whether in shaded or open ground; and, moreover, will often discover that the county map on which he has relied is of little use in locating "stations," for he can never be sure that the plants he has seen in one swamp will occur in a corresponding swamp in the next township; and, indeed, it is highly probable that species abundant on one side of a mountain range will entirely disappear when he reaches the other side. In the case of Eastern Massachusetts, to give a clearer illustration, certain Orchids grow within thirty miles of Boston, but one's success in getting them depends chiefly on whether he measures the thirty miles north or south of the city. The subtle influences of soil and climate sometimes contradict one's learned conjectures very unpleasantly.

I am indebted to Professor Gray for permission to make liberal extracts from his Manual, to Rev. Henry P. Nichols of New Haven, Conn., Dr. N. L. Britton of Columbia College, and especially to my friends Henry H. Donaldson and Frederick H. Horsford, to whom this work is informally dedicated.

ORCHIS FAMILY IN NEW ENGLAND.

(Synopsis from, and mainly as arranged in Gray's Manual.)

I. Anther only one. (The 2 cells should not be mistaken for anthers!)

TRIBE I. OPHRYDÆ. Anther (of 2 separate cells) borne

on and entirely adnate to the face of the stigma, erect or reclined. Pollen cohering into a great number of coarse grains, which are all fastened by elastic and cobwebby tissue into one large mass and to a stalk that connects it with a gland or viscid disk which was originally a part of the stigma. Flower in our species ringent, the lip with a spur beneath: one distinct gland to each pollen-mass.

Genus I.—*Órchis*. The two glands, or viscid disks, enclosed in a common pouch. Sepals and petals nearly equal, all (in our species) converging upwards and arching over the column. Anther-cells contiguous and parallel. 1 or 2 leaves at base of scape. Root of fleshy fibres. A spike of several flowers.

O. spectábilis, *O. rotundifólia*.

2. *Habenária*. The two glands or disks naked (without pouch or covering), either approximate or widely separated: otherwise nearly as in true *Orchis*: the lateral sepals, however, mostly spreading. Scape 1 or 2 leaved at base, or with leafy, bracted stems. Root a cluster of fleshy fibres, or tuberous thickened. A close or open spike of numerous flowers.

H. tridentàta, *H. viréscens*, *H. vtridis* var. *bracteàta*, *H. hyperbòrca*, *H. dilatàta*, *H. obtusàta*, *H. Hoókeri*, *H. orbiculàta*, *H. ciliàris*, *H. blephariglóttis*, *H. láccra*, *H. psycòdes*, *H. fimbriàta*.

TRIBE II. NEOTTIÆ. Anther dorsal and erect or inclined, attached by its base only or by a short filament to the base or summit of the column, persistent. Pollen in our genera loosely cohering (mostly by some delicate elastic threads) in 2 or 4 soft masses, and soon attached directly to a viscous gland on the beak of the stigma.

3. *Goodyèra*. Lip entire, free from the column, without callosities at the base; sac-shaped, sessile. Otherwise as in *Spiranthes*. Leaves clustered at base of scape. Root of thick fibres. A spike of numerous small flowers.

G. rèpens, *G. pubéscens*, *G. Menzièsii*.

4. *Spiránthes*. Lip ascending and embracing the column below, 2 callosities at the base. Flower somewhat ringent; sepals and petals all narrow, mostly erect or connivent. Leaves near the bottom or at the base of stem. Roots clustered—tuberous. A twisted spike of numerous small flowers.

S. latifolia, *S. Romanzoviàna*, *S. cèrnea*, *S. graminea*, *S. gracilis*, *S. simplex*.

5. *Lístera*. Lip flat, spreading or pendulous, 2-lobed at the apex. Sepals and petals nearly alike, spreading or reflexed. A pair of opposite leaves in the middle of the stem. Roots fibrous. A raceme of numerous small flowers.

L. cordata, *L. convallariòides*.

TRIBE III. ARETHUSEÆ, MALAXIDEÆ, &c. Anther terminal and inverted (except in No. 11) like a lid over the stigma, deciduous.

* Pollen powdery or pulpy, in 2 or 4 delicate masses: no gland.

6. *Arethùsa*. Lip bearded, its base adherent to the linear column. Pollen masses 4. Flower ringent, sepals and petals nearly alike, united at base, ascending and arching over the column. Leaf solitary. Scape, from a globular solid bulb, bearing usually a single flower.

A. bulbòsa.

7. *Pogònia*. Lip more or less crested, free from the club-shaped column. Pollen masses 2. Flower irregular; sepals and petals separate. A single leaf in the middle of stem, or several either alternate or in a whorl at the summit. Root a cluster of fibres or oblong tubers. Flowers solitary or few in number.

P. ophioglossòides, *P. péndula*, *P. vertillàta*, *P. affinis*.

8. *Calopògon*. Lip bearded, stalked, free: column winged at the apex. Pollen masses 4. Flower with the ovary or stalk not twisting, therefore presenting its lip on the upper or inner side. Sepals and petals nearly alike, spreading, distinct. A

single leaf at base of scape. A small solid bulb. A scape of several flowers.

C. pulchellus.

* * Pollen in 4-8 smooth waxy masses.

+ Without stalks, attached directly to a large gland.

9. Calýpso. Lip inflated and sac-like. Column winged and petal-like. Scape 1-flowered. Sepals and petals nearly similar, ascending, spreading. A green autumnal leaf. A small solid bulb.

C. boreàlis.

+ + With stalks to the 2 or 4 pollen-masses, connecting them with a gland.

10. Tipulària. Lip short, flat, long-spurred beneath. Raceme many flowered. Sepals and petals spreading. A greenish autumnal leaf. A large solid bulb.

T. discolor.

+ + + Without either stalks or glands to the 4 pollen masses.

++ Plants green and with ordinary leaves. Sepals spreading.

11. Micróstylis. Column minute, round: anther erect. Lip entire or nearly so. Sepals and petals spreading. A single leaf at base or middle of stem. A small solid bulb. A raceme of minute flowers.

M. monophýllos, M. ophioglossòides.

12. Líparis. Column elongated, margined at the apex: anther lid-like. Lip flat, entire. Sepals and petals nearly equal. 2 root leaves. A solid bulb. A raceme of several flowers.

L. lilifòlia, L. Læsèlii.

++ ++ Plants tawny or purplish, leafless, or with a root-leaf only.

13. Corallorhiza. Perianth gibbous at base, or with a spur adherent to the ovary. Perianth somewhat ringent. Sepals and petals nearly alike, the upper arching. Anther lid-like. Lip entire or deeply lobed. No leaves. Root-stocks branched and coral-like. A spiked raceme of flowers.

C. innàta, C. odontorhiza, C. multiflora.

14. *Apléctrum*. Perianth not gibbous nor spurred at base. A green autumnal leaf. Lip free from the base of column. Otherwise the flowers and scape as in *Corallorhiza*. A solid bulb or corm. A loose raceme of several flowers.

A. hyemàle.

II. Anthers two, or very rarely three.

TRIBE IV. CYPRIPIEDIEÆ. The stamen which bears the anther in the rest of the order here usually forms a petal-like, sterile appendage to the column. Pollen not in masses: no stalks nor gland.

15. *Cypripèdium*. Lip an inflated sac. Anthers 2, one on each side of the column. Sepals and petals spreading; the former usually broader and all three distinct, or in most cases two of them united into one under the lip. Leaves large, many nerved and plaited, sheathing at base. Root of many tufted fibres. Flowers solitary or few, large and showy.

C. arictònum, *C. parvisflòrum*, *C. pubéscens*, *C. spectàbile*, *C. acàule*.

Apléctrum. From the Greek α privative and $\pi\lambda\eta\kappa\tau\rho\nu$, a spur, from the total want of the latter.

Arethusa. Name from the nymph *Arethusa*.

Calopogon. Greek, $\kappa\alpha\lambda\acute{o}\varsigma$, beautiful, and $\pi\acute{\omega}\gamma\omega\nu$, beard, from the bearded lip.

Calypso. Name from the goddess *Calypso*.

Corallorhiza. Greek, $\kappa\omicron\rho\acute{\alpha}\lambda\lambda\iota\omicron\nu$, coral, and $\rho\acute{\iota}\zeta\alpha$, root.

Cypripedium. Greek, Κύπρις , *Venus*, and $\pi\acute{o}\delta\iota\omicron\nu$, a sock or buskin.

Goodyera. Dedicated to *John Goodyer*, an early English botanist.

Gymnadenia. Greek, $\gamma\upsilon\mu\nu\acute{o}\varsigma$, naked, and $\acute{\alpha}\delta\eta\nu$, gland.

Habenaria. From the Latin *habena*, a rein or strap, in allusion to the shape of the lip or spur of some species.

Liparis. Greek, $\lambda\iota\pi\alpha\rho\acute{o}\varsigma$, fat or shining, in allusion to the shining or unctuous leaves.

Listera. Dedicated to *Martin Lister*, an early and celebrated British naturalist.

Malaxis. From a Greek word meaning "soft," in allusion to the smooth or unctuous leaves.

Microstylis. Greek, $\mu\iota\kappa\rho\acute{o}\varsigma$ little, and $\sigma\tau\upsilon\lambda\iota\varsigma$, a column or style.

Neottia. Greek, *νεοττιά*, a *bird's nest*, from the tangled appearance of the roots of some species.

Orchis. Dissolute son of a rural deity, changed after death into the flower bearing his name.

Platanthera. Greek, *πλατύς*, *wide*, and *άνθηρά*, *anther*.

Pogonia. Greek, *πωγωνίας*, *bearded*, from the lip of some of the original species.

Spiranthes. Greek, *σπείρα*, a *coil* or *curl*, and *ανθος*, *flower*.

Tipularia. Name from a fancied resemblance of the flowers to insects of the genus *Tipula*.



FIG. 3.—SHOWY ORCHIS. (*Orchis spectabilis*.)
SMALLER TWO-LEAVED ORCHIS. (*Habenaria Hookeri*.)

THE ORCHIDS OF NEW ENGLAND.

THERE are those who maintain that it is impossible to determine the period when spring actually arrives in New England. There are days early in May, in Northern Vermont, when I am almost persuaded that I feel her presence. The practical farmer, recalling the precise date when the ice in the lake broke up, or when he sowed his grain, rebukes this sentimental lack of faith, and the birds assert their satisfaction in more poetical language. If Spring did not summon the song-sparrows, who did? Why have the blackbirds been pirating about for weeks? The hepaticas are "passing by," in local speech; the wreaths of bloodroot around the boulders by the roadsides are losing their freshness; the rocky ledges are tufted with saxifrage and houstonia; the swelling beech buds herald the downy yellow violet; but with snowdrifts still visible upon the mountains, I remain incredulous until the middle of the month, when the season makes haste to fulfil its promises. The south wind, puffing as from a furnace mouth, sets the young leaves twinkling on their branches, and wafts faint perfumes from unknown sources. The ground is hot to the touch. You can trace the blossoming maples along the hillsides until the smoky atmosphere quenches their brightness. The ferns, as some one once described them, are coming up "fist first," and trilliums and Canada violets whiten the wooded hillsides.

In my rambles at this time, in cool upland places, I expect to

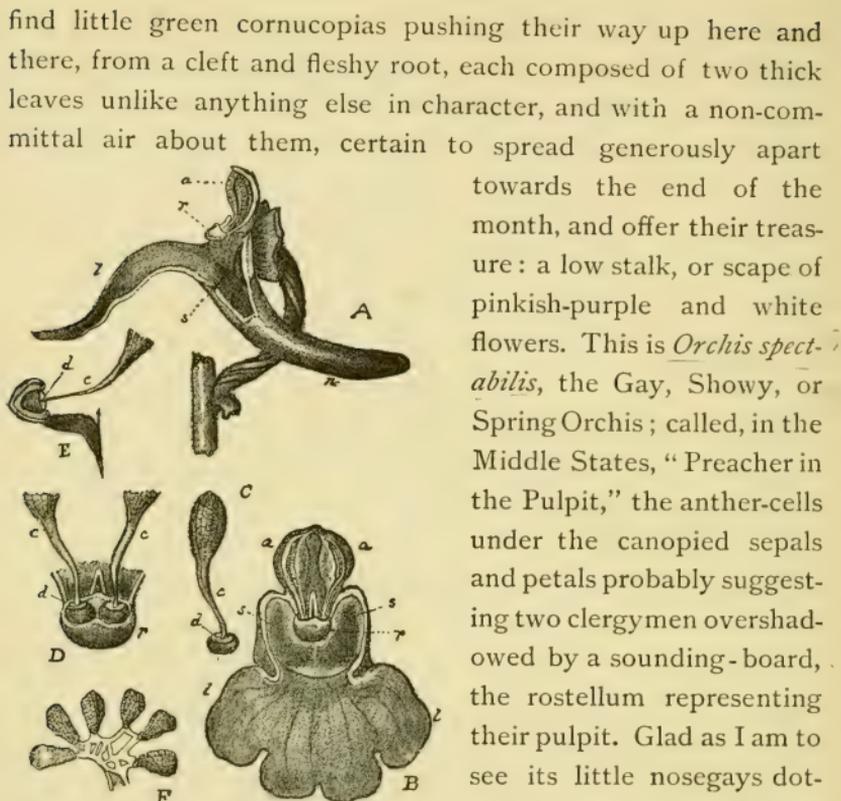


FIG. 4.—ORCHIS MASCULA. (From Darwin.)

- | | |
|---------------|-------------------------------|
| a. anther. | n. nectary. |
| r. rostellum. | p. pollinium, or pollen-mass. |
| s. stigma. | c. caudicle of pollinium. |
| l. labellum, | d. viscid disc of pollinium. |

A. Side view of flower, all the petals and sepals removed, except the labellum, of which the near half is cut away, as well as the upper portion of the near side of the nectary.

B. Front view of flower, sepals and petals removed, except the labellum.

C. One pollinium, or pollen-mass, showing the packets of pollen-grains, the caudicle, and the viscid disc.

D. Front view of the caudicles of both pollinia with the discs lying within the rostellum, its lip being depressed.

E. Section through one side of the rostellum, with the included disc and caudicle of one pollinium, lip not depressed.

F. Packets of pollen-grains, tied together by elastic threads, here extended. (Copied from Bauer.)

towards the end of the month, and offer their treasure: a low stalk, or scape of pinkish-purple and white flowers. This is *Orchis spectabilis*, the Gay, Showy, or Spring Orchis; called, in the Middle States, "Preacher in the Pulpit," the anther-cells under the canopied sepals and petals probably suggesting two clergymen overshadowed by a sounding-board, the rostellum representing their pulpit. Glad as I am to see its little nosegays dotting the woods, I take small pleasure in gathering the plant, which is too short to be grouped with trilliums and bellworts, too coarse to go with mitellas and violets; but when analysis is undertaken, sentiment quickly gives way, and I am willingly compelled to hold the Showy Orchis in high honor.

Orchis spectabilis agrees pretty closely with the British *Orchis mascula*, and I use Darwin's account of the manner

in which the latter is fertilized, as retold by Prof. Gray,* together with the figures that accompany the original description. We see in fig. A, above the entrance to the spur-shaped nectary, the two-lobed stigma, a surface so sticky as to hold fast whatever substance touches it; dust, insects too feeble to detach themselves, or the pollen that should properly be placed there. Above the stigma is the rostellum, which has assumed the shape of a pouch or cup; and over the rostellum is the anther, with its two wallet-like cells, each containing a tiny lump of pollen, which may be likened to an exclamation point, from its shape and the surprising things it does. A pollinium, or pollen-mass, consists of "a mass of coarse grains fastened together by elastic and cobwebby tissue," a tapering caudicle or stalk, and "a minute piece or disc of membrane with a ball of viscid matter on the under side." These two discs are enclosed and kept moist by the rostellum.

"The pollen, although placed tantalizingly close to the stigma, is incapable of reaching it." Nor is this desirable, as "a stigma is more sensitive to the pollen of another flower than to that of its own," and the chief object of the peculiar construction of these flowers is to secure cross-fertilization. The first winged visitor, moth or butterfly, attracted to the newly opened blossom, very likely by its bright colors, now comes to render aid, and unconsciously pay for the nectar abstracted, for it can hardly reach the entrance of the nectary without hitting its head or proboscis against the rostellum, the surface of which is so delicate that at the least touch "it ruptures transversely along the top." "This act of rupturing changes the front part of the rostellum into a lip, which can be easily depressed," and "when thoroughly depressed, the two balls of viscid matter are exposed." If the insect alights on the lip, "its best landing place," it will naturally face the opening into the nectary as it crawls up, and in *Orchis spectabilis* the sepals and

* *American Journal of Science*, vol. 34, II Series.

petals shut down so as almost to compel direct approach. There is also a little channel along the lip, which, we may suppose, catches and guides the proboscis. The insect will, therefore, almost invariably touch the rostellum; this will rupture, be depressed, and one or both exposed viscid balls stick fast "to the intruding body, the viscid matter setting hard, and dry, like a cement, in a few minutes' time. The firmness of the attachment is very necessary, for if the pollinia were to fall sideways or backwards they could never fertilize the flower." The pollinia would thus be wrenched from their cells, and carried away, standing out "like horns" on the insect's head, eyes, or proboscis. The lip of the rostellum swings back into place "when pressure is removed," so that if but one pollinium has been taken, the disc of the remaining one is kept damp and in readiness for the next light-winged guest.

If a pollinium remained erect on the insect, it would strike above the stigma of the next flower visited, and fail of its purpose; but by a curious contraction of the disc-like membrane to which its stalk is attached, the pollinium, in about half a minute's time, bends downward, "always in one direction, viz., toward the apex of the proboscis." Supposing the insect to occupy this amount of time in passing to another plant, "the pollinium will have become so bent that its broad end will exactly strike the stigmatic surface of the next blossom," and in case all the pollen is not torn off, enough will be left to fertilize several other stigmas. In *O. mascula* (and presumably in our own Orchis) the nectar is not "free," but contained between the inner and outer membranes of the spur, and as Mr. Darwin explains, "as the viscid matter of the disc sets hard in a few minutes when exposed to the air, it is manifest that insects must be delayed in sucking the nectar, by having to bore through several points of the inner membrane and to suck the nectar from the inter-cellular spaces, time being thus allowed for the disc to become immovably fixed."

Müller's stupendous work, *The Fertilization of Flowers* (it has recently been translated from the German) gives very clear and plausible reasons for the concealment of the pollen and the peculiar formation of the nectaries in plants, and I am sure it will add to the reader's pleasure in studying the Showy Orchis if I insert some extracts.

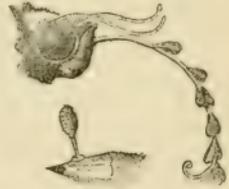


FIG. 5. — HEAD OF MOTH, *Acontia luctuosa*, with pollen-masses attached to its proboscis. Pollinium removed by a pencil and before undergoing the movement of depression. (Both from Darwin.)

“Freely exposed, pollen is liable to be spoilt by rain, devoured by flies and beetles, or carried away by pollen-collecting bees. Of these contingencies, the first is wholly an evil, the second becomes advantageous if any considerable amount of pollen is conveyed to the stigma, and the third almost always results in fertilization, and is therefore altogether advantageous. Concealment of the pollen, as of the honey, must have been brought about, in the first place, as a protection from rain. Since with this advantage comes the disadvantage that the sheltered pollen is less likely to be touched and placed on the stigma by insect visitors, concealment of the stamens has not become general. . . . And all flowers with hidden anthers have only been able to shelter their pollen from rain in so far as they have developed other adaptations for particular visitors, which compensate for the less general access of pollen-carrying insects. For this reason, flowers with hidden pollen (Orchids, for instance) afford the most conspicuous examples of adaptation in form and in dimensions to a more or less narrow circle of visitors. But the more perfectly flowers are adapted for cross-fertilization by particular insects, the more unlikely does it become that other insects visiting the flowers will effect cross-fertilization, and the more will such visits of other insects be useless or injurious. So concealment of the pollen is useful (to a subsidiary degree) in limiting insect visitors. . . . The mechanism is so perfect and so effectual in these flowers,

that cross-fertilization is thoroughly insured, though Orchids offer sap only to their visitors."

"Species with a short and not very narrow nectary," says Darwin, "are fertilized by bees and flies; those with a much elongated nectary, or one having a very narrow entrance, by butterflies and moths." "The concealment of the honey in a nectary, protected by other parts of the flower," says Müller, "protects the honey from rain, and permits a larger supply to be accumulated, thus attracting visitors in an increased degree." With these disadvantages: "The honey is the less easily discovered the more it is protected, so that a great host of the less acute visitors are excluded; and the more intelligent visitors which are able to detect it, cannot obtain it so quickly as if it were more exposed, so that the work of fertilization goes on more slowly." But "exclusion of the multitude of less intelligent short-lipped visitors is only injurious so long as more specialized visitors are not abundant enough to accomplish all the work of fertilization," and "delay in this work, owing to concealment of the honey, is diminished by a great variety of contrivances, and sometimes entirely removed, . . . pathfinders (colored spots or lines) point towards the honey, and enable the more intelligent visitors to find it in a moment; delay in obtaining deeply-placed honey is lessened by the development of convenient standing-places, of apertures specially fitted for the insect's head or proboscis," etc. He supposes that "the first honey-yielding flowers exposed their honey on flat surfaces, and that the first flower-visiting insects were only furnished with organs capable of licking up freely exposed honey. Under these circumstances, elongation of the proboscis would be of no advantage to any insect, but shelter from rain and increased room for accumulating honey would be beneficial to the plant, even before insects became divided into short-tongued and long-tongued." With these changes in the structure of the plant, it came to pass that only those

dependent insects possessing proboscides long enough to reach the honey survived.

Here let me quote from Darwin the passage previously alluded to (he is speaking of the *Angræcum*, a Madagascar Orchid): "As certain moths became larger, through natural selection, . . . or as the proboscis alone was lengthened to obtain honey from the *Angræcum* and other deep tubular flowers, those individual plants of the *Angræcum* which had the longest nectaries (and the nectary varies much in length in some Orchids), and which consequently compelled the moths



FIG. 6.—SHOWY ORCHIS.—Front view of flower, and ripened seed vessels.

to insert their proboscides up to the very base (for then only would the pollen be removed), would be the best fertilized. These plants would yield most seed, and the seedlings would generally inherit long nectaries; and so it would be in successive generations of the plant and of the moth," a race, as he puts it, between nectary and proboscis, and this pleasing theory, very likely, may apply to the long nectaries of some of the species included in the present treatise, the *Habenarias*, for example.

I doubt if the Showy Orchis would gain anything by a modification of structure; certainly not in the matter of fertilization, if my experience is the common one; for I rarely come across a plant that has gone out of flower that has not developed all its ovaries. This Orchis grows so low that it must be visited by many kinds of small insects; the short spur would appear to tempt even those that would not naturally come to it; and as there are but a few blossoms to a spike, the insect cannot be as fastidious as where there are many to choose from. The character of the root has already been described; but I have lately read Prof. Meehan's chapter on

this plant in *Native Flowers and Ferns*, and transfer his interesting statement, that while "most of the true Orchises of Europe have a tuberous root in addition to their fibres, our species has fleshy fibres only."

The few who have found the Showy Orchis in Maine tell me that it does not bloom before June in that State, and even then is preceded by two other Orchids, but May is its time in Massachusetts, and in Connecticut, where it has been gathered as early as May 3d; and as we rarely fail to get it the third week of the month in Vermont, I think it may rightly be said to open the Orchid season. The Stemless, or Pink Lady's Slipper, *Cypripedium acaule* (*C. humile* of the old writers) presses it so closely, however, that it is not a matter of wonderment when I secure them both on the same day. The latter, known better, perhaps, as "Moccasin Flower," "Venus' Slipper"—names applied to the other species as well—"Indian Moccasin," "Old Goose," "Camel's Foot," "Noah's Ark" (the last two popular names are probably rarely heard out of the Middle States), represents the other extreme of the Orchis family, and Mr. Darwin held, as late as 1877 certainly, when the second edition of his "Fertilization of Orchids" was published, his original opinion that "the single genus *Cypripedium* differs from all other Orchids far more than any other two of them do from each other," adding, "an enormous amount of extinction must have swept away a multitude of intermediate forms, and left this genus, now widely distributed, as a record of a former and more simple state of the great Orchidean order." Mr. George Bentham, in a paper read before the Linnæan Society of London in 1881, took the opposite side, saying: "The importance of the single character (the possession of more than one anther) separating the *Cypripediæ* from Orchids generally has fallen so much in estimated value that they have by common consent been reunited with that order as a distinct tribe only."

"The single anther," says Darwin, "which is present in all

other Orchids, is rudimentary in *Cypripedium*, and is represented by a singular shield-like projecting body" conspicuously placed just over the lip. The fertile anthers which supply its deficiencies lie back of it, one on either side of the short, bent column, and each bearing two small oval cells. These anthers "belong to an inner whorl or circle, and are represented in ordinary Orchids by various rudiments. There is no

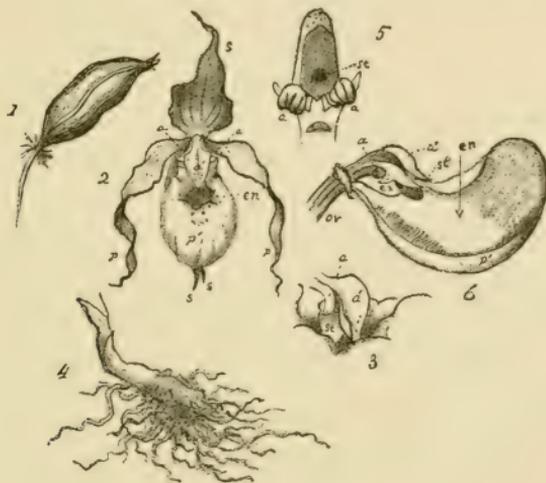


FIG. 7.—CYPRIPEDIUM.

1. Ripened seed-vessel of Smaller Yellow Lady's Slipper.
2. Front view of same flower. *a, a*, anthers; *a'*, sterile stamen; *s, s, s*, sepals; *p, p*, petals; *p'*, labellum; *en*, entrance.
3. Side view of organs of Showy Lady's Slipper; *st*, stigma.
4. Root of Lady's Slipper.
- 5-6. (From Müller.) Essential organs in *C. calceolus* seen from below. Flower in longitudinal section after removal of sepals and superior petals; lip bent slightly downward; *ov*, ovary; *ex*, exit.

rostellum, for all three stigmas are fully developed," though so united as to appear as one body, and this, also shield-shaped, lies behind and concealed by the rudimentary anther, and is only slightly viscid. The pollen has no stalk or disc, but is "loose and pulpy or powdery," and, where it is exposed by the opening of the cells, sticky, so that it is often carried off either bodily or piecemeal." There is no nectar in the lip, but "the inner surface is coated with hairs, the tips of which secrete

little drops of slightly viscid fluid." "Insects such as flies," says Gray, "may enter the flower by one of the side openings, and so take a load of pollen upon the back of the head as they pass under the anther, which they would rub against the stigma, since they must crawl directly under it (to get at the hairs), and, escaping by the opening under the other anther, they would carry off some of its pollen to the flower of the next plant visited; but they ordinarily go in by the front entrance (even in *C. acaule*), crawl under the ample face of the stigma as they feed, rubbing their heads or backs against it, and, passing on, make their exit by one of the side openings, which now become visible to them, almost inevitably carrying off pollen as they escape, which they would convey to the stigma of the next flower. The stigma, instead of being smeared with glutinous matter, as in ordinary Orchids, is closely beset with minute, rigid, sharp-pointed papillæ or protuberances, all directed forwards," and these comb off the pollen from the insect.

All of our five species of Lady's Slipper have fibrous roots, but *C. acaule* differs in not having a leafy stalk,—its pinkish, veined, and fissured lip being swung on a slender scape. "The stem," as Prof. Goodale says, "is really present, although concealed underground and often disguised by assuming the shape of a thickened root." That ingenious but much disputed English writer, Grant Allen,* believes that where plants have little competition they produce, as a rule, such large, coarse, entire leaves as are borne by our Lady's Slippers; but where they grow in thickets or in the grass, as many of our other Orchids do, and the struggle for food, air, and sunshine is fierce, the leaves are forced to become slender and subdivided in order to obtain their share. The variety in the shapes of the leaves of our Orchids will give the reader a good opportu-

* "The Forms of Leaves," *Nature*, March, 1883.

nity of proving Mr. Allen's hypothesis, especially if he studies the plants as they grow.

Whether a Lady's Slipper comes from New England, Siberia, or the Tropics, its lip, or labellum, as this part is usually called, is its most picturesque feature, and I do not think that any one who ever saw that of *C. acaule* could soon forget it. A countryman once described it to me as blue, ignorant of the fact that that is the only color Orchids are not allowed to wear. The botanist Pursh speaks of "its delicate and expressive purple," while Barton, in his *Flora of North America*, calls the petals "siskin green," and shows a better perception of color than botanists generally do, though, in truth, the sepals and petals vary as much as the lip, and are often of a deep purplish or reddish brown. All flowers of a pink hue exhibit white varieties, and *C. acaule* is not uncommonly met with in this garb, as in the Franconia Valley; Essex Co., Mass.; Knox and Penobscot Cos., Maine; and in the last-named State Miss Kate Furbish discovered and reported in the *American Naturalist* two perfect blossoms growing back to back on the same plant—a freak repeated the following year in the White Mountains. Meehan, in *Native Flowers and Ferns*,* gives a plate representing a plant with two buds. This species is as variable in size as in color. T. W. Higginson, in *Outdoor Papers* characterizes it as "high bred," and says he never can resist the feeling that each specimen is a rarity, even when he finds a hundred to an acre.

In early springs, this Lady's Slipper sometimes appears the first week in May in Southern Maine. June 1 has been sent me, on good authority, as the average date for Essex Co., Mass. Thoreau, giving a specific date with his well-known dictum, "Cypripedium not due till to-morrow," expected it at Concord on the 20th of May, and it is about that date when I

have been accustomed to hunt for it in the pine woods of East Hartford, Conn., my signal and guide-post being the pretty little Fringed Polygala. A lady familiar with it as it grows in the Adirondacks assures me that she most often meets with it where pines have fallen. "It seems to have a great fondness for decaying wood; and I often see a whole row perched like birds along a crumbling log." Gray rather restricts it to "dry or moist woods, under evergreens," for which he is corrected by Meehan, who says: "its general place of growth is in woods of deciduous trees," and, for myself, I know that sandy soil and pines and shade are not indispensable to its welfare: the finest specimens I ever saw sprang out of cushions of crisp reindeer moss high up among the rocks of an exposed hill-side, and again I have found it growing vigorously in almost open swamps, but nearly colorless from excessive moisture. This is, perhaps, an unusual place for it, as would appear from the last verse of a pathetic poem I have read detailing the struggles of an ardent botanist:*

" The mud was on his shoon, and O
 The brier was in his thumb ;
 His staff was in his hand, but not
 The Cypripedium."

Elaine Goodale has put her impressions of this flower in the following verses (she represents the azaleas as blooming at the same time), and, it will be seen, makes it an upland flower:

Stately and calm the forest rears its crown
 Above the eternal height,—
 Wide sweeps of early color, shimmering down,
 Renew its gracious might !

 — Shy and proud among the forest flowers,
 In maiden solitude,
 Is one whose charm is never wholly ours
 Nor yielded to our mood.

* Ye Lay of ye Woodpeckore, *Odds and Ends*, Henry A. Beers.

One true-born blossom, native to our skies,
 We dare not claim as kin,
 Nor frankly seek, for all that in it lies,
 The Indian's Moccasin.
 Graceful and tall the slender drooping stem,
 With two broad leaves below,
 Shapely the flower so lightly poised between,
 And warm her rosy glow.
 Yet loneliest rock-strewn haunts are all her bent,
 She heeds no soft appeal,
 And they alone who dare a rude ascent
 Her equal charm may feel.
 We long with her to leave the beaten road,
 The paths that cramp our feet,
 And follow upward thro' the tangled wood,
 By highways cool and sweet;
 From dewy glade to bold and rugged steep
 Pass fleet as winds and showers,—

 With careless joy we thread the woodland ways
 And reach her broad domain.
 Thro' sense of strength and beauty free as air,
 We feel our savage kin ;
 And thus alone, with conscious meaning, wear
 The Indian's Moccasin!"*

I was once on the point of throwing away some Pink Lady's Slippers I had gathered, they had become so wilted by the sun, when it occurred to me to try a means of restoration that had been successful in the case of other flowers, and, selecting the most discouraged one of the bunch, I put it in a glass of almost boiling water. The pouch was a shapeless mass, and part of the scape shrivelled and black, but in the course of an hour I returned to behold the scape stiff and green and the pouch swelled out to its original size.

The Downy, or Yellow Lady's Slipper, *C. pubescens*, which has a pretty local name, "Whip-poor-Will Shoe," and comes

* In Berkshire with the Wild Flowers

close, according to Professor Gray, to *C. calceolus*, of Northern Europe, itself known in France as "Sabot de la Vierge" and "Soulier de Notre Dame," will display its bright yellow blossom a few days later, its broad, alternate leaves contrasting finely with the more delicate foliage about it. The labellum is flattish on the sides, exhibits slight inequalities of surface (which in *C. calceolus*, if the pictures of that species I have seen are correct, become decided folds or ridges), and often develops quite a pointed toe. There is no fissure in front such as we see in the Pink Lady's Slipper. The labellum of *C. pubescens* retains its color very well in a pressed state and the shape may be kept by inserting a little cotton. "All parts of a flower," says Meehan, "were originally designed by nature to be ordinary green leaves, and it was only by a subsequent plan that she altered them into sepals, petals, etc., and it is interesting to note that when she goes to work on this change of leaves to flowers, she generally carries along some peculiarities especially belonging to the leaves. Now in the usual forms of the Larger Yellow Lady's Slipper we find the leaves very much undulated, botanically speaking, or with wavy and twisted margins; and it is in these cases where they are the most waved that we have the greatest twisting of the floral segments."

I sometimes find this species under evergreens, but its preference is for maples, beeches, and particularly butternuts, and for sloping or hilly ground, and I always look with glad suspicion at a knoll covered with ferns, cohoshes and trilliums, expecting to see a clump of this plant among them. Its sentinel-like habit of choosing "sightly places" leads it to venture well up on mountain sides, and I am often startled when climbing a gloomy, moss-draped cliff by coming face to face with one of its colonies. In Holmes' novel, *Elsie Venner*, the heroine brings her school-teacher a "rare, Alpine flower," and Higginson supposes it to have been the Yellow Lady's Slipper,



FIG. 8.—PINK LADY'S SLIPPER. (*Cypripedium acaule*.)
RAM'S-HEAD. (*C. arietinum*.)
SMALL YELLOW LADY'S SLIPPER. (*C. parviflorum*.)

knowing well the locality referred to, with "its precipitous walls of rock." The very flower one would select to figure in a weird story, but, unfortunately, it is afterwards described as "a little delicate thing that looked as if it were made to press," and I reluctantly conclude that the writer fashioned his plant to suit himself or had something very different in his mind.

In experimenting with this genus, Darwin discovered that *C. calceolus*, "in a state of nature" depended "on bees belonging to five species of the genus *Andrena*," and selecting one of these bees, of very small size, he gave it a blossom of *C. pubescens* to work upon. The insect entered by the upper opening and attempted "to crawl out the same way, but always fell backwards, owing to the margins being inflected. The polished inner sides," he thinks may also have been a hindrance, and so the labellum acted "like a trap," such as is made in our kitchens by pasting a paper over the mouth of a tumbler, cutting slits in the paper and turning the edges in. Flies have no trouble in getting at the contained liquid, but are rarely able to escape. "The bee could not creep out through the slit between the folded edges of the labellum, as the elongated, triangular, rudimentary stamen here closes the passage. Ultimately it forced its way out through one of the small orifices close to one of the anthers, and was found when caught, to be smeared with the glutinous pollen." When put back, several times, it climbed out in the same way, and the stigma was fertilized as we saw in the Pink Lady's Slipper. "Thus the use of all parts of the flower,—the inflected edges, or the polished inner sides,—the two orifices and their position close to the anthers and stigma,—the large size of the rudimentary stamen,—are rendered intelligible." "The hairs," says Müller, speaking of *C. calceolus*, "which are arranged in a broad band on the floor of the labellum, seem to help the bees to climb up toward the orifices, besides attaching them by their secretions.

Smaller bees and flies which are too large to pass freely through the orifice and too weak to force their sides apart, must as a rule perish of hunger within the labellum. Small beetles are often able to crawl freely out, but sometimes they are held fast by the sticky pollen and remain to perish."

A valuable contribution to the study of our Lady's Slippers has been sent me by Professor Trelease of the University of Wisconsin, who writes: "In *C. pubescens*, *parviflorum*, and *candidum* (a small white species not found in New England) there is a variable number (1-4) of crescent-shaped or irregular translucent spots on the back of the labellum, which readily catch the eye of an imprisoned bee (*Halicta*, *Augochlora*), and lead in back under the stigma, whence it sees the light through the small opening under the anther at either side, and makes its exit there. Small bees introduced into the labellum usually went direct to these thin places; failing to get out there they went on to its regular exit openings. The labellum is so translucent throughout in all my herbarium specimens of *C. arictinum*, *spectabile* and *acaulc*, that I cannot say whether these species have the same character; a number of conservatory species that I have observed, do not."

C. pubescens has what Burroughs calls "a heavy, oily odor," and is less pleasing than the Small Yellow Lady's Slipper, *C. parviflorum*, opening about this time in swampy places. This species, though rarer, is more widely diffused throughout North America, according to Sir Joseph Hooker, who adds to his description of *C. pubescens*, without giving his authority, the statement that "its rhizome or root-stock replaces the Valerian as an anti-spasmodic, in the estimation of Anglo-Americans." Some hesitate to call the Small Yellow Lady's Slipper a distinct species, but its dwarf size, richer color, curiously twisted petals and decided perfume easily gain it the precedence in favor with those who care for externals only. The lip is smoother on the outside and flatter above than that of the

larger species. The Pink and the Showy Lady's Slippers have two of their sepals "united into one, under the lip," while both Yellow Lady's Slippers have the united sepals, "cleft at the apex."

In Northern New England, one is sometimes fortunate enough to gather with the Yellow Lady's Slippers, especially with the dwarf species, the Ram's-head Lady's Slipper, *C. arictinum*, the rarest species North America produces, and to me the most attractive; a small plant, perhaps a foot high, with dark green leaves and a fragrant, purplish-pink and white, veined lip, which has a hairy, triangular orifice and is small enough to be put into a child's thimble. Far fetched as the popular name appears to be, the reader will notice if he holds the page containing the illustration of this flower in a certain position that the protuberant lip has a slight resemblance to a nose, and that the curving petals—often decidedly curled—may be fancied to represent the animal's horns. The sterile stamen is blunter than in the other species and the three sepals are separate. "This Lady's Slipper," says Meehan, "is a connecting link between *Cypripedium* and other genera of the Orchis family. In many Orchids the outer whorl of three (the calyx in other flowers) can be readily traced; but it is one of the peculiarities of *Cypripedium* to have apparently but two. . . . As this union of the sepals was formerly considered one of the chief foundations of the genus *Cypripedium*, some botanists made this (Ram's-head) into a distinct genus, on account of its three-leaved calyx, under the name of *Arietinum Americanum*."

This little flower has been known to botanists only since about 1808, when it was discovered near Montreal. It has been reported from the Saskatchewan Valley, from Minnesota and from Nebraska; in New England it is so rare, except in the extreme north, that many a collector who has it in an herbarium has never seen it growing, and it is so incon-

spicuous, even when it grows in clumps, that one may have minute directions given him and yet be unable to put finger upon it at once. The Ram's-head does not confine itself to low or damp ground, but is sometimes met with, in Vermont at least, on dry hill-sides at the feet of pines. I strongly suspect that some elf, refused a night's lodging in the cradle of a Pink Lady's Slipper, and faring no better on application to a Yellow Lady's Slipper, originated the pert little Ram's-head as a caricature of both.

The musky smell possessed by many Orchids, and used, it is supposed, to attract night-flying insects, is very noticeable in our Lady's Slippers, particularly in their roots. It is an earthy scent that one grows to like and to associate with nature, as he does the smell of a wood fire. The fact that plants of the Orchis family rarely grow in abundance, though a single one like the English *O. maculata* produces over 186,000 seeds, and its grandchildren, at this rate of increase, would nearly carpet the globe, has been remarked on at length by Mr. Darwin.* Burroughs, in one of his most successful descriptions, accuses Cypripedium of affecting privacy, declaring that when he comes across it, he seems to be intruding on some very exclusive company; and of our native species, the Pink Lady's Slipper is apt, for reasons before stated, to be found in an isolated state, but I have counted fifty blossoms in a space less than fifty feet square, have picked fifteen blossoms of the Small Yellow Lady's Slipper from one clump, and noticing, one day, as I sat down to rest in a cedar wood, twenty young Ram's-heads within reach, I applauded the remark of a companion who was loaded with equally valuable trophies: "the only really rare thing in this region appears to be grass!" Even these are instances of scarcity when compared with the number of spent seed-vessels I find each spring. How easily insects discover these plants is

* Müller says, his brother "estimated over 1,750,000 seeds in a single capsule of a *Maxillaria*."

proved by the fertilization last year of some dwarf Yellow Lady's Slippers that were brought the year before from a swamp fifteen miles away. The spot where they were set out in my garden is not far from the lake shore, to be sure, but the nearest place where any Lady's Slippers grow, and that high ground, is two miles away. They were, therefore, not dependent upon the insects of any particular locality, and even in a very sheltered, and as it seemed unfavorable position, were quickly found out by the proper bees or flies.

Orchis spectabilis is called a True Orchis, because its anther-cells are "parallel and contiguous," and the glands of the stigma (the viscid discs) are enclosed in a pouch; and next to the True Orchises, in botanical arrangement, stand the Naked-gland Orchises, belonging to the sub-genus *Gymnadenia*. In these the anther-cells are still parallel, but the viscid discs, though near together, have no pouch to enclose them. We have but one representative species in New England, *H. tridentata*, to be spoken of hereafter, as it blooms later than *Orchis spectabilis*, although allied to it in structure. After the Naked-gland Orchises, in our botanies, come the False Orchises, belonging to the sub-genus *Platanthera*, and these, says Gray, have their anther-cells "more separated and divergent," so that the viscid discs, also unenclosed, "are carried, one to each side of the broad stigma." In some species, in which the discs do not stand far apart, there are curious contrivances, such as a channelled lip, lateral shields, etc., compelling moths to insert their proboscides directly in front. "The sticky disc, in some American species looking like a little pearl button, stands, when the flower bud opens, directly in the way of the head of a moth or bee; and here the viscosity of the disc is beautifully adapted to the state of things, for although fully exposed to the air, instead of setting hard at once, as in *Orchis*, the disc retains its viscosity during the whole period of the expansion of the flower, awaiting the coming of the insect, and quite sure

to stick fast to the side of the face (the eye most likely, as the discs, to quote Darwin, 'cannot adhere to a scaly or very hairy surface,') of the first one that dips its proboscis into the attractive nectary." Moreover, as the discs are uncovered, and "the viscid matter serves to attach the pollen-masses firmly, without setting hard, there would be no use in the insects being delayed by having to bore holes at several points through the inner membrane of the nectaries," and, therefore, in these open nectaries "we find copious nectar ready stored for rapid suction."

Gymnadenia and Platanthera are now included in the genus *Habenaria*, and this genus, together with *Orchis*, forms, in this country, the tribe Ophrydeæ. If it is a virtue to be a True *Orchis*, the *Habenarias*, or Rein-*Orchises*, are compensated in proportion to their departure from the standard, by acquiring more attractive features: gayer colors, fringed or divided lips, and generally speaking, greater height. Gray's Botany contains a list of nineteen, and of this fair sisterhood thirteen are natives of New England.

The first to offer itself for a spring bouquet is *Habenaria Hookeri*, or the Smaller Two-leaved *Orchis*, placed by some of my correspondents before *C. parviflorum*, the difference in dates of flowering being a matter of but a few days. Finding it in the same localities with *Orchis spectabilis*, you would trace a family likeness at once, in the bracted, angled scape and flat-lying leaves, if going no further into the study. The colors it wears are green and yellow, and it cannot be styled prepossessing, but, nevertheless, it has a decided dignity of mien. In its structure it is much like the British *H. chlorantha*, but its anther-cells "are more widely divergent, consequently a moth, unless of gigantic size, would be able to suck the copious nectar without touching either disc; but this risk is avoided in the following manner: the central line of the stigma is prominent, and the lip, instead of hanging down, as in most

of the other species, is curved upwards, so that the front of the flower is made somewhat tubular, and is divided into halves. Thus a moth is compelled to go to the one or other side, and its face will almost certainly be brought into contact with one of the discs. Professor Gray has seen a butterfly from Canada with a pollen-mass of this species attached to each eye." *H. Hookeri* has the muskiness characteristic of the family but no "strong, sweet odor," such as is attributed to *H. chlorantha*. A variety, *oblongifolia*, occurs in New York State, differing, as the adjective implies, simply in the shape of the leaves.

The first time I analyzed a flower of Hooker's *Habenaria* I was struck with the prominent beak between the bases of the anther-cells. "In both divisions of the *Ophreæ*," Darwin says, "namely the species having naked discs, and those having discs enclosed in a pouch—whenever the two discs come into close juxtaposition a medial crest or process, sometimes called the rostellate process, appears. When the two discs stand widely apart, the summit of the rostellum between them is smooth, or nearly smooth." In the illustration of *O. mascula*, fig. 4, B, D, we see the developed crest; in the illustration of *Peristylus viridis*, fig. 11, "the first stage in the formation of the folded crest, the overarching summit bent like the roof of a house." It is his belief that "whilst the two discs were gradually brought together, during a long series of generations, the intermediate portion or summit of the rostellum became more and more arched, until a folded crest, and finally a solid ridge

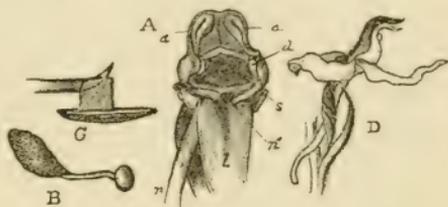


FIG. 9.—*HABENARIA CHLORANTHA*. (From Darwin.)

- A. Front view of flower. *a, a*, anther-cells; *d*, disc; *n*, nectary; *n'*, entrance to nectary; *L*, labellum; *s*, stigma.
 B. A pollinium (this has hardly a sufficiently elongated appearance). The drum-like pedicel is hidden behind the disc.
 C. Diagram giving a section through the viscid disc, the drum-like pedicel and the attached end of the caudicle. The disc is formed of an upper membrane, with a layer of viscid matter beneath.
 D. Side view of flower of *H. Hookeri*.

was formed." He mentions, however, one British species, *Herminium monorchis*, "which has two separate and large discs," and also "a crest or solid ridge, more plainly developed than might have been expected;" and have we not in our *H. Hookeri* a similar instance?

"*Habenaria chlorantha* depends," says Darwin, "on the larger nocturnal Lepidoptera," and he shows the contrivances for securing fertilization to be even more interesting than in *Orchis spectabilis*. "The two anther cells are separated by a wide space of connective membrane, and the pollen-masses are enclosed in a backward, sloping direction. The viscid discs front each other and stand in advance of the stigmatic surface. Each disc is circular, and in the early bud consists of a mass of cells of which the exterior layers (answering to the pouch in *Orchis*) resolve themselves into matter which remains adhesive for at least twenty-four hours after the pollen-mass has been removed." The stalk, or caudicle, of the pollen-mass does not rise directly out of the flat side of the viscid "button," like the stem on a cherry, but is attached to it by "a short drum-like pedicel or continuation of the membranous portion of the disc;" the shank of the button, to carry out the simile. This stalk is united "in a transverse direction to the embedded end of the drum, and its extremity is prolonged, as a bent rudimentary tail, just beyond the drum. The stalk is thus united to the viscid disc in a plane at right angles. The drum-like pedicel is of the highest importance, not only by rendering the viscid disc more prominent, but on account of its power of contraction. The pollinia lie inclined backward in their cells, above and some way on each side of the stigmatic surface: if attached in this position to the head of an insect, the insect might visit any number of flowers and no pollen be left," the pollinia "striking against the anther-cells." But in a few seconds after the pollinium is removed "and the inner end of the drum-like pedicel exposed to the air, one side of the drum contracts and draws

the thick end of the pollinium inwards so that the stem and the viscid surface of the disc are no longer parallel as they were at first, and as they are represented in the section, fig. 9, C. At the same time, the drum rotates through nearly a quarter of a circle, and this moves the stalk downward like the hand of a clock, depressing the thick end of the pollinium." A disc once affixed to the side of an insect's face, by the time another flower on another plant is reached, "the pollen-bearing end of the pollinium will have moved downward and inward and will infallibly strike . . . the broad stigmatic surface between the anther-cells. The little rudimentary tail projecting beyond the drum-like pedicel shows that the disc has been carried a little inward, and that originally the two discs stood even further in advance of the stigma than they do at present."

Habenaria viridis, var. *bracteata*, the Bracted Green Orchis, figures in old botanies as *Platanthera bracteata*. The European species, *H. viridis*, according to Darwin, has the viscid under side of each disc "enclosed in a small pouch;" "this," says Gray, "is not yet verified in ours." Although it is usually assigned to the following month, I generally find the Bracted Green *Habenaria* blooming with *H. Hookeri*, and therefore introduce it here. It has the same greenish-yellow colors, but differs in several respects, such as a leafy stem, bristling bracts, smaller flowers with toothed lip and very short, two-lobed, bag-shaped nectary which, it would seem, almost any insect could rifle. Neither beautiful nor singular, as far as outward appearance goes, it occupies a neutral position, and

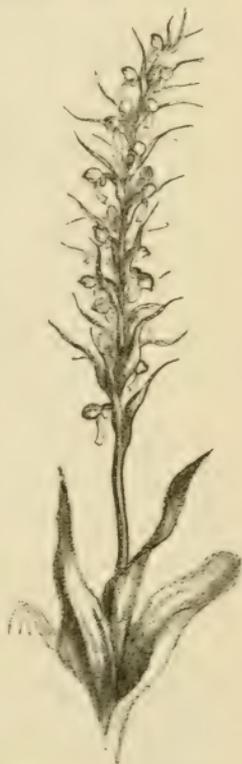


FIG. 10.—BRACED GREEN ORCHIS.

H. VIRIDIS, VAR. BRACTEATA.

is, on that account, easily overlooked in the woods, but "it serves," says Professor Gray, "almost completely to exemplify Mr. Darwin's account of the mechanism of *Peristylus viridis*." The latter authority informs us that the widely separated discs have oval balls of viscid matter on the under side, and that "the upper membrane to which the stem of the pollinium is attached is of large size relatively to the whole disc, and is freely exposed to the air. Hence probably it is that the pollinia, when removed from their cases, do not become depressed until twenty or thirty minutes have elapsed. Supposing a pollinium to be attached to the head of an insect and to have become depressed, it will stand at the proper angle vertically for striking the stigma. But from the lateral position of the anther-cells, notwithstanding that they converge a little toward their upper ends, it is difficult to see at first how the pollinia when removed are afterward placed on the stigma; for this is of small size and is situated in the middle of the flower between the two widely separated discs."

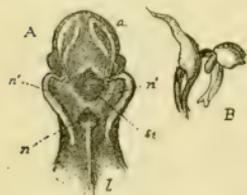


FIG. 11.—A. PERISTYLUS VIRIDIS. (From Darwin.)

a, anther-cell; n, entrance to nectary; n' n', nectar-secreting spots; st, stigma; l, part of lip.

B. H. VIRIDIS, VAR. BRAC-
TEATA.

He explains as follows: The base of the elongated lip forms a rather deep hollow in front of the stigma, and in this hollow, but some way in advance of the stigma, a minute slit-like orifice leads into the nectary. Hence an insect in order to suck the nectar would have to bend down its head in front of the stigma. The lip has a ridge down the middle, "which would probably induce an insect first to alight on either side; but apparently to make sure of this, besides the true nectary, there are two spots which secrete drops of nectar on each side at the base of the lip, directly under the two pouches. An insect alighting "on one side of the lip so as first to lick up the exposed drop of nectar there, from the position of the pouch exactly over the drop, would almost certainly" detach

the pollinium from this side. "If the insect then went to the mouth of the true nectary" this pollinium would not have had time to be depressed and to hit the stigma, so that there would be no self-fertilization. "The insect would then probably suck the exposed drop of nectar on the other side of the lip, and perhaps get another pollinium attached to its head; it would thus be considerably delayed by having to visit three nectaries. It would then visit other flowers on the same plant and afterward flowers on a distinct plant, and by this time the pollen-masses will have undergone the movement of depression and be in a proper position for effecting cross-fertilization. The secretion of nectar at three separate points—the wide distance of the two discs, and the slow downward movement of the stem are all correlated for the same purpose of cross-fertilization."

In some papers on The Colors of Flowers published in *Nature* during July and August, 1882, Mr. Grant Allen endeavors to prove that all flowers were originally yellow, and that highly modified ones, like those of the Orchis family, changed this primitive color for more decided tints to attract the highest forms of insect life; and finding a number of examples of flowers more or less green, such as the European *Habenaria viridis*, he infers that they have begun "to degenerate;" have found, that is, that the bright colors did not serve them as well as the original yellow, and are working back through the intermediate green.

No one now holds the opinion of some old writers on Orchids, that flowers shaped like bees, flies, etc., were formed for the express purpose of attracting these insects, but that certain colors are more attractive than others is a well settled point. Sir John Lubbock considers blue the most attractive; Müller states that in the Alps it is yellow rather than white. An article in *Nature* (March 22, 1883) gives abstracts from papers read before a meeting of the Linnæan Society, from which I have made the follow-

ing extracts—it must be noted that flowers in general are referred to. “A. W. Bennett had made a series of observations. Among Lepidoptera (butterflies, moths, etc.), 70 visits were made to red or pink flowers, 5 to blue, 15 to yellow, 5 to white. Diptera (two-winged insects), 9 to red or pink, 8 to yellow, 20 to white. Hymenoptera (bees, wasps, etc.), 303 to red and pink, 126 to blue, 11 to yellow, 17 to white. Mr. R. N. Christy records in detail the movements of 76 insects, chiefly bees, and thinks bees decidedly confine their successive visits to the same species. Butterflies generally wander aimlessly. He thinks insects are not guided by color alone, and suggests that sense of smell may be brought into play. Bees have poor sight for long distances; of 55 bumble-bees watched, 26 visited blue flowers; of these, 12 were methodic, 9 irregularly so, and 5 not at all. 13 visited white flowers; 5 were methodic. 11 visited yellow flowers; 5 were methodic. 28 went to red flowers; 7 methodic, 9 nearly so.”

If we can imagine the months as quarrelling over their floral offspring, we may be sure that June bitterly disputes the claim of May to *Calypso borealis*. This beautiful little inhabitant of cold bogs and cedar swamps is the only known Orchid that reaches 68° north latitude, and while very abundant in Oregon and the North-west, is so rare in New England that in New Hampshire, as Prof. Flint writes me, “one may be thoroughly acquainted with our flora and yet never have seen it.” Fortunately, the summer tourist arrives in the White Mountains too late to find and exterminate the plant, and one can hardly blame those who do know its stations for refusing to reveal them. At Bangor, Maine, it sometimes blooms as early as May 3d, and is always in advance of the Showy Orchis. At Middlebury, its most southerly known station in Vermont, May 20th is regarded as exceptionally early; and finding it on the same date near Charlotte, in the late spring of 1883, I attributed its appearance to caprice, as it was several days ahead of the apple-



FIG. 12.—CALYPSO BOREALIS.

trees, with which it usually blooms when it does come early, and quite had the start of the Showy Orchis. If any one objects to my opinion that the first week in June is the average time for Calypso in Vermont, he is at liberty to contradict it, but he must convince me that he has gathered the flower more than once.

In the genus Calypso, and this, our only species, the sepals and petals are tinged with pink; the whitish column is "broadly winged and petal-like, bearing the lid-like anther just below the apex;" the slipper, lined with delicate hairs, is purple-pink at the heel, inside and out, shading toward the curiously two-pointed toe into yellowish white. A tuft of bright yellow hairs and dots of purple or pink adorn the instep. It recalls the Lady's Slippers very strongly, and Linnæus called it *Cypripedium boreale*; but "its closest relations in this country," says Meehan,* "are perhaps *Liparis* and *Microstylis*. Its real relationship, however, is with *Cœlogyne*, a genus inhabiting the warmer parts of the East Indies, and we see by this comparison how isolated Calypso must be when we learn that instead of a warm sub-tropical climate in which most of the *Cœlogyne* are found, this one exists only in the extreme north of our country, and Lapland and Russia." He also quotes, in speaking of its habitat, a writer in the *Gardener's Monthly*, who found it in Canada, "on a high limestone ridge . . . sparsely covered with white pines, in holes caused by tearing up of the roots and superincumbent earth when forest trees are uprooted by storms. The pine needles had collected and decayed in these holes, "forming a rich vegetable mould covering to a depth of 5 or 6 inches the broken fragments of limestone left in the hole." In Vermont there are extensive swamps of the white cedar, the arbor vitæ of our gardens, a tree that attains considerable size in its native soil, and the black earth

* *Native Flowers and Ferns*, II. Series.

formed by the decaying leaves gives birth to this bright hued Orchid.

Even when her sanctuary is discovered, *Calypso* does not always reveal herself. The ground and the fallen tree-trunks are thickly padded with moss and embroidered with trailing vines of Snowberry and Linnea; Painted Trilliums dot with their white stars the shadows lying under the tangled, fragrant branches; the silence of the forest, disturbed only by the chirr of a squirrel or the sudden jubilation of the oven-bird, envelops you and seems the appropriate accompaniment of such an expedition. You follow, perhaps, a winding path made by the wild animals among the underbrush; moving slowly, or you easily overlook the dainty blossom, nestling in some soft, damp nook, and poised lightly on its stem as if ready to flutter away between your covetous fingers; and when in the presence of the goddess you are compelled to stoop, whatever title of dignity you may wear. Come a week later, and she has vanished: the plantain-like leaf has shrivelled also, and it will be three months before another arises to tell where the tiny white bulb is secreted. Take up the bulb and wonder, as I am sure you will, how it survives the frosts and snows, it slips so readily out of its loose bed. You will, doubtless, feel repaid for a day's journey by the sight of a single specimen, and will not wonder that the pretty recluse has so wide a reputation. The most favored person I have yet heard of is Professor Scribner, of Girard College, who informs me that once in Maine, he came on a place, "not a foot square, containing over fifty plants in bloom."

Some verses by Professor Bailey of Providence, that have been reprinted several times since they first appeared in the *N. Y. Evening Post*, deserve quotation whenever *Calypso* is mentioned, if for no other reason than to prove that a botanist may love the object of his study for its own own sake. Struck by their out-door flavor and picturesqueness, I committed them to mem-



FIG. 13.—ROUND-LEAFED ORCHIS. (*Orchis rotundifolia*.)
ARETHUSA BULBOSA.

ory years before I ever found the plant, and hope that those who read them here for the first time will be filled with a desire to see *Calypso* for themselves.

Calypso, goddess of an ancient time
 (I learn it not from any Grecian rhyme,
 And yet the story I can vouch is true),
 Beneath a pine tree lost her dainty shoe.

No workmanship of mortal can compare
 With what's exhibited in beauty there;
 And looking at the treasure 'neath the tree
 The goddess' self I almost hope to see.

The tints of purple and the texture fine,
 The curves of beauty seen in every line,
 With fringes exquisite of golden hue
 Perfect the wonders of the fairy shoe.

The goddess surely must have been in haste,
 Like Daphne, fleeing when Apollo chased,
 And leaving here a slipper by the way,
 Intends to find it on another day.

But will she come to seek it here or no?
 The day is lengthening, but I cannot go
 Until I see her bring the absent mate
 Of this rare beauty, though the time is late.

I watch, but still no classic form I see,
 Naught but the slipper 'neath the forest tree :
 And so, for fear of some purloining elf,
 The precious relic I secure myself.

Another nymph belonging to the same tribe, *Arethuseæ*, and almost as charming as *Calypso*, comes into notice, clad in rose-purple, during the last days of May in Connecticut and Massachusetts, and about the 7th of June in Central Vermont and

New Hampshire. *Arethusa bulbosa* chooses the open cranberry swamp or the scanty shade of tamaracks. Gray calls it rather scarce or local, but as at Litchfield, Conn., and near Andover, Mass., where hundreds have been gathered at a time, it is wont to be abundant in its pet localities, and one is justified in hunting for it anywhere. Its range in the Eastern United States is from "North Carolina to Wisconsin and northwards," and the unsentimental Hooker states that the bulbs, with us, "are used to stimulate indolent tumors, and as a cure for toothache."

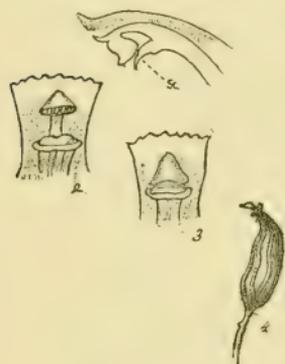


FIG. 14.

1. Side view of column of *Arethusa*. *St.*, stigma.
 2 and 3. Front views of anther.
 (From Gray's Botanical Text Book.)
 4. Seed-vessel of *Arethusa*.

The *Arethusa* is sometimes very fragrant, as Chapman, Goodale, and Burroughs in *Pepacton*, testify, and I regret that it has never been my fortune to find a flower possessing that attraction. White varieties have been reported from Plymouth and other places in Massachusetts, but such instances are said to be very rare in the case of this Orchid.

Plymouth has also furnished two abnormal specimens.* "One had a two-flowered scape, the flowers complete and united at the base; the other had the flowers, which were both incomplete, united throughout nearly the whole length." And even these are less worthy of record than the oddity discovered at New Haven, Conn., by Mr. H. M. Denslow, where "two distinct scapes sprang from the same bulb; one bearing the usual single flower, the other, two." The genus *Arethusa* contains but two other known species, natives respectively of Japan and Guatemala, and in this genus, to quote Gray, "the lanceolate sepals and petals, united at the base, ascend and arch over the

* See Bibliography.

column, which is petal-like, dilated at the apex, and adherent to the bearded lip below. The anther is lid-like, terminal, deciduous, of two approximate cells, each containing 2 powdery-granular pollen-masses." This lid-like, deciduous anther is, with one exception, characteristic of all the members of the tribe. In *A. bulbosa*, says Gray, "the 4 loose and soft pellets lie in an inverted casque-shaped case, hinged at the back, resting on a shelf, the lower face of which is a glutinous stigma, over the front edge of which the casque-shaped anther slightly projects." At the bottom of the cup formed by the united sepals and petals there is a slight secretion, and the yellow beard on the lip either acts as a guide to this concealed nectar, or is an additional attraction. "The anther is raised by the head of a bee when creeping out of the gorge of the flower. The loose pellets are caught upon the bee's head, to the rough surface of which they are liable to adhere lightly, and so to be carried to the flower of another individual, there to be left upon its glutinous stigma by the same upward movement which immediately afterward raises the anther lid and carries away its pollen to be transferred to a third flower, and so on. The scape rises from a globular, solid bulb, and the leaf is solitary, linear, hidden in the sheaths of the scape, protruding from the uppermost after flowering."

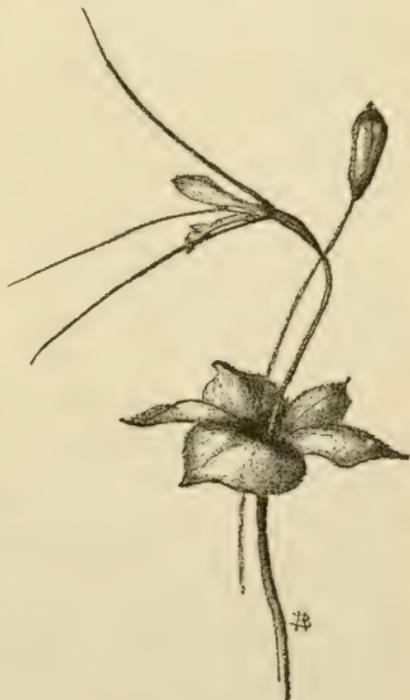


FIG. 15. WHORLED POGONIA.
P. verticillata.

A nearly related but rarer flower, the Whorled Pogonia, *P. verticillata*, springing from a fibrous root, comes with *Arethusa* or follows her pretty closely, and also makes its home in wet places. In Pogonia, "the only group of which Darwin has given no account," for he mentions but one species and then quotes from an American writer, the column arches over the lip, as in *Arethusa*, but is "free from it, elongated, club-shaped and wingless." The anther is also "terminal and lid-like," but has a stalk, and the powdery-granular pollen-masses are but 2 in number, each occupying a cell. It will be seen from the illustration how very long the sepals are when compared with the petals. My sketch was made from a specimen not fully blown, and the three lobes into which the lip in this species is divided are folded together too much. A narrow crest runs down the middle of the lip. Gray calls the flower "dusky purple," but I should prefer, myself, to describe it as brownish-purple, while yellowish specimens have been met with, and Barton's plate represents it as yellow, with the sepals strongly tinged with brown. The whorl of leaves beneath does not add much grace to the flower, and if it were not so stiff we might call it dishevelled. The whole plant lacks the trimness and poise of *Arethusa*.

The occurrence of this Pogonia in the Northern New England States is a matter of doubt, particularly in Maine, where the "Portland Catalogue" issued in 1862, and the botanists of the present day are ranged on opposite sides. From the stations sent me, I judge this Orchid to be more common in Connecticut and Massachusetts than is generally supposed. It is met with as far west as Michigan, and as far south as Florida, while a smaller species, *P. affinis*, bearing greenish-yellow flowers, is so dependent on a genial climate that it has been found but once in New England (at New Haven, Conn.), and, ambitious as I am, I admit that it hardly seems fair to keep it on our list.

Some Orchids belonging to the *Arethuseæ*, natives of Australia and New Zealand, as described by Darwin, have such sensitive lips that when touched they spring up, shutting the insect within the flower and either forcing it against the pollen-masses, or, as in *Cypripedium*, compelling it to carry off the pollen as it escapes by some narrow passage. The lips after a time, varying in one species "from half an hour to one hour and a half," re-open and are ready for another visit.

"Few flowers," says a competent writer, "have suffered ruder divisions at the hands of botanists than Orchids." The *Habenarias* have been peculiarly unfortunate in this respect, but a change that cannot be regretted was made in 1877, when *H. rotundifolia*, the *O. rotundifolia* of Pursh, and the *P. rotundifolia* of Lindley, was reassigned by Gray as a True Orchis to its proper place by the side of *O. spectabilis*, which had been having a lonely time as the sole representative in this part of the world of a prolific genus. The Round-leafed Orchis lives on mossy knolls, or tucked away under ferns in damp cedar woods, and is a small but exceedingly pretty plant. It has but one leaf; "its lateral sepals spread like those of most European species;" its waxy flowers are tinged and the lip is dotted with purple. Hooker's description, "pale, dirty white," simply maligns them. If far enough north, for like Calypso this dainty Orchis requires cold, you will probably gather it before the *Arethusas* fade, and in their vicinity.

Any swamp is a treasure-house at this time of year to one who wades recklessly into it. The treacherous sphagnum, shading through all the tints of green into rich reds and umbers, lures you on by offering a bird's nest here and a bizarre mushroom there, till wet feet seem a very small price to pay for so great an amount of pleasure. The *Linnea* swings her fragrant bells; the Bunch-berry masses her involucre into a semblance of the snow-drifts that lay there not so very long ago; the Pitcher-plant offers her brimming beakers; slender

ferns and plumed sedges sway in the wind. With so much that is immediately presented to the eye, how can the Tway-blade, *Listera cordata*, tiniest of our Orchids, hope to turn your steps toward her bower? True, you may not appreciate her after you have brushed away the branches of Kalmia and Labrador Tea, and found her to be a plainly dressed little thing, perhaps six inches high, but she is entitled to as much respect as any of her race. *L. cordata*, the Long-lipped or Heart-leaved Listera, as Barton calls it, came, in 1883, with Calypso, but in our Vermont lowlands generally accompanies *C. arictinum*. It is common all through the Green Mountains during July, particularly under the low spruces on the top of Mansfield and Camel's Hump, and, through July and August, may be looked for in the White Mountains, where it reaches an elevation of 3,000 feet to my knowledge, and probably climbs still higher, as it requires little sustenance except moisture. Beyond New England it extends as far north as Alaska.

The genus *Listera* brings to our notice another tribe, that of the Neottieæ, containing, in this country, *Goodyera*, *Spiranthes* and *Listera*, and standing according to structure between the Ophrydeæ and Arethuseæ. The Neottieæ have "the anther attached to the back of the column, erect and parallel with the stigma; the 2 cells approximate, the pollen rather loose or powdery, or elastically cohering." The genus *Listera* has among other characteristics, the "lip mostly drooping, 2-lobed or 2-cleft; the column wingless; the stigma with a rounded beak; the pollen-masses joined to a minute gland, and the roots fibrous." Of the three species mentioned in Gray, we have two in New England, and *Listera cordata* has the same elaborate mechanism as the British *Listera ovata*.

"The rostellum is of large size, convex in front and concave behind, with its sharp summit slightly hollowed out on each side; it arches over the stigmatic surface. The anther, situated behind the rostellum and protected by a broad expansion of

the top of the short column, opens in the bud. When the flower is fully expanded, the pollen-masses are left quite free, supported behind by the anther cells, and lying in front against the concave back of the rostellum, with their upper pointed ends resting on its crest. Each pollen-mass is almost divided into two. The few elastic threads of the grains are weak, and large masses of pollen can be broken off easily. The lip has two basal lobes which curve up on each side, and these would compel an insect to approach the rostellum straight in front. As

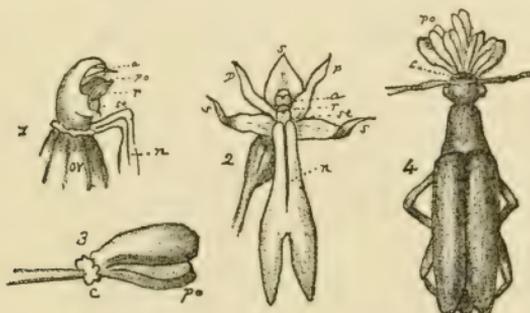


FIG. 16.—*LISTERA OVATA*. (From Muller.)

1. Side view of unfertilized flower: *ov*, ovary.
2. Front view, after the pollen-masses, *po*, have been removed from the anther. The flat rostellum (*r*) is bent forward and partly conceals the stigma (*st*). (Magnified one-half as much as 1.) *n*, nectary.
3. Pollen-masses adhering to a needle (greatly enlarged). *c*, cement.
4. *Grammoptera lewis*, with a number of pollen-masses on its head.

soon as the flower opens, if the exquisitely sensitive rostellum be touched ever so lightly, a large drop of viscid fluid is instantaneously expelled, and, on exposure to the air, in two or three seconds the drop sets hard, soon assuming a purplish brownish tint. As the pointed tips of the pollen-masses lie on the crest of the rostellum, they are always caught by the exploded drop." This drop, then, does the work of a viscid disc for the pollen-masses.

"When the anther-cells open, the rostellum slowly curves over the stigmatic surface, so that its explosive crest stands at a little distance from the summit of the anther; and this is very necessary, otherwise the summit would be caught by the viscid

matter (which expels the drop) and the pollen forever locked up. Small insects alight on the lip for the sake of the nectar copiously secreted (by the furrow on it); as they lick this, they slowly crawl up its narrowed surface until their heads stand directly beneath the overarching crest of the rostellum; when they raise their heads they touch the crest; this then explodes (expelling the viscid drop), and the pollen-masses are instantly and firmly cemented to their heads.

“The rostellum, which is naturally somewhat arched over the stigma, quickly bends forward and downward at the moment of the explosion so as then to stand at right angles to the surface of the stigma. When the rostellum is touched so quickly that the pollen-masses are not removed, they become fixed to the rostellum and by its movement are likewise drawn a little forward. In the course of some hours, or of a day, the rostellum not only slowly recovers its original position (pushing back the pollen-masses, and while this is going on, Müller adds in his account, the groove of the lip is secreting fresh honey), but becomes quite straight and parallel to the stigmatic surface. The downward movement of the rostellum protects the stigmas of the young flowers of a plant from impregnation, and the upward movement leaves the stigmatic surface of older flowers, now rendered more adhesive, perfectly free for pollen to be left on it. The pollen-masses, once cemented to an insect's forehead, will remain attached until brought into contact with the stigma of a mature flower; then the weak, elastic threads which tie the grains together” are ruptured. Sometimes an insect is too feeble to remove the pollen-masses, and one was found by Darwin “vainly struggling to escape, with its head cemented by the hardened viscid matter to the crest of the rostellum and to the tips of the pollen-masses, where it miserably perished.” He also speaks of the number of spider-webs spread over the plants of *Listera ovata*, “as if the spiders were aware how attractive the *Listera* is to insects.”



FIG. 17.—TWAYBLADE. (*Listera cordata*)
LISTERA CONVALLARIOIDES.
LIPARIS LÆSELII.

“All dull yellow (dirty-yellow, brownish-yellow, yellowish-white) flowers,” says Müller,* giving a long list of genera which includes *Neottia*, “are entirely or almost entirely avoided by beetles; closely allied white flowers are visited by beetles, more or less to their injury; and brightly colored flowers, even though they are scentless and offer no honey, or none that is accessible, attract beetles in numbers. If (as he supposes) beetles are only or mainly attracted to flowers by bright colors, dull yellow must be an advantageous color for plants with freely exposed honey, protecting them from these injurious guests. And the fact that dull yellow colors only occur in flowers with exposed honey lends support to this view.” Speaking in another place † of the effect of conspicuousness in inducing insects’ visits, he says: “. . . those insects whose bodily organization is least adapted for a floral diet are also least ingenious and skilful in seeking and obtaining their food, so that with anthophilous insects intelligence seems to advance *pari passu* with structural adaptation,” hence, “short-lipped insects, little or not at all specialized for a floral diet, can usually only find fully exposed honey, such as *Listera* (and others) afford; honey still easily accessible but not directly visible to them is passed by.”

He says again: “Insects in cross-fertilizing flowers endow them with offspring which, in the struggle for existence, vanquish those individuals of the same species which are the offspring of self-fertilization. The insects must, therefore, operate by selection in the same way as do unscientific cultivators among men who preserve the most pleasing or most useful specimens, and reject or neglect others. In both cases, selection in course of time brings those variations to perfection which correspond to the taste or needs of the selective agent.” As insects became more skilful and intelligent, flowers became more varied in color, more complicated in structure, etc. “The

* *Fertilization of Flowers*, p. 574.

† Page 571.

Ichnemonidæ at first surpassed all other visitors in observation and discernment, and were thus able to produce inconspicuous flowers which escaped the notice of other visitors. On the appearance of sand-wasps and bees these inconspicuous flowers were banished by competition to the less frequented localities (*e. g.*, *Listera* to shady woods)."

Our larger species, *Listera convallarioides*, due ten days or so later in damp places along brooks, has a longer column than *L. cordata*, and the flowers are somewhat pubescent or downy. *L. convallarioides*, as I learn partly from the *Report of the Geological Exploration of the 40th Parallel*, has the following extended range: "Canada to North Carolina (rare in lower New England for some mysterious reason), westward to Rocky Mountains and Unalaska. Found in the East Humboldt Mountains at an elevation of 7,000 feet." Both our species are so faintly colored that it is almost absurd to speak of them as having color at all, and they

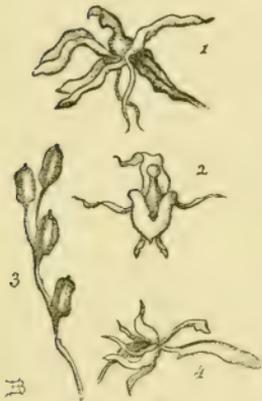


FIG. 18.

1. 2. Flower of *Liparis Læselii*.

3 Seed-vessels of same.

4. Flower of *Listera convallarioides*. (Anther removed.)

are so fragile, watery and translucent in substance that it is impossible to represent them in a sketch without exaggerating their size. I have grouped them with a species of *Liparis*, or Twayblade, *L. Laselii*, a small, coarse herb with the greenish-yellow colors of the *Listeras*, and like them a dweller in wet places.

In *Liparis*, which is a genus of the tribe *Malaxidæ*, "the anther is attached to the apex of the elongated, incurved column; the 4 pollen-masses arranged in one row (2 to each cell) have no stalks, connecting tissues or gland." These herbs have "solid bulbs." The lip is spurless as in *Listera*; and in *L. Laselii*, whose flowers have a combative air like so many little drag-

ons, there is a furrow or median line on the lip, corresponding probably to the nectar-secreting groove in *Listera*, and as the edges of the lip curve up at the sides, an insect would have but one easy mode of entrance offered, and in crawling up this passage-way would be led directly under the anther. Barton gives a fairly good plate of this *Liparis*, calling it *Malaxis longifolia*, the Long-leaved *Malaxis*, and describes the root as "a roundish bulb, sending off a few radicles and a large offset, the germ of a new plant." England produces a smaller species, and this, together with *Listera ovata*, is considered by Grant Allen to be degenerating like *H. viridis*.

Our more common species, *L. liliifolia*, Barton's Lily-leaved *Malaxis*, with brownish-purple, larger-lipped flowers, follows *L. Læselii* in the course of a week or so. This species grows as far south as Georgia; *L. Læselii* ranges from New England and the Middle States to Wisconsin and above the 50th parallel. I was quite impressed by the diminutive size of *Listera cordata* until I opened an herbarium containing among its Orchids a row of fully developed plants related to *Liparis* (*Malaxis paludosa* from Scotland), few of them over an inch high.

Some pasture, threaded by sluggish streams, or some wet road-side, will, about the middle of June, afford the next Orchid and the first of the genus *Spiranthes* or Ladies' Tresses; *S. latifolia*, the Broad-leaved *Spiranthes*. The small, white blossoms, climbing spirally up their spike, and suggesting to a highly imaginative person a lock of hair, would seem to have originated the popular name:



FIG. 19.—LILY-LEAVED LIPARIS.
L. liliifolia.

but this is evidently only a natural corruption of the name given in the old botanics, Ladies' Traces, which likened the arrangement of the flowers to the traces or strings of a bodice.

Spiranthes is intermediate between *Goodyera* and *Listera*. "In *Spiranthes*," says Meehan, "there are callous protuberances at the base of the lip; the other genera have none. *Listera* has sepals and petals spreading, the petals of the others are ringent (or gaping) at the base. In some cases of *Spiranthes*, the rachis, or that part of the stem to which the flowers are attached, is perfectly straight and only the flowers seemed coiled around it, while in other species it is screw-like and seems to carry the flowers with it as it coils." "Gaping" describes most admirably the appearance of the tubular blossoms. The stem of *S. latifolia* is "naked or leafy below; the roots clustered-tuberous," to quote superficially from Gray. The arrangements for fertilization are probably similar to those of *S. gracilis* and *S. cernua*, and I reserve a description of the process until I come to those later species. Meehan states that these Orchids are seldom, if ever, obtained beyond the Mississippi.

I have found *Spiranthes latifolia* quite high up on mountain roads when hunting for another Orchid that requires cold and dampness, *Habenaria dilatata*. The latter, it is safe to assume, is associated in many a mind with a Maine carry, a White Mountain flume, or a Green Mountain notch. Perhaps you recall the very spot, a green nook near the limpid pool in which you dipped your hands; or it may have been higher up where white-throated sparrows were whistling through the mist, and icy springs came trickling through beds of moss and snow-berry, and the bleak summit was almost gained.

H. dilatata, the Northern White Orchis, has been often confounded with *H. hyperborea*, the Northern Green Orchis, as by Sir William Hooker, who feared it was only a luxuriant form of the latter, and by Dewey, who, in his *Herbaceous Plants*



FIG. 20.—NORTHERN WHITE ORCHIS. (*Habenaria dilatata*.)
THREE-TOOTHED ORCHIS. (*Habenaria tridentata*.)

of *Massachusetts*, called it "unattractive," while Mrs. Lincoln, whose *Lectures on Botany* were published at Hartford in 1835, thought the difficulty bridged by her statement: "in the woods the flowers are green." *H. dilatata* is one of the most stately children of the forest, and her velvety spike, springing out of rank sedges and ferns, catches the eye at once, or where the plant grows profusely, so perfumes the air as to need no other sign of its presence. Its color is usually pure white, but Mrs. Sarah C. Purington, of Auburn, Maine, writes me that she once found this species deeply tinged with pink-purple. As Gray well says: "the spike is wand-like;" both bracts and spurs are short; and there is "a trowel-shaped conspicuous beak (rostellum) between the bases of the anther-cells." *H. hyperborea*, which, as has been intimated, comes at the same time and generally in the same places, is more numerous flowered; the lip is tapering instead of "dilated;" and the stem is sheathed with broader leaves. The *Report of the Geological Exploration of the 40th Parallel* gives the range of these two *Habenarias* as follows: "*H. hyperborea*; Border States and Canada to Greenland and the Arctic Circle (Iceland also has its *H. hyperborea*) and Unalaska. The Saskatchewan region and Washington Territory and southward on the mountains to California(?) and Nevada. In Nevada found at an elevation of 8,000 feet, as July-Aug. *H. dilatata*; Nevada, 6,000 to 9,000 feet, July-Sept. Posterior sepal not hooded." The chief difference between the species, however, is that *H. dilatata* cannot fertilize itself, while *H. hyperborea* "habitually" does.

"*H. dilatata* has," says Gray, "its anther-cells near together and almost parallel, and the very large strap-shaped discs are parallel, vertical and near together, and placed just over the back side of the narrow orifice of the spur, looking forward; they are nearly as long as the pollen-mass and its stalk together; the latter is short and flat and attached to its disc just below the summit of the latter. No movement of depression or of

rotation was detected. The throat of the flower is a narrow chamber; and the narrow stigma and the discs lie so low in it that fertilization cannot be effected without insect aid, and this can be given only by means of a proboscis. We find accordingly, that a pig's bristle cannot be thrust down to the bottom of the spur and withdrawn without bringing away one of the pollen-masses. But the anther-cells open early and the pollen-masses are often dislodged as soon as the flower opens. Yet from the arrangement of the parts, we think that they can never fall over upon their own stigma as they do in the allied

“*Platanthera (Habernaria) hyperborca*. Here the lip, spreading from the base, leaves a more open throat, the more exposed stigma is broad and transverse, the anther-cells are more divergent, and from the curvature of the flower, more overhanging, and the stalks of the pollen-masses very slender and weak. Thus disposed, the pollen-masses very commonly fall out of the anther-cells while the tip of the lip is still held under the point of the upper sepals and petals, or even in the closed buds, and when the lip is disengaged and becomes recurved, or even before, the pollen-masses are apt to topple over and fall upon the broad stigma beneath.” In this respect the plant is much like *Ophrys opifera* in Darwin's treatise, but *H. hyperborca* is also fertilized by outside aid. “The packets of pollen are looser and the threads that attach them to the stalk weaker than usual; while the discs (which are oval and rather small) retain for a good while their viscosity, so that a fitting insect on visiting the open flowers, in which the pollen-masses have already fallen over on to the broad stigma underneath, will yet catch one or both of the discs upon his proboscis, carry off the pollen-masses (which may be readily detached from the stigma, leaving some pollen behind) and apply them in succession to the stigmas of other flowers of other individuals, and thus effect occasionally the crossing so uniformly effected in most



FIG. 21.—PUTTY-ROOT. (*Aplectrum hyemale*.)
Leaf, Flowers and Seed-vessels.
LARGE CORAL-ROOT. (*C. multiflora*)

species of the tribe. We have observed that this species is very fertile, usually maturing all its ovaries."

The genus *Corallorhiza* (Coral-root), northern or extra-tropical in range and containing about ten species, has four representatives in the North-eastern United States, three of them occurring in New England. This genus follows *Liparis* in Gray's Botany; the plants are supposed to be root-parasitical,* and send up "a simple scape, furnished with sheaths instead of leaves, from a much branched and toothed coral-like root-stock." The lip, "slightly adherent to the base of the 2-edged straightish column," "is often more or less extended into a protuberance or "short spur coalescent with the ovary." The anther is "terminal, lid-like." The 4 pollen-masses are "soft-waxy or powdery, and have no stalks or connecting tissue." *C. innata* (Early Coral-root), and *C. odontorhiza* (Dragon-claw, Coral-tooth, Small Late Coral-root) are mentioned together here, although the latter belongs rather to July, in Vermont, because the next Orchid mentioned is a near relative and might be mistaken for them. *C. innata*, which Hooker says closely accords with the European species, is a low dingy-green herb bearing a few spurless flowers, and found in swampy or wet shaded places. Growing as far south as Georgia, it yet follows Calypso across the 60th parallel, but notwithstanding this extensive range, it is rare. *C. odontorhiza* is found in Florida, and Chapman makes the singular statement that although vernal in the North it does not bloom till September and October in the South. This Coral-root has a depression where its flower-spur should be. From its greater height, which may be sixteen inches, and its

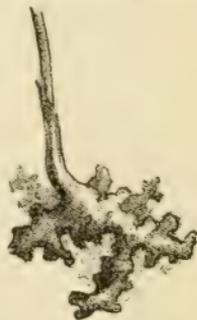


FIG. 22.—ROOT OF
CORALLORHIZA.

* Sachs (*Botanical Text Book*) calls the Coral-roots, particularly *C. innata*, "saprophytes," because they "make use . . . of the material of other plants which are already in a state of decomposition."

more numerous and purplish blossoms, it has a better claim to attention, but I fear that neither species will ever have its praises celebrated in any but the heaviest prose.

Aplectrum hyemale, the Winter Aplectrum, has a bulb like a crocus, and on digging this up, two or more are found connected with it, as offsets, generally in a horizontal line like beads on a string. (See root of *Tipularia*, fig. 27.) Each "requires two years for its perfect development, and dies at the end of the third," after producing a scape of flowers; and as each year one bulb shrivels and another is added, the scape may almost be said to keep in motion. The character of the root has given the popular name of "Adam and Eve" to this Orchid, and the bulbs are worn as amulets by the southern negroes and poor whites, who also place the (separated) bulbs in water and according as Adam or Eve "pops up," calculate the chances of retaining a friend's affection, of "getting work, or of living in peace with neighbors;" while Pursh tells us that the sticky matter of which they are composed is mixed with water and used by thrifty housewives to mend their crockery, and Putty-root is the more widely known name at the North. Like *Calypso borealis*, it sends up its single distinct leaf at the end of summer or early in September, in rich dry woods. A stiff, dark purple horn first pricks the ground, rises slowly, for it has a long and severe life before it, and when it grudgingly uncurls, shows a coarse leaf, greenish on the upper side and threaded with numerous white veins. Crushed down and bleached by the snows, it presents itself in the spring in a very wrinkled condition, holding on bravely till the plant flowers, when it withers away. Barton styles it the "Double-bulbed *Corallorhiza*," and criticises Pursh and Willdenow for endowing it with two leaves. The flowers resemble in shape those of *C. odontorhiza*, and, as the Greek substantive signifies, are spurless. The sepals and petals are dull yellow tipped with brown; the lip white, flecked with purple, and the per-

fume delightful. The lip is free from the column, but the flowers and scape have the general structure of those of the Coral-roots.

While the *Aplectrum* grows as far north in America as the Saskatchewan Valley, it is rare in New England. The earliest date obtained from Connecticut is June 6th, and in Central Vermont and Western New Hampshire its mean time of blooming would appear to be June 20th, though once in a while it ignores set times and celebrates its birthday in May. A Michigan botanist writing to the *American Naturalist* some years ago, called it "a shy bloomer." It is very abundant near Detroit, but he had watched for years without seeing any flowers, and although buds formed on transplanted specimens they never matured. I have been more fortunate myself, both in finding flowers from year to year and in transplanting, but have always been struck with the disproportion between the number of flower stalks and the number of leaves. The bulbs have a rank smell, and to my thinking are fully as disagreeable to the taste, but I know persons who profess to be fond of them.

The silent procession seems to be dwindling down and becoming sad-colored, but it is time to expect the most regal of our Orchids, the Showy Lady's Slipper, *C. spectabile*, whose tropical lustiness of growth one can hardly attribute to our climate. The first time I found the plant, I was working my way out of a low, wet wood, where the osmundas grew tall and palm-like, and coming suddenly upon a group of what were unmistakably Lady's Slippers, I was as startled as though a gaudy cockatoo had fluttered by. Already, it was the last of May, the broad plaited leaves reached, on their stalwart stems, above my knees. Could this be their natural home, and if so, must they not have made a compact with August and be waiting for an intense heat to call out their great flowers?

This species displays a crimped, shell-shaped lip that varies from a rich pink-purple blotched with white to pure white;

indeed, as *C. album*, it was known in England before 1770. Two blossoms often, sometimes three or four, are found on the same plant, and I have been interested to learn from a friend that he broke off a bud from a root he was transplanting one fall and found on cutting it open, two embryo flowers packed away there, and even saw their pollen-masses without the aid of a glass.

C. spectabile comes as early as the 20th of June in southern Connecticut, and, in early seasons, has been gathered on the same date in Penobscot Co., Maine, where, says Miss Furbish, "whole swamps appear to be devoted to it, and it really impedes progress by its height and abundance." The 28th will answer for Central Vermont and New Hampshire, but the White Mountains, I think, rarely afford it before July. Its range, elsewhere, is Wisconsin, Illinois and "southward along the Alleghanies." I have read of a supposed case of poisoning by *C. spectabile* and *C. pubescens*, and am eager in their behalf to shift the blame upon the Poison Ivy and Poison Sumach, old offenders, generally found skulking in the same localities. The False Hellebore, a stout, coarse perennial, very abundant in low ground, bears when young and before its racemes appear, a superficial likeness to the Lady's Slippers, and I do not wonder that it is considered a prize by the inexperienced who are searching for *C. spectabile*.

Prof. E. S. Bastin, of the University of Chicago, has kindly allowed me to make extracts from a paper read by him at the last meeting of the Social Science Association, in which a remarkable specimen of *C. spectabile* is described. It was "found in June, 1881, in the pine barrens on the southern end of Lake Michigan. The monstrosity was an almost regular flower growing on the same stem with one of the ordinary form. It possessed three broadly lanceolate sepals, all alike and not at all united. It had no lip, but three regularly formed pure white petals all of the same size and shape, as long, but some-

what narrower than the sepals and alternating with them. Representing the first circle of stamens were two, instead of one, fleshy dilatated triangular bodies occupying the normal position, that is alternating with the petals. They resembled in thickness and in general shape the one in the normal flower, and were also spotted like it, but were somewhat smaller and not bent, but erect or nearly so. The second staminal circle consisted of three fully developed stamens inserted on the column opposite the petals and closely resembling those of the normal flower in structure, except that coalescence with the style (the part of the pistil that bears the stigma) was less complete, and the connective or projection at the back of the anther was rather more distinct. The stigma was very nearly equally three-lobed, and the lobes were conspicuous and arranged alternately with the stamens. The column was but slightly bent, the ovary scarcely twisted, and the flower was but slightly bent to one side. Here, in a genus affording some of the most strikingly irregular flowers in nature, was a flower all but regular, and unsymmetrical only in not possessing even a vestige of the third stamen of the first staminal circle. This specimen tends to establish the conclusion, if regarded as an instance of reversion to an ancestral type, that the large, fleshy dilatated triangular organ of the ordinary flower is the rudiment of a stamen belonging to the outer staminal circle. No doubt the organ originated by the disappearance of the anther and the broadening and thickening of the filament and its extension, the connective. In fact, in the monstrosity under consideration, the fertile stamens were, when viewed from the back, very much like miniatures of the two rudiments of the outer circle.

“The missing stamen of the outer circle had left no trace behind, and there was no evidence, either from difference in size or difference in venation of the petals, that it had become confluent with one of them. It would seem probable that the lip, if it is a compound organ at all, is made up merely of the lower petal

united to the stamen of the inner circle that would normally come opposite to it."

Mr. S. I. Smith, of Norway, Maine, in some notes read before the Boston Society of Natural History, in 1863, says that he came on a bunch of this Lady's Slipper, "which was almost covered with numbers of a minute flower-beetle, apparently attracted by the nectar-like fluid that moistens the long hairs



FIG. 23.—DWARF ORCHIS.
Habenaria obtusata.

in the labellum. These beetles were crawling over the flowers in every direction; and presently one crawled from one of the lateral petals up the column, over one of the pollinia with some difficulty, and out upon the stigma. This was repeated three or four times by different individuals; some returning by way of the column, others passing over the sterile stamen on to the labellum. Several beetles passed from the lateral petals down to the labellum without touching the pollinia or the stigma. Only two were seen to alight upon any of the flowers; and one of these went into the labellum without touching the pollinia or stigma; the other passed over both. Nearly all the beetles, when examined with a lens, were found to have little masses of

pollen attached to them; and many could scarcely walk for this reason. Most of the flowers on which the beetles were found had been fertilized, and under a strong lens showed minute particles of pollen among the sharp pointed papillæ which beset the stigma. Of many flowers from different places, nearly all had the pollen removed in minute particles from the anther to the stigma; but in two or three instances the pollen had been removed in one mass as if by some large insect."

Turn now from this, our largest Orchid, to the Dwarf

Orchis, *H. obtusata*, contented with a few inches in stature and two quiet colors, green and white. "The flowers are rather large for the size of the plant; the anther-cells are curved like a bow and widely separated." Sir William Hooker somewhere gives a plate of this *Habenaria*, and in an enlarged drawing of the lip shows two oval spots at the base—these serving, probably, to attract insects by secreting nectar. You come across this species almost anywhere in the Green Mountains (particularly on Mansfield, Camel's Hump and Killington Peak) from the last of June, on through July; in the sub-Alpine region of the White Mountains in August; and early in the same month at Mt. Desert. Gray follows this *Habenaria* north of Lake Superior, and the Geological Exploration of the 40th Parallel made known its existence in Colorado.

There is a sandy tract of country lying to the north-east of Burlington, where patches of original forest alternate with second-growth timber, and roads go zigzagging as if trying to find their way out—a fascinating exploring ground if one is not vexed by the dust and the depth to which his wheels sink, because apparently so unpromising. I was not favorably disposed toward it, when introduced, one day toward the middle of July, for I was returning from Mt. Mansfield, and the impressions produced by the mighty scenery left behind; the gorges, the leafy silences, the contest of mist and wind on the summit, still had me in their hold, but as we turned from the highway into a narrow track and wound under low-hanging boughs of pine and oak, the despised region began to rejoice and blossom at every step. In the grassy openings where feasts of late strawberries tempted us to loiter, stood row after row of Turk's-cap lilies, their brilliancy somewhat softened by the bindweeds that thrust up their cool white cups among the ferns already dappled with brown and gold. At last we parted the branches and came out on the shore of a little pond, so lonely and so black that it would have depressed us had it not

been dotted with water-lilies and spangled along its marshy edge with the leaves of the sun-dew, and here, side by side, grew the objects of our search, *Calopogon pulchellus* and *Pogonia ophioglossoides*, whose harsh, and to me always irritating names, seemed at that time peculiarly inharmonious.

These Orchids may be styled inseparable, for there are few extensive bogs that do not afford both; and the more dangerous the morass, the more untrustworthy the scow you have discovered on the shore of lake or creek, the more confident you may be that your prize is awaiting you—just out of reach. The genus *Calopogon* is represented in the Eastern United States by three or four species, but one of which favors New

England, and this, sometimes known as the Grass Pink, wears colors that one would not naturally select to go together. Nature has combined the white and yellow of the bearded lip and the purple-pink of the other parts with her usual boldness, but the result is not sufficiently agreeable to cause us to notice the



FIG. 24.—FLOWER OF
C. PULCHELLUS.

flower particularly, on that account alone. The peculiarity of the genus is that the ovary is not twisted as in all our other Orchids, and the lip is therefore in its proper place on the upper side.

“The type of most Orchids is ternary,” says Meehan, in *Native Flowers and Ferns*; “in other words, three leaves form a verticil in them whenever the spiral growth is rapidly arrested, and the spiral coil is brought down to a plane. We generally look for three leaves on the flower stem of an Orchid of this kind; but in this species, *C. pulchellus*, only the central one has been developed, while the lower has advanced no farther than a reddish-brown sheath, and the third or upper one has been so entirely absorbed by the stem that only a small reddish-brown spot is left to show where the leaf might have been. In the flower, however, the ternary character is better



FIG 25.—ADDER'S-MOUTH POGONIA. (*P. ophioglossoides*.)
GRASS PINK. (*Calopogon pulchellus*.)

developed. The lowermost division (lowermost in the accompanying figure), and the two upper ones form the lower series or verticil, or, as it would be called in other orders, the calyx. The lower leaf (lower as before noted), if the 3 were drawn out on a stem as real green leaves, would be the upper or 3d in the cycle, and we see that it has begun to change its form. The next drawing in of the spiral twist, which has resulted in another cycle or verticil of 3 leaves brought down to one plane, has ended by bringing the upper normal leaf, and the most changeable, as we have already seen, just opposite to where the twisting of the lower verticil ended. . . . In other Orchids . . . another twist takes place in the ovarium just as the petals are about to open and after all the twisting so far described has been done, and the result is that the lip (which in our flower is the uppermost leaf of the 2d verticil) assumes the position of the lowermost part of the flower. In *Calopogon* the extra twist has not occurred, and the result of this limited torsion is that the lip forms the upper instead of the lower part of the flower."

Some Orchids have the foot-stalk twisted instead of the ovarium, Darwin says. In either case, "from slow changes in the form or position of the petals, or from new sorts of insects visiting the flowers, it might be advantageous to the plant that the labellum should resume its normal position on the upper side of the flower, as is actually the case with *Malaxis paludosa* and some species of *Catasetum*, etc. This change . . . might be simply effected by the continued selection of varieties which had their ovaria less and less twisted; but if the plant only afforded varieties with the ovarium more twisted, the same end could be attained by the selection of such variations, until the flower was turned completely round on its axis." Thus in *Malaxis paludosa*, "the labellum has acquired its present upward position by the ovarium being twisted twice as much as usual."

In newly opened flowers of *Calopogon* the lip bends over the column, and Professor Goodale,* speaking as if this were its ordinary position, calls it "an arched roof decorated with attractive colors." Gray describes it as "distant from the column," and I do not think, myself, that the arched position is retained very long, but that the lip usually appears as an inviting signal, held aloft above an open-faced, easily entered flower. In *Calopogon*, the column, free from the lip or barely hinged to it, curves like the keel of a boat, and is lobed on either side of the apex where the lidded 2-celled anther with its 4 soft pollen-masses, "lightly connected by delicate threads," is situated. As Goodale expresses it: "the lateral stamens (seen in *Cypripedium*) are missing, but the one corresponding to the sterile stamen in *Cypripedium* is here that bearing the pollen." The stigmatic surface lies in front of the anther, between the lobes.

"The anther," says Hervey, in *Beautiful Wild Flowers*, "is a thin-walled cup, hinged on its back with the extreme end tissues of the column. It lies in a little hollow and faces inward toward a thin partition wall which is raised up at that point across the axis of the column. The stigma is on the other surface of this partition, and of course still nearer the centre of the flower. The ripened anther, when touched by a body moving in a direction away from the centre of the flower, will roll upward on its hinge with the greatest possible ease, exposing the pollen-masses to contact with the disturbing body. . . . The stigmatic surface which . . . lies on the other side of the wall that closes the mouth of the anther is in exactly the right place and position to be fertilized by pollen from another flower upon the under surface of his (the insect's) body . . . and he will most certainly touch the anther at the end of the column with that part of his body."

The scape rises from a small bulb, an offset from that of the

* *Wild Flowers of America*.

previous year, and as this Orchid bears from 2 to 9 flowers it is naturally more abundant than the Pogonia in their locality; indeed, Meehan says, it rarely fails to perfect its seed-vessels, and he also calls it fragrant, a compliment that has been paid by Burroughs, as well; and here again I fail to agree, deriving much consolation from the recent editions of Gray's Manual, which have dropped the adjective used in former years. The Adder's-mouth or Snake-mouth Pogonia, *P. ophioglossoides*, on the other hand, always has a decided odor like that of violets, and I recall no wild flower of as pure a pink unless it is the Sabbatia (chloroides). Barton's conscientious attempts at description delight me, and in this case, his "peach-blossom red" would probably satisfy most masculine admirers of the Pogonia. To the yellow bearded lip that makes the Arethusa so bright, it adds a pretty tuft of purple-pink, and if the Arethusa is striking in its appearance, this Pogonia is to be praised for its refinement. It figures as an Arethusa, in old botanics, but, to recall one point of difference; in that genus, it will be remembered, the base of the lip adheres to the column. Gray mentions a "monster" flower, found in New York State, which had "two additional lips and some other petaloid parts." The root of this species consists of long, worm-like fibres.

Outside of New England, *C. pulchellus* ranges from Florida, through Arkansas and Nebraska to Minnesota, and as *P. ophioglossoides* is found in Florida, I take it that it keeps the Calopogon company westward. I have seen specimens of this Pogonia from Japan, and should think it would appeal strongly to the native artists as a subject for caricature or realistic treatment, but as yet I have not recognized it on any vase or fan.

In the *Proceedings of the Boston Society of Natural History* (Vol. IX., 1863), Dr. Samuel H. Scudder gives the following account of the fertilization of this Pogonia: "The flower is

thrust out at nearly right angles to the upright stem, the column being a little raised from the horizontal; the shield-shaped stigmatic surface is situated at the upper front portion of the column, which is surmounted by a pretty deep clinandrum with an elevated, jagged border, and to the hind part of this, the curiously shaped auriculated anther is attached by a narrow elastic hinge which compels the anther-lid to remain deeply seated in the clinandrum, whose thin, jagged edges border it on every side. Upon the under surface of the anther-lid, as it thus lies, are situated the two bunches of pollen, confluent, forming a prominent oval mass, which a slight touch may remove. The thin edges of the clinandrum do not border the anther-lid equally on every side, for if it were so, the raising of the lid would brush the prominent pollen-masses against the front edge, causing the pollen to fall useless into the bottom of the pit, and thus render the plant self-destructive: to obviate this, the edge of the clinandrum in front is hollowed and thrust forward slightly, leaving sufficient room for the passage of the pollen-masses at the raising of the lid: the resulting space is not, however, left completely open, but as if to prevent the accidental removal of the pollen-masses, the lower front edge of the anther-lid is furnished with a row of fringe of elongated papillæ, quite effectually closing the opening. So by this means, although the masses of pollen and the stigmatic surface are in close contiguity, they are entirely prevented by the exact structure and sculpture of the parts of the flower from ever coming in contact with one another except through foreign aid; for the pollen-masses are seen to be completely packed away in a deep pit, pressed down by a ponderous lid, whose elastic hinge will not allow its elevation without considerable force; and should by any possibility a portion of the pollen escape through the opening in front, rarely effectually closed by the fringe, it would drop, not upon the stigmatic surface, but upon the lip, opposite to it.

“An insect flying to the flower and intent on its sweets, would alight on the lip, and creeping in would strike its head and back first against the protruding anther-lid, only pressing it down more tightly, effecting nothing, and then against the stigmatic surface. The passage into the flower is narrow, allowing no room for anything but a very small insect to turn round in, so that no sooner does the insect withdraw itself backward, than the top of the back and of the head, striking, as it almost infallibly must, against the front of the anther-lid (which at its upper portion projects forward somewhat in order the more readily to catch the passing head), raises it more and more with its continued withdrawal, rolling the outer and under surface of the lid against the upper and front portion of the head of the insect till it has passed, when the lid snaps back to its original position, leaving the pollen-masses adhering to the upper portion of the front of the insect's head; or if only a portion of the pollen be removed, the lid being closed again is ready for the services of the next visitor. The insect flies to another flower, and striking with the top of the head plump against the stigmatic surface, leaves the pollen glued to it.

“Besides the prominence of the front of the anther-lid, the fringe upon the under side of the lid in front is directed slightly outward, and may assist by becoming entangled or interlocked in the hairs of the retreating insect and more surely effect the raising of the lid. The edges of the column on either side of the stigmatic surface project outward a little, making a shallow channel for the better guidance of the insect toward it; and it does not seem too fanciful to suppose that the heavy beard upon the lip, through which the insect must pass with difficulty, may cause it to walk through it as it were on tip-toe, in order to raise its abdomen high above the obstacle, and therefore to strike more surely the stigmatic surface on entering and the anther-lid on retiring. There is besides another curious fact: on raising the lid it will be seen that it does not open alto-

gether as we should expect it, but is thrust forward a little, apparently through some elasticity of the hinge, so that the pollen-masses, when the lid is partially open, are found to reach a position nearly as far forward as the projecting front of the lid did when closed, although on the removal of the pressure it will revert to its original position; this again seems to lend its aid in the same direction.

“ Out of nine flowers examined, seven had both pollen-masses and stigmatic surface intact; the other two had each their stigmatic surface smeared with pollen, and the pollen-masses in one wholly, and in the other partially, removed. The plant very generally has but a single flower, so that by what has been stated it will be seen that with rare exceptions no plant is ever fertilized by its own pollen. It is stated by Prof. Gray in his Manual of Botany, that the *Arethuseæ* all have the fertile anther like a lid over the column, and that this is, after a time, deciduous. It may be questioned on this account whether it might not here prove to be directly capable of self-fertilization; but in one plant examined in which the pollen-masses had been removed, the stigmatic surface smeared with pollen and the petals of the flower quite withered, the lid still remained and no loss of elasticity in the hinge was noticed, so that the anther probably does not fall off till a period subsequent to the fertilization of the plant. In another plant, not yet showing any signs of decay, where the pollen had been partially removed, that which remained was much discolored, and even seemed to show signs of decay, as if but a temporary exposure to the atmosphere were injurious to it.

“ This Orchid agrees more nearly with *Dendrobium chrysanthum* than with any other mentioned by Darwin, but differs peculiarly from that in altogether wanting a rostellum, a second of the characteristic features shared by most Orchids which is wanting in this plant, the pollinia (having no caudicle and disc) being the first.”

The Large Coral-root, *C. multiflora*, shows itself in dry woods about this time, in Vermont, dull pink, purple and yellow shading into each other on its scape and blossoms, and a decided knob borne on the ovary answering to a spur. This species is found in Washington Territory and California, as well as in the Northern States and Canada, and it was found in one locality at an elevation of 7,000 feet by the explorers of the 40th Parallel, their botanical report describing it as flowering in July, and having "sepals and petals strongly veined." Our New England woods bring forth at the same time another parasitic plant, puzzlingly like a Coral-root to the young collector, and this, known as *Epiphegus* or Beech-drops, is a stiff, unhappy looking thing, which, if it really masquerades as an Orchid, quite overdoes the business by branching into a low shrub and blooming more profusely than *Multiflora* even.

Having spoken rather disparagingly of the Coral-roots, I scarcely know how to describe or to make my finest pointed pencil flatter the One-leaved Adder's Mouth, *Microstylis monophyllos*, or the other species, coming later in July, *M. ophioglossoides*; diminutive bulbous herbs that stagger under their scientific titles. Wholly attired in green, and odorless, they are well concealed in their swamps and wet forests, but to the tiny gnats and flies that must fertilize them they are fully as important as the gigantic Lady's Slipper that may overshadow them is to its bee. Here, in each flower, are spreading sepals and petals; a long, round column with an erect anther; 4 waxy pollen-masses in one row. The coat of arms, though small, is legitimately dis-



FIG. 26.—ADDER'S MOUTHS.
Microstylis ophioglossoides.
Microstylis monophyllos.

played, one must allow. The Adder's-mouth *Microstylis* carries its leaf near the middle of the stem, and is by this feature most quickly distinguished from the other species which has its leaf sheathing the base.

It was observed by a naturalist of Ottawa, Canada, that in 1882, *M. ophioglossoides* was very common in that region, while few specimens of *M. monophyllos* could be found. In 1883, the reverse was the case: *M. monophyllos* was abundant, and only one or two plants of the other species noted. This habit of appearing and disappearing without any apparent reason is another charm of the Orchis family.*

Our rarest Orchid, if we reject the doubtful *Pogonia affinis*, is the Crane-fly Orchis, *Tipularia discolor*, which straggles across the sandy woods of Massachusetts into Southern Vermont, and probably into New Hampshire, and is scarce west and south as well as in New England. The genus, as given in Gray, follows Calypso (one would say that fancy needed to call a good many intermediate forms back to life). In *Tipularia* the very long spur is noticeable; the column, as is not the case in Calypso, is narrow and wingless; the lid-like anther is terminal and not "below the apex," and the "2 waxy pollen-masses, each 2 parted" are "connected by a linear stalk" instead of directly to the gland of the stigma. The scape, sheathed at the base, rises like that of the *Aplectrum* from one of several connected bulbs, and as with Calypso and *Aplectrum*, a distinct leaf is put forth in autumn. The flowers of *T. discolor* ("distinguished by the blunt tip of its lip from a recently discovered Himalayan species"), scattered down the long, angular scape, are brownish-purple, but attract less attention than the green column, which is very much exposed. The leaf is reddish-purple while getting its growth, and is smoother in texture and less strongly veined than that of *A. hyemale*, but approaches it in size.

* The same irregularity has been noticed in the case of *H. ciliaris* and *P. verticillata*.



FIG. 27.—CRANE-FLY ORCHIS. (*Tipularia discolor*.)
Also front view of flower, side view of column and lip,
and bulbs with offset.

Having living specimens of these three Orchids in my garden, this fall (1883), I have taken pains to note the dates when their leaves appeared: Calypso, Sept. 2d; Aplectrum, Sept. 9th; Tipularia, Sept. 14th. As *T. discolor* blossoms late in July, it has, one might say, but little rest from toil, and somehow the wriggling spur and spreading sepals and petals convey the idea that the plant really has a good deal of business on hand. My drawing was made, I should add, from a fine and large specimen.

A meadow in midsummer presents the same temptation to a pedestrian that an untracked sheet of ice does to a school-boy. There is a great satisfaction in making the first break in the soft, undulating expanse that resists the knees so feebly; and your path is sure to be a winding one, for on this side and that, lilies, rues and spiræas beckon, and as their beauty will not avail them when the scythe is whetted, why should you not anticipate it? If the ground is at all damp and the meadow skirts some woods, notices to trespassers will fail to daunt the stubborn man who is after Fringed Orchises and suspects that some are secreted among the bushy knolls and hummocks.

Habenaria fimbriata (*O. grandiflora*), the Large Purple or Tattered-fringe Orchis, less common than the smaller and later species, *H. psycodes*, is claimed for June by Rhode Island; while dates from Burlington, Vt., Claremont, N. H., and Mt. Desert, Me., would seem to indicate July as its proper period northward. I have seen leaves as broad as a man's hand, and I think it has as opulent and self-assured an air as any of our Orchids. Its loose, feathery spike, which saves it from any imputation of coarseness, always suggests to me a flock of birds struggling to get foot-hold on the same branch. A curious specimen was reported to the *American Naturalist*, not long ago by Mr. W. W. Denslow, of Massachusetts, in which the flowers were all abnormally developed and destitute of both fringes and spurs, and the herbarium of Columbia Col-

lege contains a singular form, supposed to be intermediate between this and the Smaller Purple Fringed-Orchis, which has the middle division of the lip merely toothed like the petals. Gray describes the spike or raceme of *H. fimbriata*, as "oblong," that of *H. psycodes* as "cylindrical;" the petals of the former as "denticulate (or toothed) above," the petals of the latter as "toothed down the sides."

Thoreau, who found both these Fringed Orchises in Northern Maine, grumbled loudly because they were so abundant where only moose and moose-hunters could see them, and so rare in Concord. Meehan says of *H. fimbriata*, that it is most common on hilly ground (another point of difference between it and the other species), that it ranges from New England to Michigan and Southern Ohio, and that England produces species "but little different in appearance," some of them known in old literature as Dead Men's Fingers, Dead Men's Thumbs, and Long Purples (*O. morio*); two of these names occurring in Hamlet in the passage where the queen describes the manner of Ophelia's death.

"In the stem growth," the same writer says, "there has been a gradual elongation, but we see that it takes but three leaves to make a full circle round the stem. We do not notice indications of the spiral growth which takes these leaves round the stem, but it is there. It is the more sudden twisting and arresting of the elongating growth that make the set of 3 sepals and 3 petals. These lengthenings and twistings do not go on with regular intensity, but as in waves, sometimes fast and sometimes slow. If we watch the growth of the flower we shall find that it first makes a slow elongating growth, and that the twisting comes on suddenly, usually taking but a few hours to make a half turn."

"The two side divisions of the lip," says Gray, "aid in hindering approach" from those directions, "while the middle division offers a convenient landing-place in front. The con-



FIG. 28.—LARGE PURPLE FRINGED-ORCHIS.
Habenaria fimbriata.

tracted base of the lip is grooved, or with incurved margins, the trough leading as a sure guide to the narrow orifice of the nectary. The two anther-cells are widely separated, but little divergent; their lower ends projecting strongly forward, bring the naked discs just into line with the orifice of the nectary. The pointed tip of a pencil brought to the orifice neatly catches the sticky discs and brings away the pollen-masses; when the movement, which is effected within a quarter or a third of a minute, converges them just enough to make them hit the broad stigma (which lies rather high) upon the re-application of the pencil. The 'drum-like pedicel' (seen in *H. Hookeri*), is present in this species also, but reduced to a minimum; the movement which takes place appears to result wholly from its change of form, the portion towards the anther contracting most, and to be one of depression solely."

Habenaria tridentata, Barton's Three-toothed Orchis, which has already been mentioned as coming close to the True Orchises, is the *Orchis tridentata* of Muhlenberg and the *Gymnadenia tridentata* of Lindley, and through July and August at the North, and sometimes as late as August in Eastern Massachusetts, presents its single leaf and its few greenish-white flowers.* This *Habenaria* resembles *H. hyperborea* in that the anther-cells open "before the flower bud," as Gray says, "is fully grown, or at least four or five days before the flower opens, and as the flowers at this time are horizontal and somewhat reclining, the packets of pollen which spontaneously detach themselves from the pollen-mass may fall out. In every case of flowers opening naturally, the anther-cells were found widely gaping, yet so far as we can see the pollen-masses cannot of themselves fall upon or reach the stigmatic surface." There are, however, in this *Habenaria*, "three club-shaped projections or processes, which are nearly

*I have drawn them a little too large, in my illustration (Fig. 20).

alike, one outside each anther-cell, and one between them, which rise as high as the anther-cells," and may be sterile stamens. Their surfaces are viscid and the spontaneously detached grains of pollen stick fast to them, and "send down pollen-tubes freely into their substance, so that they appear to act as stigmas, although the normal stigma is found in its proper place and of ordinary appearance underneath the discs." This real stigma, strangely enough, is not as viscid as the surfaces of the processes, but "the large discs are in perfect condition; the stems of the pollen-masses are promptly depressed when removed."



FIG. 29.—GREENISH ORCHIS.

Habenaria virescens.

Habenaria virescens, the Greenish Orchis, agrees with the foregoing species in date, in a preference for wet (but more open) ground, and a little in the character of its flowers as it follows in natural order. *H. tridentata*, according to Chapman, is found as far south as Mississippi; *H. virescens* occurs in Florida, and the latter has been as plentifully endowed with titles as any royal personage; *O. flava*, *O. bidentata*, *H. herbiola*, and *P. flava*, being a few of the names given it by different writers. "The structure of the disc-bearing portion of the column," says Gray,

"answers, perhaps, to what is expressed by Lindley's vague character of *Gymnadenia*, '*rostello complicato*,' and is quite different from that which prevails in the more genuine species of *Platanthera*. Viewed from the front (on removing the lip), each disc is found to line an oblong cavity or deep groove: viewed vertically from above, this appears as a ring with the front edge cut away or as something more than a semicircle lined by the thin broad disc. A narrow, nose-shaped protuberance on the lip projects upward and back-



FIG. 30.—SMALL PURPLE FRINGED-ORCHIS. (*Habenaria psycodes*.)
LARGE ROUND-LEAVED ORCHIS. (*Habenaria orbiculata*.)

ward so as almost to touch the column between the two discs (or rather between the two cups or grooves that contain them) and therefore lying over and dividing the orifice of the spur. The anther-cells are parallel but a little apart, and lie almost in line with the lip, but with their front ends depressed so that the discs are a little lower than the base of the protuberance. These discs and this protuberance are so correlated in shape and position that the proboscis of an insect fitted to suck nectar, inserted obliquely from above, as it must be, cannot keep the middle line at the entrance, but will take right or left of the protuberance, and so slide into the disc-bearing groove of that side. On directing a delicate bristle vertically from above into the spur, taking either side of the protuberance, the bristle will either enter the discal groove from above as a thread enters the eye of a needle, or, if presented more obliquely from the front, will slide into the groove when, as it enters the spur, it is raised, as it must be, to a more vertical position, the disc clasps the bristle and is withdrawn with it along with the attached pollinium. It is evident that in this species, self-fertilization cannot occur, that only one pollinium will be likely to be withdrawn at one visit of an insect, and that this will doubtless be conveyed to another flower."

A correspondent tells me that he is not familiar enough with the Orchis family to know the difference between *H. virescens* and *H. viridis*, but if he bears in mind the fact that *H. virescens* carries a spur, and *H. viridis* a bag, he need not have to refer to the botany. Or, to state it still more simply, the one having the longer name has the longer nectary of the two.

If there is a more enticing place than a boulder-strewn hill-side pasture, I have yet to find it: the copses, the beds of brake and fern, the grassy basins with their refreshing springs, give me no excuse for hastening through, even on a July afternoon; but by climbing higher, into the hemlock woods, I hope to be repaid by seeing the Great Round-leaved Orchis, *H. orbi-*

culata, the "Heal-all" of Pennsylvania. Its glossy silver-lined leaves, often nine inches across, lie, like those of *H. Hookeri* (the Small Round-leaved Orchis), close to the needle-strewn ground, and the waspish green and white flowers are lifted from one to two feet above them. "Many light-colored flowers," writes Müller, "which often grow in shady places, are inconspicuous by day but conspicuous by night (*c. g.* *Platanthera*). These are chiefly visited by crepuscular Lepidoptera,* but insects are excluded not so much by the color as by the situation of the honey at the base of long, narrow tubes."

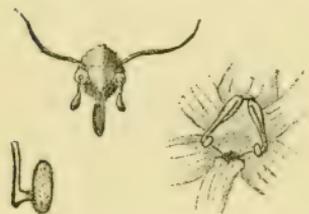


FIG. 31.—HEAD OF MOTH, *Sphinx drupiferarum*, with attached and depressed pollen-masses of *Habenaria orbiculata*.

Front view of flower of *H. orbiculata*, showing anther-cells and exposed viscid discs.

Disc and part of pedicel. (All from Gray's *Botanical Text Book*.)

The arrangements for fertilization are substantially the same as those of *H. Hookeri*. "The way," says Gray, "in which the anterior (lower) portion of the anther-cells with the combined arms of the stigma taper and project forward, so as to raise the discs on a sort of beak, a little in advance of the orifice of the nectary, is well exhibited in Hooker's figure of this species (*H. macrophylla*) in the *Flora Bor. Amer.*, but the discs do not look outwardly in the manner there represented. These, being affixed to the stalk of the pollen-mass laterally, by that intermediate body called the "drum-like pedicel" (here developed perhaps even more than in *H. Hookeri*) really look forward and inward—in fact are so placed that they will be sure to stick fast, one to each side of the head of a humble bee or of a large moth that thrusts its proboscis down into the spur so as to reach the nectar. As the divergent bases of the anther-cells are so separated by the broad stigma that the viscid discs stand nearly a quarter of an inch apart and the full-grown spur is from one inch to an inch and a half long, it is evident that

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* Butterflies, moths, etc., that fly after sunset.

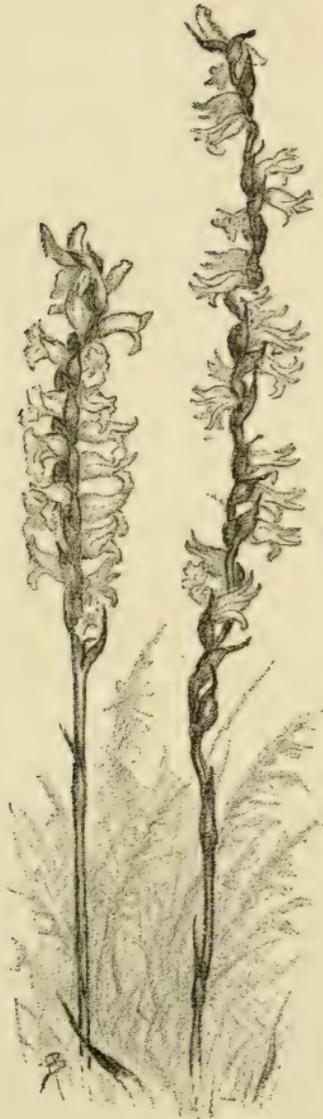


FIG. 32.—LADIES' TRESSES.
SPIRANTHES ROMANZOVIANA.
GRASSY SPIRANTHES. (*S. graminea*, Var. *Walteri*.)

fertilization is effected by the agency of large Lepidoptera and Hymenoptera. The movements of rotation and depression are pretty slow but distinct."

This species ranges Northwestward to Lake Superior, and follows the Alleghanies to Virginia, if not still farther south. I have placed it, in the illustration, in unnatural combination with *H. psycodes* that the coarseness of the one may be compared with the delicacy of the other.

Three species of *Spiranthes* link July with August. *S. Romanzoviana* bears, like *S. latifolia*, its flowers in three ranks and its leaves at the base of the stem. Sepals and petals unite in a close hood over the lip, the flowers have the odor of violets, and there is in general a resemblance to the later *S. cernua*. A physician living in North-eastern Vermont writes me that he has jumped from his carriage many a time, supposing he had at last found this *Spiranthes*; only to renew again his acquaintance with *S. cernua*.

This pretty flower has not been credited to New England by the botanics; but inhabits many of the cold upland bogs of our three northern States. Its range, as given in the *Report of the Geological Exploration of the 40th Parallel*, is remarkable. "Maine and Canada to Lake Superior, the Saskatchewan and Washington Territory; northward to Unalaska and southward to California and Colorado. East Humboldt Mts., 6,000 to 8,000 feet, July-Sept." It is a singular fact that this Orchid is confined, in Europe, to a few bogs in County Cork, Ireland, and Prof. Gray would have it that "these are merely the last or among the last lingering stations of a species once common to both continents." I accept this explanation more easily but not more graciously than I do that given in "*Colin Clout's Calendar*," in the chapter entitled, "Some American Colonists," where Grant Allen affirms his belief that the seeds were carried across the ocean by chance, at some remote period. Its origin may be uncertain but not so its end; for the last named writer

mournfully says: "the ardor of modern botanists is fast putting an end to its brief career," and then adds, "this case presents some features of peculiar interest, because the Irish specimens would seem to have been settled in the country for a very long period, sufficient to have set up an incipient tendency toward the evolution of a new species; for they had so far varied before their first discovery by botanists that Lindley considered them to be distinct from their American allies, and even Dr. Bentham originally so classed them, though he now admits the essential identity of both kinds."

Spiranthes graminea, variety *Walteri*, carries one straight rank of more open flowers and gets its adjective, "grassy," from the localities where it grows. A more lowland species than the last, it appears to have also a more southward range and to be most common in the meadows along the coast.

Spiranthes gracilis, the Slender Spiranthes, arranging its tiny flowers like *S. graminea*, bears its leaves clustered at the base of the stem, but from their small size and their habit of withering when the plant flowers they count for very little. This species ordinarily has clustered roots, but Dr. N.



FIG. 33—FOOT OF
SPIRANTHES RO-
MANZOVIANA.

L. Britton, of Columbia College, has found it in Ulster Co., New York, with a single tuber. Nature must be fond of the Slender Spiranthes, or she would not permit it to flourish in comparatively dry soil and to enjoy a four months' lease of life. One need not be surprised to see it in July or to gather it with *S. cernua* in October.

In the structure of *S. gracilis* (and of *S. cernua* as well) we have a more more complex arrangement than one would dream existed in flowers so minute and unpretending; as is shown in Darwin's account of the British *S. autumnalis*. The stigma occupies about the same place that it does in a *Habenaria*. There is also a rostellum, but this is curiously different from

a little milky adhesive fluid exudes. The fissure runs up the whole length of the rostellum from the stigma beneath to the summit: at the summit, the fissure bifurcates, runs down the back of the rostellum on each side and round the stern of the boat-formed disc. Hence after this splitting action the boat-formed disc lies quite free, but imbedded in a fork in the rostellum. When a bristle is laid for two or three seconds in the furrow of the rostellum, and the membrane has consequently become fissured, the viscid matter within the boat-formed disc, which lies close to the surface, and indeed slightly exudes, is almost sure to glue the disc longitudinally to the bristle, and both are withdrawn together, and the two sides of the rostellum are left sticking up like a fork. This is the common condition of the flowers after they had been open a day or two and have been visited by insects. The fork soon withers.

“Long before the flower expands, the anther-cells, which are pressed against the back of the rostellum, open in their upper part so that the included pollen-masses come into contact with the back of the disc. The projecting ends of the threads uniting the leaves of pollen (which in *Ophrys* become true stalks or caudicles), then became firmly attached to rather above the middle part of the back of the disc. The anther-cells afterward open lower down, and their membranous walls contract and become brown; so that by the time the flower is fully expanded, the pollen-masses lie almost naked, their bases (thick ends) resting in a little cup formed by the withered anther-cell and protected on each side by a membrane which extends from the edges of the stigma to the filament (stalk) of the anther,” and forms another cup or “clinandrum.” These membranous sides of the clinandrum are thought to be the rudiments of the two anthers which are seen in a developed state in *Cypripedium*, only. “These rudiments aid their brother anther.”

“The lip is channelled down the middle; the nectar is col-

lected in a smaller receptacle in the lower part of the lip," and on either side of the orifice there is "a globular process or swelling which secretes nectar." When the flower first opens the receptacle contains nectar, and at this period the front of the rostellum lies close to the channelled lip, consequently a passage is left, but so narrow that only a fine bristle can be passed down it, and a bee could not pass down its proboscis without touching the furrow of the rostellum. "At this period, the stigma is only slightly viscid." The pollen-masses could now be easily removed, but the passage is so narrow "that the pollen-masses attached to a proboscis cannot possibly be forced in so as to reach the stigma; they would either be up-turned or broken off; but after a day or two the column moves a little farther from the lip, and a wider passage is left." Bees, as he observed, "always alighted at the bottom of a spike and crawling spirally up it, sucked one flower after another, the most convenient method; on the same principle that a woodpecker climbs up a tree in search of insects." If a bee alighted on the top of a spike, "she would certainly extract the pollen-masses from the uppermost, last opened flowers; but when visiting the next succeeding flower, of which the column in all probability would not as yet have moved from the lip (for this is very slowly effected), the pollen-masses would be brushed off her proboscis and wasted.

"But nature suffers no such waste. The bee goes first to the lowest flower, but effects nothing on the first spike till she reaches the upper flowers, and then she withdraws the pollen-masses. She soon flies to another plant, and alighting on the lowest and oldest flower," which now has a wide passage, "the pollen-masses will strike the protuberant stigma. If this stigma has already been fully fertilized, little or no pollen will be left on its dried surface; but on the next succeeding flower, of which the stigma is adhesive, large sheets of pollen will be left. Then, as soon as the bee arrives near the summit of the spike,

she will withdraw fresh pollen-masses, will fly to the lower flowers of another plant, and thus fertilize them; as she adds to her store of honey, she perpetuates the race of our autumnal *Spiranthes* which will yield honey to future generations of bees."

Habenaria lacra, the Greenish or Ragged-fringed Orchis, is a common species at this period in open or partly shaded, wet places; and I have known it to live on contentedly when its locality had been drained and tunnelled by the gas and water pipes of an encroaching town. Sweet, in his *British Flower Garden*, calls it the Torn-flowered *Habenaria*, and calls attention to "its elegantly jagged appearance." "It must," says Gray, "be very attractive to some insects, the pollen-masses are so generally removed from oldish flowers and the stigma fertilized. The nectary can be approached only from the front, the sides being guarded by a broad and thick shield on each side—the arms of the stigma much developed—above supporting the anther, while its inner and concave face bears the remarkably long and narrow viscid discs. These guards or arms of the stigma project forward like beaks; the viscid discs are "as long as the stalks of the pollen-masses, are directly attached to them near the middle, and nearly face each other. When detached, a movement of depression takes place by which the pollen-mass is brought down so as to be nearly parallel to the disc and close to it—just in proper position to reach a stigma.

Dwarf the flowers of *H. fimbriata*, increase their number, deepen their color, shorten their fringes, and the Small Purple Fringed-Orchis, *H. psycodes*, stands before you: a variety, some think, of the former species. It may appear in a grassy ditch by a roadside; perhaps, holding its soft plume above the tangled brakes, sedges and poison ivy in your nearest meadow; always refined wherever it grows. As with *H. lacra* and *H. fimbriata*, says Gray, "a development of the sides of the column as a kind of guard, protects the discs, preventing all ready

access to the nectary except from the front. A short bristle, slid along the base of the lip and into the nectary for some distance, will not touch the viscid discs, they lying a little too far back; but on pushing it down deep into the long and curving spur (only the lower half or quarter of which is filled with nectar) it has to be bowed back somewhat, when it catches the disc; so that before an insect can have drained the nectary, the pollen-masses will be affixed to the base or upper part of its proboscis, or to the forehead of a smaller insect. When extricated, the movement of depression is prompt—within a few seconds—and on re-application, the pollen is accurately brought into contact with the stigma. The anther-cells are widely separated but little divergent, their tapering bases (supported as in *H. lacera*), project strongly, the discs looking forward and downward. In both *H. psycodes* and *H. lacera* the nectar appears to be much more plentiful in the spurs of older flowers than of freshly opened ones, most so indeed in blossoms which had their pollen removed and their stigma fertilized several days before, and which were becoming effete. In such flowers the spur was often half full in the present species, and sometimes almost full in *H. lacera*. But although little had dripped down to the bottom of the spur in freshly opened blossoms, the walls were moistened with nectar throughout its length.”

The botanist quoted when *C. spectabile* was spoken of, gives in the same paper some observations made at different times during the month of August. “A *Sesia*,* began to suck nectar (from a plant of *H. psycodes*), poised on the wing. It visited more than a dozen flowers, proceeding spirally up the spike, and I found about thirty pollinia attached to its proboscis near the base. They were all in a space of less than a tenth of an inch in length and much crowded. Those nearest the tip of the proboscis had lost much of their pollen by contact

* *S. Thysbe*, Fabr.

with many stigmas." At another time, "a *Sesia* * sucked nectar from every open flower on one spike: when caught, it had about twenty pollinia attached to it; both moths had proboscides so encumbered with the pollinia that it was impossible for them to be coiled up between the palpi. The shortness of the time occupied in the depression of pollinia in this species and the time that the insects remained at one plant would seem to indicate that the upper flowers on the spike, at least, were fertilized by pollen from the same plant. I have frequently seen the orthopterous insect *Phaneroptera curvicauda*, *Scrv.*, feeding upon the flowers of this Orchid, but could not find that they ever effected its fertilization, although pollinia were several times found attached to their feet."

The author once examined four spikes of *H. psycodes* to see what their attendant insects had accomplished. The plants grew near together in a damp hollow by a shady roadside. Omitting 45 that had set their seed, there were in all 182 open flowers (one spike bore 64 blossoms, two of them double, and the plant was twenty-three inches high), and of this number, 69, mostly on the upper parts of the spikes, had had no pollen removed; 49 had lost both pollen-masses; 61 had lost one apiece, 34 removed from the right hand, 27 from the left. In the case of one spike where but 8 flowers had lost both pollen-masses and 19 had lost but one, only 5 had been taken from the left hand. I found one pollinium sticking by its disc to a stigma, and one I removed myself fell, striking the stigma, not with its heavy end as one would suppose, but with its disc. I questioned whether the pollinia might not be occasionally shaken out of their cells by hard winds, but this was improbable; and in Müller's work I have since found an explanation. Speaking of humble-bees caught with pollen-masses on them, he says, "we frequently observed . . . that when the pollen-masses bent forward the bee was able

* *S. diffinis*, *Boisd.*

to tear them off with its mandibles. Some bees which we caught with pollinia on their heads had them attached to their fore-legs when examined shortly afterward. These frequently successful efforts on the part of the bees to free themselves from the pollinia explain why we often find whole pollinia or pairs of pollinia attached to the flowers, generally in the neighborhood of the stigma."

These flowers I have just described had a rank smell, and I do not remember that I ever found a really fragrant specimen of this Fringed-Orchis, though it is the only *Habenaria* called fragrant by Gray.

In some parts of Vermont, *H. psycodes* bears the picturesque name of "Flaming Orchis," which ought rather to be transferred to the Yellow Fringed-Orchis, *H. ciliaris*, fit symbol of the wealth and glow of August; resplendent in orange and gold, not only in sepals and petals but even in spurs and ovaries, and admitting but one rival, the cardinal flower, burning its torch well into September in Northern New England. In Connecticut and Rhode Island, where it is local but abundant, it is not unfrequently met with in July. Near Plymouth, Massachusetts, as I am informed, there is a bog in which it is "almost a weed," but one must go west or south to get it by the wholesale. There are places near New York, for instance, where it grows by the acre. If I had my own way, it should never grow in bogs among coarse pitcher plants; it needs a richer background; but in ferny meadows bordering a sandy brook, as it does in a jealously guarded spot I know of in Guilford, Conn.; and if I ever write a romance of Indian life, my dusky heroine, Birch Tree or Trembling Fawn, shall meet her lover with a wreath of this Orchis on her head.

The White Fringed-Orchis, *H. blephariglottis*, known as the Feather-leaved Orchis in some localities on Cape Cod, grows with *H. ciliaris*, and as Gray well says, "commonly takes its place northward." This species does not grow as high, has

smaller flowers less conspicuously notched and fringed, while there is a variety, *holopetala*, that has these adornments reduced to a minimum. *H. blephariglottis* closely resembles its gayer sister in appearance and structure, and by reason of its purity is quite as fascinating. Gray considers these species to be "chiefly remarkable for having their viscid discs projecting



FIG. 35.—YELLOW FRINGED-ORCHIS.
Habenaria ciliaris.

much more even than in *H. orbiculata*, the anterior part of the anther-cell and the supporting arm of the stigma united tapering and lengthened to such a degree that the viscid discs are as if raised on a pedicel, projecting considerably beyond the rest of the column. The anther-cells are nearly horizontal, greatly divergent, but inclined somewhat inward at the ends; so that the discs are presented forward and slightly inward, at least in *H. blephariglottis*, or in *H. ciliaris* more directly forward. Evidently these projecting discs are to be stuck to the head of some nectar-sucking insect. The stigma, which is rather small, is between the lateral arms, in the same horizontal line with the discs: the discs are small but quite sticky and directly affixed to the extremity of a stalk which in just proportion to the forward elongation of the anther-cell, etc., is re-

markably long and slender, twice or thrice the length of the pollen-mass it bears. Upon removal, a slight bending or turning of the slender stalk brings the pollen-mass into position for reaching the stigma. The discs in ordinary flowers of *H. ciliaris*, are about a line and a half apart (the English line is the twelfth part of an inch), the slender spur an inch long,

from which somewhat of the structure and size of the insect adapted to the work in hand may be estimated."

These two *Habenarias* have curious white ear-shaped appendages on the outside of the anther, small in size but so strongly contrasted in *H. ciliaris* with the yellow of the anther as to be conspicuous; and if the reader has a good herbarium to turn to, he will probably notice that these little auricles are visible without a glass, in both species, and have kept their color after the other parts have turned brown. I can find no printed allusion to them; even Gray's Manual, which carefully mentions the strange club-shaped processes in *H. tridentata*, being silent on this point. Professor Gray writes me that he has noticed these "crests," as he calls them, but does not think they correspond to the fertile stamens in *Cypripedium*. Is not the answer to this pretty riddle hidden away somewhere in the following passage from Darwin?

"Although the two anthers a_1 and a_2 of the inner whorl (see Fig. 2) are not fully and normally developed in any Orchid, excepting *Cypripedium*, their rudiments are generally present and are often utilized; for they often form the membranous sides of the cup-like clinandrium on the summit of the column. These rudiments thus aid their fertile brother anther. In the young flower-bud of *Malaxis paludosa* the close resemblance between the two membranes of the clinandrium and the fertile anther in shape and texture was most striking; it was impossible to doubt that in these two membranes we had two rudimentary anthers. In *Liparis pendula* and some other species, these two rudimentary anthers form not only the clinandrium, but likewise wings, which project on each side of the entrance into the stigmatic cavity, and serve as guides for the insertion of the pollen masses. . . .

"In nearly all the members of the *Ophreæ* and *Neottææ* two small papillæ, or auricles as they have often been called, stand in exactly the position which the anthers a_1 and a_2 would have

occupied had they been developed. Not only do they stand in this position but the column in some cases . . . has on each side a prominent ridge, running from them to the bases or mid-ribs of the two upper petals; that is, in the proper position of the filaments of these two stamens. It is impossible to doubt that the two membranes of the clinandrium in *Malaxis* are formed by these two anthers in a rudimentary and modified condition. Now, from the perfect clinandrium of

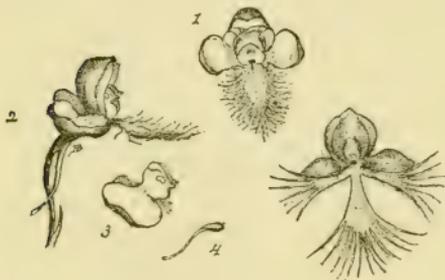


FIG. 36.

1. Front view of flower of Yellow Fringed-Orchis.
2. Side view (natural position).
3. The anther with its auricle.
4. A pollinium.
5. Flower of Green Fringed-Orchis. (From Sweet.)

Malaxis, through that of *Spiranthes*, *Goodyera*, *Epipactis latifolia*, and *E. palustris*, to the minute and slightly flattened auricles in the genus *Orchis*, a perfect gradation can be traced. Hence I conclude that these auricles are doubly rudimentary; that is they are rudiments of the membranous sides of

the clinandrium, these membranes themselves being rudiments of the two anthers so often referred to. . . . Such vessels may quite disappear. . . . The two upper anthers of the inner whorl are fertile in *Cypripedium*, and in other cases are generally represented either by membranous expansions or by minute auricles. . . . These auricles, however, are sometimes quite absent, as in some species of *Ophrys*.*

Summer, in her flight, invariably forgets to drop one flower from her cornucopia at the proper time; at least it seems so, when we behold at this late day, in damp woods, a little plant that brings the *Pogonias* to mind. It is the Nodding or Pendent *Pogonia* (*P. pendula*), and has still another name, *Triphora pendula*, none as musical as the rustic one, Three Birds. This Po-

* See, also, Sachs' *Text Book of Botany*, 1872, p. 603.

gonia has a tuberous root ; the delicate blossoms, one or more in number (3-7 according to Chapman), vary in color from pale rose to pure white and have a slight odor. The lip is prettily cleft or lobed, and has in place of a crest, three tiny green lines, which I am inclined to suspect secrete nectar. "A comparison between the different Pogonias," says Meehan, "establishes confidence in the doctrine that all the parts of a flower are but modifications of simple leaves—in *P. pendula*, the vegetative force seems feeble, and spends itself in often-repeated attempts ; hence small leaves and insignificant flowers are scattered all along the stem, but in *P. verticillata* the force exercised is evidently greater, not only in amount but also in degree, and its action is more concentrated. The stem, therefore, instead of slowly elongating and sending out a leaf and a flower here and there, rapidly draws in its spiral coils, thus producing only a whorl of leaves, and annihilating all tendency to flower in the axils, after which it makes another growth and then another sudden arrest and coil, resulting in a large single flower. In *P. ophioglossoides* the acting force was intermediate in intensity. Having coiled up the primordial leaves to form the flower stem, the force was not powerful enough to arrest the formation of the leaves suddenly, and it therefore still left them somewhat scattered. The lowermost leaf is little more than a sheathing scale. The next shows by the groove down the stem opposite how very near it came to diverging still more than it actually does from the interior leaves out of which the stem is formed ; and the upper one by its greatly reduced size, reveals the fact that the force employed in arresting the elongating growth and in working up all the separate parts into a flower is now in active operation." *

Spiranthes simplex, the Simple Spiranthes, "Aug.-Sept.," a low, narrow-spiked species, graces the dry and sandy pastures of the three southern States, especially along the coast ; scarce,

* *Native Flowers and Ferns*, I. Series, Vol. 1.

perhaps, or confounded with other species, as I have but lately been able to hear of a station in Connecticut. Like the other *Spiranthes*, it ranges as far south as Florida, and except with us, appears to be common enough. Its root is a "solitary, spindle-shaped or oblong tuber;" it loses its leaves, which grow like those of *S. gracilis*, in a cluster at the ground, at flowering, and produces "very short" blossoms.

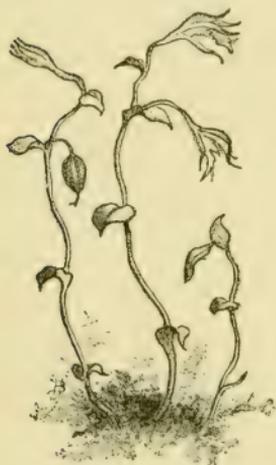


FIG. 37.—NODDING POGONIA.
P. pendula.

So many weeds and wild plants have white spikes or tufts of flowers that I am not surprised when people to whom I have shown one of our Ladies' Tresses tell me they have never seen it before; and then again, the time when the Ladies' Tresses are due is not one when there is much exploration of the fields, unless it is by hunters, or "city folks" who are more likely to have their eyes directed upward toward a white birch they want to mangle or scribble their names on than toward the ground

they are tramping over, but there is no good reason why the Rattle-snake Plantains should not be known to every one, for all the year round their pretty rosetted leaves ornament the woods.

The genus *Goodyera*, to which they belong, contains some twenty-five species, scattered over Europe, temperate and tropical Asia, and North America, and forms, according to Darwin, "an interesting connecting link between several very distinct forms." There are points of resemblance to both *Orchis* and *Spiranthes*, and accordingly *Goodyera*, in our botanies, stands between these two genera. Two of our species, *G. pubescens* and *G. repens*, are common to Great Britain, and in describing the latter, which he calls a "rare Highland

Orchid," Darwin mentions first the "shield-like rostellum," a feature at once recalling the True Orchises. This is almost square, and projects beyond the stigma; it "is supported on each side by sloping sides rising from the upper edge of the stigma, in nearly the same manner as in *Spiranthes*. The surface of the protuberant part of the rostellum is rough, and when dry, can be seen to be formed of cells; it is delicate and when slightly pricked, a little milky viscid fluid exudes; it is lined by a layer of very adhesive matter, which sets hard quickly when exposed to the air. The protuberant surface of the rostellum, when gently rubbed upward (as it would be when an insect withdrew its head) is easily removed, and carries with it a strip of membrane to the hinder part of which the pollen-masses are attached. The sloping sides which support the rostellum remain (as in *Spiranthes*) projecting up like a fork and soon wither." The pollen-masses become attached to the back of the rostellum, much as in *Spiranthes*, and also before the flower expands, and the anther-cell "ultimately opens widely, leaving the pollen-masses almost naked but partially protected within the membranous cup uniting the filament or supporting thread of the anther to the edges of the stigma. The pollen-grains cohere in packets as in *Orchis*," and these packets are tied together by strong elastic threads, "which at their upper ends run together and form a single flattened brown elastic ribbon, of which the truncated extremity adheres to the back of the rostellum.

"The surface of the orbicular stigma is remarkably viscid, which is necessary in order that the unusually strong threads connecting the pollen packets should be ruptured. The lip is partially divided into two portions; the tip is reflexed, and the basal portion is cup-formed and filled with nectar." Gray, speaking of this same species says, "All freshly opened blossoms have the column so directed—a little bowed forward—that the tip of the *disc and of the anther* are presented to

view as you look into the narrow opening of the flower ; and a proboscis or bristle introduced and following as it will the curvature of the lip-like or nozzle-shaped apex of the lip, and passed down to its nectar-bearing base will inevitably hit the disc, and if detained a moment, will bring the pollinia away when withdrawn. On re-introduction, the pollen-masses will not pass down to the stigma, but lodge on the upper side of the column, from which they were taken. But on looking into older flowers of the same spike, still fresh and good, whether their pollen-masses have been extracted or not, the stigma is in full view, the summit of the column being now turned somewhat upward and backward ; and there is now room enough between it and the lip, for the pollen to pass ; indeed, now the pollen-masses will regularly hit the stigma." Bees proceed, therefore, in visiting these flowers just as they do when visiting the Ladies'-Tresses. The description of the fertilization of *G. repens*, I should have said before, agrees with that of *G. pubescens*.

Darwin again says : " In no other member of the Neotticæ (the tribe to which *Goodyera* and *Spiranthes* belong), observed by me is there so near an approach to the formation of a true stalk, and it is curious that in this genus, *Goodyera*, alone, the pollen-grains cohere in large packets, as in the *Ophreæ*" (the tribe containing with us *Orchis* and *Habenaria*). " In the rostellum being supported by sloping sides, which wither when the viscid disc is removed—and in the existence of a membranous cup or clinandrum between the stigma and anther—and in some other respects, we have a clear affinity with *Spiranthes*. *Goodyera* probably shows us the state of the organs in a group of Orchids, now mostly extinct, but the parents of many living descendants." In the chapter entitled, " Gradation of Organs," he traces the development of the caudicle or stem of the pollen-mass in the different genera. " As I find that chloroform has a peculiar and energetic action on the caudicles of all Orchids, and likewise on the glutinous



FIG. 38.—RATTLE-SNAKE PLANTAINS.
Goodyera pubescens. *Goodyera repens*.

matter which envelopes the pollen-grains in *Cypripedium* and which can be drawn out into threads, we may suspect that in this latter genus—the least differentiated in structure of all the Orchideæ—we see the primordial condition of the elastic threads by which the pollen-grains are tied together in other and more highly developed species. . . . In some *Neottea*, especially in *Goodyera*, we see the caudicle in a nascent condition projecting just beyond the pollen-mass, with the threads only partially coherent. . . . In the *Ophreæ* we have better evidence than is offered by gradation, that their long, rigid and naked caudicles have been developed, at least partially, by the abortion of the greater number of the lower pollen-grains and by the cohesion of the elastic threads by which these grains were tied together. I had often observed a cloudy appearance in the middle of the translucent caudicles in certain species; and on carefully opening several caudicles of *O. pyramidalis*, I found in their centres fully half way down between the packets of pollen and the viscid disc, many pollen-grains (consisting as usual, of four united grains), lying quite loose. These, from their embedded position, could never by any possibility have been left on the stigma of a flower, and were absolutely useless.” He supposes that “the changes have not always been perfectly effected, and that during and after the many inherited stages of the abortion of the lower pollen-grains, and of the cohesion of the elastic threads, there still existed a tendency to the production of a few grains where they were originally developed; and these were consequently left entangled within the now united threads of the caudicle. . . . The little clouds formed by the loose pollen-grains within the caudicles of *O. pyramidalis* are good evidence that an early progenitor of this plant had pollen-masses like those of *Goodyera*, and that the grains slowly disappeared from the lower parts, leaving the elastic threads naked and ready to cohere into a true caudicle.”

The Downy Goodyera, *G. pubescens*, Barton's Veined-leaved Neottia, with its popular names of Adder's Violet and Scrofula Weed, is our best known and most common species, and its blue-green velvety leaves may be seen in hanging-baskets at any florist's. Josselyn, *New England's Rarities*, 1672, supposes it to be a *Pyrola*, and says of the leaves, "the Ground whereof is a sap Green embroydered (as it were) with many pale yellow Ribs." Dewey speaks of the "elegant appearance" presented by this plant, and of its great reputation among herb and Indian doctors, though in the only case in which he saw it applied, "no results followed." Pursh says it has a wide-spread reputation as an infallible cure for hydrophobia, and the *American Herbal*, published at Walpole, N. H., in 1801, by Sam. Stearns, LL.D. (who gives as a prescription for dyspepsia, a mixture of ants' eggs and buttermilk), mentions the Rattle-snake Plantain as follows: "Country people use a decoction of the leaves for skin diseases, and Captain Carver says the Indians are so convinced of its power as an antidote that they allow a snake to drive its fangs into them, then chew the leaves and apply them to the wound."

The Creeping Goodyera, *G. repens*, considered by many to be a variety of the former, and not, as Darwin and Gray both maintain, a distinct species, rarely, if ever, attains to the height of a foot. Its leaves are more pointed than those of the other, more openly veined, and yellow-green in color; the flowers are not crowded on the spike, but fewer and arranged in a row; but intermediate forms are not uncommon. The difference in the color of the leaves is sufficiently marked to be noticed by one passing quickly through the place where both species grow. I once found a very beautiful group of *G. pubescens*: the leaves were a dull blue with scarcely a tinge of green, and instead of the usual net-work of veins, there was a silvery frost-work over them. *Goodyera Menziesii*, a species added to our New England Flora within a few years by the intrepid explorations

of Miss Furbish in the extreme north of Maine, is larger than the others, and in the structure of its flowers, says Gray, closely resembles *Spiranthes*. "The lip is barely saccate below, . . . anther ovate and long-pointed, borne on the base of the very short proper column, which is continued above the stigma into a conspicuous long tapering awl-shaped gland-bearing beak. Flowers rather numerous in a looser often 1-sided spike; flower-buds less pubescent (confounded with *G. pubescens*)."

The leaves of the only living specimens I have seen, and those poor ones, were much like those of *G. repens* in shape but stiffer and less strongly marked. The net-work, Gray says, is sometimes entirely wanting. Like the other species, this has a "root of thick fibres, from a somewhat fleshy creeping root-stock." It derives its specific name from that of the explorer Menzies.

A little pamphlet, entitled *Plants of Malden and Medford* (Mass.), arranging the species found in those localities according to the months in which they bloom, has *G. pubescens* down for May, a most unwarranted performance for it, and one it does not attempt here in Vermont, though in very early seasons it might be found the latter part of June; still, we do not expect it before August. Once in a while *G. repens* surprises us in July, though this is later than *G. pubescens*, and being more of a northern and mountainous plant it tempts the early frosts by lingering on through September. *G. Menziesii* agrees with it in date. *G. repens*, I find, grows in the Caucasus mountains, and Prof. Gray tells us that in America it crosses the line of 60°. *G. Menziesii*, which is the *Spiranthes decipiens* of Hooker, ranges westward as far as California, where it is found under the groves of sequoia, and in all probability it outstrips *G. repens* in the attempt to reach the Arctic Ocean. *G. pubescens*, is widely distributed in the eastern and southern United States, and together with *G. repens* is found on the Carolina mountains.

I do not often find a Rattle-snake Plantain in bloom ; and an experienced botanist, whose travels in our State cover a wide and varied tract of country, assures me (1883) that he has not come across a flowering specimen for two years, though there is hardly a patch of woods of any size that does not contain both species.

I happened to be in a little grove of hemlocks two years ago, in September, and noticing that these Orchids were quite abundant, counted them roughly. Out of 200 plants of *G. pubescens*, young and old, only 12 had flowered, and 20 plants of *G. repens* furnished but 2 spikes.

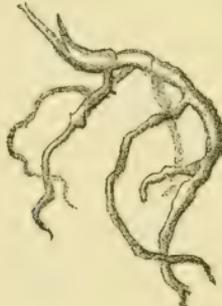


FIG. 39.—FLOWER OF DOWNY GOODYERA.

Lip, the other parts removed.

Root of same.

the following year resulted in giving 102 flower spikes from 572 plants, young and old, of *G. pubescens*. One patch, that lay like a mat on the ground, had 226 plants in it and but 15 spikes. *G. repens* in this place is very scattered, and I saw but one plant and this had not flowered. I have noticed that the Goodyeras

always mature their ovaries. In Scotland, *G. repens* is fertilized by humble-bees, and I suppose they perform the same offices in this country ; but it would seem as if they must drain the little white syrup pitchers in a very bungling way. "That arrangements for propagation," says Sachs, "are especially promoted by the upright growth of the stem is evident from the fact that in the large number of plants which develop their leaves in a rosette close to the ground, or on a stem that creeps along it, a rapidly ascending flower-stem is formed only just before the unfolding of the flower-buds. [This is] strikingly the case in the case of parasites (*Neottia*) which vegetate below and blossom above."

By the middle of September the nights at the North have become sparkling and frosty. My favorite spring in the woods is choked with leaves; the blue-stemmed golden-rods and the tick-seeds begin to look a little discouraged, but it is still too early for dolorous poems on the death of the flowers and man's mortality. If I go in to the forest there is bustle and noise on every side: the crows are gossiping over the scandalous thefts of the blackbirds; the jays are making their usual ado about nothing; the downy woodpeckers glide up the trees calling "poort! poort!" whatever that may mean; the squirrels are poking nuts into the ground with their noses, covering each one with nervous little taps of their paws, and as they know perfectly well I cannot find their hoards, though I go down on hands and knees, the beratings I get for looking on are quite uncalled for. Outside, the western sloping meadows are warm, and sprinkled with not a few daisies and dandelions; I even find some violets. The old orchards are full of bluebirds, come like professional singers to cheat us by twittering "last farewells;" and so, under the rich sky, it is no wonder that our most beautiful Ladies' Tresses, *Spiranthes cernua*, has condescended to open her fragrant, cream-white chalice: and leaving out of mind *S. gracilis*, sometimes found in October, I like to think of it as ending the Orchid season; the only species that month can rightfully call her own.

S. cernua is popularly called the Drooping or Nodding-flowered Ladies' Tresses, and in the old botanies, the Nodding-flowered Neottia. It is very common in low ground, but varies so in height, and in the number and size of its flowers, that one ignorant of botanical distinctions cannot be blamed for mistaking it for other species. As to time, too, though it is late blooming with us, I have known it to come as early as August 20th, in Berkshire Co., Mass. Two characteristic features of this species are that, as Hooker expresses it, "the lateral sepals cohere with the upper one and the petals for nearly their whole

length" and that the leaves usually wither about the time the plant blossoms, although Gray mentions a variety that does retain its leaves, and this produces "greenish-cream colored flowers" and occurs in dry ground. I once examined five spikes of *S. cernua* containing forty-five blossoms, and but five of these had lost their pollen-masses, while one had lost its pollen-mass but retained its disc. Some plants of this species, domesticated in England, years ago, bloomed from August to the middle of November, and were thought to grow and make offsets more freely than most species belonging to the family.

Sweet, in the *British Flower Garden*, enumerates a number of American Orchids that were successfully grown in England during the early part of the century (*Liparis liliifolia* was naturalized as early as 1758), and is of the opinion that all Orchids might be raised from seed by surrounding them with "turfs of grass" for the young plants to attach themselves to when the plants first vegetate, "as they appear to be all more or less parasitic in a young state." Or, he would cover the ground with moss, scatter the seeds over it, and with a watering-pot wash them gently in. Species requiring a clayey soil he would plant on a little "mount" made of chalk covered with sandy loam mixed with powdered chalk. Stewart Murray, curator of the Glasgow Botanical Garden, gives in the *Transactions of the Horticultural Society of London*, 1826, a list of 26 North American Orchids, *Calypso borealis* among them, and the following account of his treatment of them. "I chose a well sheltered place, nearly the lowest in the garden, facing south, took out the soil to the depth of 16 inches, set in a wooden frame, 2½ feet high at the back, 15 inches in front, with movable glass lights, and filled it to the ground level with a compost, ⅓ leaf-mould, ⅓ turfy peat full of roots and stems, the remaining third ⅓ sphagnum, ⅓ sand, the whole well broken and mixed but not riddled. Care was taken to keep the surface a little higher for those requiring less moisture, like *Cyp. arictinum*,



FIG 40.—LADIES' TRESSES.
S. cernua, *S. gracilis*.

to cut away the old stems in autumn and to give a slight top-dressing of the same mixture." The frame was covered with mats in winter and great pains taken with the drainage; excessive moisture in his, as in Sweet's judgment, doing more injury than cold.

Among those in New England who make a business of cultivating our native Orchids is Mr. Edward Gillett of Southwick, Mass., who tells me that he has been most successful with the following species: *Cyps. arietinum*, *pubescens* and *parviflorum*; *Habenarias virescens*, *Hookeri*, *fimbriata*, *psycodes*; *Goodyera pubescens*; *Spiranthes cernua* and *gracilis*; *Aplectrum hyemale*. "*Calypso borealis*, obtained from Oregon, does well in sand, the wire worms eating the bulbs badly if planted in anything else." W. L. Foster, of Hanover, Mass., has succeeded well in raising the Cypripediums in a partially shaded border of leaf mould mulched with leaves. "*C. acaule*, however, always dies out within a year or two. I think it might do better if seed were sown in soil similar to that in which it naturally grows. *Calypso* has been tried in various situations, but I have never seen it after the second year, and others who have tried to grow it have had the same experience. A friend has grown many species with fair success in a brick tank filled with swampy soil, mulched with sphagnum and kept moist." F. H. Horsford, Charlotte, Vt., has the following "hardy" species on his Trade List: Both Orchises; *Habenarias*, *hyperborca*, *dilatata*, *obtusata*, *Hookeri*, *orbiculata*, *ciliaris*, *laccra*, *psycodes*, *fimbriata*; the three *Goodyeras*; *Spiranthes*, *Romanzoviana*, *cernua*, *graminea* and *simplex*, *Listeras*, *cordata* and *convallarioides*; *A. bulbosa*; *Pogonias*, *ophioglossoides* and *verticillata*; *C. pulchellus*; *Calypso borealis*; *T. discolor*; both species of *Liparis*; *A. hyemale* and all the Cypripediums.

C. acaule appears to be invariably disoblignig. Mr. R. A. Salisbury* as far back as 1812, planted it in peat earth mixed with

* Transactions London Hort. Society.

sand and leaves and treated it in various ways; "but though it started out well it always died the second or third year." A correspondent of the Bulletin of the Torrey Club complains that he used both sphagnum and nearly pure sand, with the same results. It is possible that a persistent use of the Dumesnil fertilizing-moss might effect a change in the constitution of this plant. One English florist planted *C. calceolus*, "in narrow fissures in limestone rock, well drained and filled with rich fibrous soil, increasing the plants by dividing them at the roots." He thought an "eastern, shaded aspect" best suited to them, while another says, "Lady's Slippers should be planted in loamy soil where they get the morning sun only, and the roots should be removed but seldom, as transplanting prevents their flowering." Our *C. pubescens* prefers shade, no doubt, but I have known it to do well in an open garden, exposed to the full force of the sun. *Habenarias fimbriata* and *blephariglottis* "thrive best in wet, peaty soil, partly shaded. *H. virescens* and *Liparis liliifolia* in rather dry, peaty soil." English florists have considered a sandy, red loam best suited to *Orchis spectabilis*, its size and beauty being greatly increased by cultivation, and for the Goodyeras, a mixture of silver sand and leaf mould.

Some members of the Mass. Hort. Society,* at the annual meeting in 1881, discussed the subject of the cultivation of native Orchids. Mrs. T. L. Nelson, of Worcester, had found *Cyps. parviflorum*, *pubescens* and *spectabile* adapted to gardens. "The latter forms its buds late in autumn under the old stalk, and this shows that one could be grown as well as another." Mrs. C. N. S. Horner, of Georgetown, had succeeded in winter with *C. pubescens* and the Goodyeras. Mr. E. H. Hitching had transplanted successfully, *Orchis spectabilis* and *C. spectabile*, and remarked that *Liparis liliifolia*, "one of our most deli-

* Annual Report, 1881.

cate Orchids has been cultivated for years in the house and blooms every year." Dr. Walcot had raised *Habenarias ciliaris* and *blephariglottis*, also *Calypso borealis*. Mr. Falconer, of the Cambridge Botanic Garden, thought *C. spectabile* almost the only wild flower very amenable to winter forcing. "Some Orchids, like *Calypso*, though very pretty are not generally satisfactory as out-door plants, but are better for pot culture."

I have tried my own hand in a partially shaded corner of a stone wall, adding to the leaf mould already collected there, a mixture of swamp muck and sphagnum. All the Cypripediums but *acaule* have taken kindly to their new home, and so have *Orchis spectabilis*, *Habenarias Hookeri*, *viridis* and *psycodes*, *Calopogon pulchellus*, *Liparis Loesclii*, the *Goodyeras*, and *Aplectrum hyemale*. *Calypso* bloomed finely this spring (1883), but some insect, that must have had purely malicious intentions, gnawed off the blossoms and left them lying on the ground. *Pogonia pendula* met with the same fate. There are at least thirty species in the bed, and that those unnamed are not doing well is due solely, I think, to a lack of sufficient moisture.

The appended List of Stations, though incomplete (botanists appear to be "rare" in New Hampshire, and eastern Connecticut), is reliable as far as it goes. I have been aided in compiling it by none but accurate observers, and out of a large number of stations have selected enough to be of use to collectors and to give a fair idea of the distribution of each species through New England, though my pleasure in printing it is considerably lessened by the fear that I may be sounding the death-knell of some of the rarer kinds. Grant Allen says that the Yellow Lady's Slipper in England now lingers but in two places; one of these, "a single estate in Durham, where it is as carefully preserved by the owner as if it were pheasants or fallow-deer," and in New England so many wild flowers are, as Higginson pathetically puts it, "chased into the recesses of the Green Mountains," that I predict the formation, before many

years, of a society for their protection. Unhappily, it is not always the ignorant pleasure-seeker who offends; one can forgive him when he tramples underfoot the flower that has served to amuse him for the passing moment, but when it comes to a professed botanist, who with selfish motives uproots right and left and blots out name after name in the Flora of a locality, it should be his lot to be branded with a longer and more unflattering adjective than any he has written under the crumbling, graceless specimens in his herbarium. The axe and the drain-tile, too, will have their own way, and when we can no longer defend our favorites from the despoiler or remove them to some equally congenial swamp or forest, we can as a last resort give them, in our own gardens, the protection of fences, watch dogs, and city laws.

CALYPSO.

The sun-lit copse is passed, the shadows thicken,
 With bated breath I press
 Along the narrow path, now lost, now sighted,
 That threads the wilderness.

Lest jealous bee or tattling wind give warning,
 And from her dewy glade
 The timid deity take flight to regions
 No mortal can invade.

Not here nor there my wearied eyes behold her,
 (Dimmed by her spells, perchance),
 The fir-trees glower and the cedars brandish
 Their arms at my advance.

Is this her shrine, where jeweled cobwebs tremble,
 Silk curtains, rudely rent
 As at my step profane the goddess hastened?
 (These tender ferns are bent).

Here the Linnæas swing their perfumed censers,
And Tiarellas pale
And pure as vestal virgins through the spaces
In this hushed, peaceful vale.

Ah no! to deeper glooms the woodthrush calls me
To urge my glad pursuit ;
Her laureate, who melodiously flatters
On his rich silver flute.

See ! where that thoughtless wind the leaves is lifting,
Above her mossy bed
On lightest tiptoe poised Calypso hovers,
Her rosy wings outspread.

Thrice happy I, to gaze at last upon her !
But shall I venture near ?
How frame my speech, or what petition offer
That she will deign to hear ?

I haste ; I kneel ; for joy I cannot utter
One stammered word of praise ;
She nods her graceful head ; to wait my pleasure
The goddess fair delays.

COMPARATIVE LIST.

Showing the range of each species through New England, and as far as possible in each State. The degree of abundance or rarity is indicated thus: * common; x very rare; ! probably found in the State although no stations could be obtained; in the case of towns this mark implies that the evidence is strongly in favor of the plant's occurrence there. As a rule, the columns correspond to the east and west sides of a State.

	MAINE.	N. HAMPSHIRE.	VERMONT.	MASS.	R. ISLAND.	CONN.
Orchis spectabilis	x Strong, Farmington, Watford, Otisfield, Waterville, Hollowell, Brunswick, Rockland.	* Dalton, Hanover, Charlestown, Walpole, Chesterfield, Amherst.	* Burlington, Charlotte, N. Ferrisburgh, Middlebury, Windsor, Rutland.	* Williamstown, Stockbridge, Monterey, Southwick.	x Foster! Johnston.	x Litchfield, Thompson, Granby, Middle-town, Meriden, Guilford, Windham, Oxford, Washington Ridgefield, N. Haven.
Orchis rotundifolia.	Harmony, Cambridge.	Randolph, Mt. Washington, Mt. Adams, Mt. Kinco, Thornton.	Colchester, Monkton, Bristol.	Williamstown, Peacham, Sharon, Norwich, Windsor, Brattleboro.		x x Norfolk.
Habenaria tridentata.	** Farmington, Fayette, Manchester, Harrison, Kennebunk.	Randolph, Jefferson, Gifford, Gilmanton.	Colchester, Monkton, Bristol.	* Williamstown, Ashfield, Pelham, Amherst, Northampton, Springfield, Concord.	* Warwick, S. Kingston, Warren, Barrington.	* Windsor, E. Hartford, Manchester, Killingly! Canterbury, Norwich.
Habenaria virecens.	Monson, Farmington, Hebron, Augusta.	Franconia, Claremont.	S. Hero, Burlington.	Williamstown, Northampton, Southwick, Fitchburg, Concord.	* Johnston, Middletown, Cranston.	* Granby, Suffield, Guilford, Bridgeport.

Habenaria viridis var. bracteata.	* Monson, Rangely L? Farmington, Waterville, Manchester, Hebron, Rockland.	Ft. Kent, Caribou L.	Franconia, Plymouth, Grafton, Keene, Winchester, Richmond.	Randolph, Jackson, Gilford, Gilmanton.	Charlotte, N. Ferrisburg, Middlebury.	Peacham, Norwich.	Williamstown, George- town, Lincoln, Milton.	Litchfield, Granby, Meriden, Middletown, Cheshire, Hamden, N. Branford.
Habenaria hyperborea.	* Monson, Hamony, Farmington, Livermore, Manchester, Hebron.	Ft. Kent, Caribou L. Orono.	Franconia, Hanover, Winchester, Richmond.	Gorham, Carroll, Jackson.	* Stowe, Burlington, Monkton, Middlebury, Pownal.	Irasburg, Peacham, Brattleboro.	Williamstown, Concord.	x x Salisbury, Monroe.
Habenaria dilatata	* Monson, Manchester, Hebron, Brunswick.	Mt. Katadin, Caribou L. Orono.	* Franconia, Lincoln, Woodstock, Meriden, Keene.	Mt. Adams, Mt. Wash- ington, Ripton, Jackson, Exeter.	* Stowe, Burlington, Mendon, Somerset, Pownal.	Peacham, Sharon, Windsor, Pomfret, Brattleboro.	Williamstown, Lexington	x Litchfield.
Habenaria obscura.	* Rangely L., Farmington, Hebron, Harrison.	Ft. Kent, Mt. Des- cort.	* Bethlehem, Franconia, Thornton, Mt. Kearsarge?	Randolph, Mt. Wash- ington, Crawford H.	* Brownington, Stowe, Ripton, Mendon.	Charles- ton, Peacham.	x Mt. Washington, Mt. Wachuset.	
Habenaria Hookeri.	* Waterville, Manchester, Hebron, Harrison, Auburn, Brunswick (var.), Rockland.	Orono, Calais?	* Franconia, Hanover, Keene, Amherst.	Gorham? Jackson, Gilmanton, Concord, Exeter.	Charlotte, Middlebury, Burlington, Brandon, Rutland.	Lunenburg, Barnet, Randolph, Sharon, Norwich, Brattleboro, Vernon.	Williamstown, George- town, Primrose Station!	Granby, Litchfield, Waterbury, Meriden, Oxford, Reading (var.), N. Haven.

	MAINE.	N. HAMPSHIRE.	VERMONT.	MASS.	R. ISLAND.	CONN.
<i>Habenaria orbiculata</i>	* Moosehead L. Ft. Kent, Orono. Monson, Cambridge, New Sharon, Fayette, Hallowell, Lewiston, Brunswick.	* Franconia, Woodstock, Rumney, Groton, Waipole, Hanover, Richmond, Fitzwilliam.	Mt. Mansfield, Camel's Hump, Monkton, Rippon.	William s- Groveland, Reading, Danvers, Woburn? Ashby, Canton, Stonelham, Littleton, Concord, Tewksbury.		* Norfolk, Litchfield, Hamden. Granby, Windsor, S. Windsor.
<i>Habenaria ciliata</i>	? Langdon.	x Hanover, Lebanon, Meriden, Keene.	x Burlington, Middlebury.	Easthampton E. Amherst, Northboro, Sharon, Kingston, N. Bedford.	Foster, N. Scituate, Kingston.	Thompson? Lebanon, Salem, Lyme.
<i>Habenaria bipharitidis</i>	* Monson, Fayette, Waterford, Hebron (var.), Otisfield, Manchester.	Mt. Washington, Exeter.	x N. Troy, Burlington.	Gardner, Littleton, Northboro, Concord, Hanover, Gloucester, Rockport, Seekonk.	Scituate, S. Kingston.	Colebrook, Suffield, E. Hartford, Waterford.
<i>Habenaria lacera</i>	* Monson, Readfield, Manchester, Brunswick, Saco, Kennebunk.	Hanover, Jackson, Tuftonborough, Gilmanton, Dover, Exeter.	Middlebury, Lunenburg.	* Williams- town, Northampton Rockport, Sheffield, Southwick, Amherst, Leimeadow, Fitchburg, Concord.	N. Scituate, Kingston, Newport.	Suffield, Windham, Canterbury, Norwich, S. Windsor, Hartford.
<i>Habenaria psycodes</i>	** Chesuncook L., Monson, Harmony, Andover, Manchester, Brunswick, Portland, Wells.	** Jefferson, Franconia, Warren, Hanover, Keene, E. Machias, Calais, Chesterfield, Salem, Exeter.	** Charlotte, Starksboro, N. Haven, Middlebury, Rutland.	** Westminster, Sheffield, N. Ampton, S. Ampton, Springfield, Malden, Amherst, Concord, Georgetown.	* N. Smithfield, Johnston, Providence, Kingston.	** Cornwall, Burlington, Farmington, Plainville, N. Haven, Orange, Stamford.

** Habentaria imbricata.	Chesuncok L. Orono, Monson, New Sharon, Manchester, Webster, Brunswick, Wells, Kennebunk.	* Jefferson, Franconia, Warren, Hanover, Enfield, Claremont, Keene, Hinsdale.	Gorham, Randolph, Conway, N. Sandw ^h , N. Groton, Gilmanton, Salem, Exeter.	Stowe, Burlington, Brattleboro Bennington.	Randolph, Brattleboro	* Williamstown, Deerfield, Springfield, Amherst, Leominster, Tewksbury, Methuen, Georgetown, N. Bedford	Ipswich, Danvers, Malden, Lancas- ter, Lincoln, Haverhill, Plymouth N. Bedford	Johnston Exeter.	* Farmington, Bristol, Cheshire, Monroe, Washington.	S. Windsor, Tolland, Scotland, Norwich.	
* Goodyera	Ebene L., Calais, Miltown.	Mt. Adams, Lincoln, N. Groton, Hanover.	Shelburne, Mt. Willard Conway, Campton, Gilmanton, Bristol, Manchester Portsmouth	N. Troy, Burlington, Charlotte, Monkton, Bristol, Middlebury, Salisbury.	Peacham.	Williamstown, Leverett, Fitchburg, Concord, Methuen, Rockport.	Manchester, Georgetown, Weston, Malden, Canton ?	x Lime Rock.	Hartland, Granby, N. Haven.	Norwich.	
* Goodyera	Ebene L., Orono, Castine.	Hanover, Keene, Hinsdale, Winchester.	Shelburne, Plymouth, Concord, Exeter, Portsmouth	Charlotte, Monkton, N. Ferrisburg.	Vernon.	* Northampton, Sunderland, Shelfield, Mt. Tohey, Springfield, Concord, Methuen, Georgetown, Danvers.	N. And- over, Malden, Wellesley, Kingston, N. Bedford Edgartown.	Cumberland, Lincoln.	* Salisbury, S. Windsor, E. Hartford, Wethersfield, Danbury, Bridgeport.	Scotland, Norwich, Waterford.	
Goodyera	Frenchville, Ft. Kent.										
Spiranthes	Portland, Rockland.	* Hanover? Chesterfield, Amherst.	Conway ?	Bristol, Burlington, Brandon.	Barnet, Norwich, Windsor, Bellows Falls, Brattleboro, Vernon.	Conway, Amherst, Northampton, Nantucket.	Lynfield, Newton, Kingston,		E. Hartford, S. Windsor.		
Spiranthes	St. Francis, Cambridge? Saco.	x	Mt. Washington, Bristol, New Hampton.	Stowe, Hinesburg, Bristol.	Lyndon, Peacham, N. Pomfret.						

<i>Listera con-</i> <i>variatrice</i> ?	* Bald Mt., Rangely L., Nonson, Farmington, Manchester.	Ft. Kent.	Bethlehem, Lebanis, Mt. Pleasant, Strawberry Hill, Mt. Agassiz.	Underhill, Bolton, Rutland.	Charleston, Peacham.	† N. Bedford?			
<i>Arthusa</i> <i>bulbosa</i>	** Monson, Waterville, Manchester, Hebron, Kennebunk, Wells, Portland, Brunswick.	Orono, Machias, Baileysville, Calais.	Gorham, Groton, Hooksett, Canaan, Manchester, Exeter, Greenland, Portsmouth.	* Colchester, Burlington, Monkton, Bristol, Hubbardton, Rutland.	Peacham, Woodstock.	** Westminster, Southwick, Belcher's n, Royalst' n, Fitchburg, W. Boylst' n, Concord, Methuen.	* Cumberland, E. Providence, Newport, E. Greenwich.	* Norfolk, Litchfield, Plainville, Danbury, N. Haven.	* Granby, Thompson, S. Windsor, Ashford, Scotland, Norwich, Montville.
<i>Pogonia</i> <i>ophroglossoides</i> .	** Fryeburg, Monson, Hebron, Brunswick, Portland, Saco, Wells, Farmington.	Manchester, Orono, Rockland, Mt. Desert.	Gorham, N. Sand- wich, Gilmanton, Concord, Hinsdale, Salem.	* Colchester, Winooski, Bristol, Vergennes, Brandon.	Newport, Peacham, Thetford.	** Westminster, N. Hampton, Lenox, Mt. Wash- ington, Southwick, Medfield, Plymouth, N. Bedford.	* Cumberland, N. Providence, E. Providence, Newport.	* Litchfield, Hartford, S. Windsor, Wethersfield, Ridgefield, Bridgeport.	* Thompson, Brooklyn, Manchester, Scotland, Norwich.
<i>Pogonia</i>			* Winchester, Richmond.	** Fair Haven.		* Williamstown, Deerfield, Conway, Amherst.	* N. Smithfield.	* Suffield, Southington, Hendden, N. Haven.	Norwich.
<i>Pogonia</i> <i>verticillata</i> .				** Colchester?		* Williamst' n, Haverhill L., Mt. Wash' n, Deerfield, Billerica, Amherst, Belchertown Medfield, Southwick, N. Pridge, Ashby, water, Hanover? N. Bedford.	* N. Providence, Providence.	Litchfield, Suffield, Granly, Bristol, Monroe, Woodbridge, E. Haven.	E. Hartford, S. Windsor, Brooklyn, Norwich.
<i>Pogonia</i> <i>affinis</i> .									* * * New Haven.

	MAINE.	N. HAMPSHIRE.	VERMONT.	MASS.	R. ISLAND.	CONN.
Calopogon pulchellus.	* Monson, Farmington, Hebron. Manchester, Brunswick, Portland, Saco, Wells.	** Lancaster, Canaan, Keene. Conway, Sanbornton, Meredith, Salem, Hooksett, Manchester, Exeter. Portsmouth.	** Colchester, Shelburne, Bristol, Vergennes, Brandon, Pownal.	** Peacham. Sunderland, Sheffield, Springfield, Fitchburg, Concord, Methuen, S. George't'n Gloucester.	** Wilming'tn Lincoln, Scituate, Richmond, Kingston.	** Litchfield, Thompson, E. Hartford, Windsor, Scotland, S. Mancht'r, Norwich, Bridgeport.
Calypso borealis.	x Moose R., Orono, Harmony, Bangor. Cambridge, Guilford, Dover. Farmington, Waterville.	x Milan, Success, Jefferson, W. Thornton.	Grand Isle, Monkton, Bristol, Sutton, N. Haven, Middlebury, Salisbury?	Charleston, Westmore, N. Bedford.		
Tipularia discolor.			x Bellows Falls, Brattleboro.	x Deerfield. Sandwich.		
Microstylis monophyllus.	Rangely L., Farmington, New Sharon, Manchester, Squirrel Isl., Kennebunk.	Littleton? Franconia, Hanover.	Willoughby L. Castleton.	x x N. Bedford?		
Microstylis ophioglossoides.	Rangely L. Bethel, Turner, Mousset's L., Monson.	Black Mt., N. Stratford, N. Groton, Gilsun, Keene, Richmond.	Bristol, Brandon, Middlebury.	Peru, Mt. Washington, Deerfield, Amherst.	Exeter.	Berlin, Monroe, Westville. Voluntown!

Liparis littoralis	Mt. Kinco. Bradford. Mt. Desert.		Middlebury.	Windsor, Bellows Falls. Brattleboro.	Mt. Wash- ington, Granville, Amherst.	Magnolia, Cambridge, Milton.	Lincoln	* Granby, Meriden, Hamden.	W. Hartford, Norwich.
Liparis lucida	** Rangely L. Livermore, Greene, Harrison, Auburn, Peak's Isl. Wells, Readfield.	Hanover, N. Groton, Manchester, Wendover, Hinesburg, Kecene, Hinsdale, Walpole, Winchester.	Burlington, Jericho, Hinesburg, Middlebury.	Peacham, Berlin, Thetford.	Williamst'wn Southampton, Leverett, Southwick, Amherst, Worcester, Ashland.	Andover, Lawrence Topsfield, Beverly, Milton, Woburn, Canton, N. Bedford.	* * *	* Suffield, Bristol, New Canaan, Hamden, Centerville, E. Haven.	Belton, Norwich.
Corallorhiza innata	* Monson, Cambridge, Farmington, New Sharon, Waterville, Augusta, Auburn, Brunswick.	Hanover, N. Groton, Walpole, Winchester.	Burlington, Charlotte, Bristol, Monkton, N. Haven.	Peacham, Brattleboro.	Wimstown, Cumming- ton, Amherst, Stoneham, Manchester, Dedham.	S. Natick, N. Bedford.	?	* Colebrook, Litchfield, Plainville.	
Corallorhiza odontorhiza	* Livermore, Lewiston.		Underhill, Burlington, Charlotte.	Norwich, Bellows Falls, Brattleboro.	* Williamstown? Sunderland, Amherst, Fitchburg, Roxbury.		Warwick.	* Windsor, Manchester, Wethersfield, Hamden.	Pomfret, Norwich.
Corallorhiza multiflora	Monson, Farmington, Manchester, Hallowell, Richmond, Brunswick.	* Franconia, N. Groton, Walpole.	* * * Stowe! Burlington, Ripton.	Barnet, Norwich.	Wimstown, Washington, E Hampton, Southwick, Mt. Tobey, Worcester, Reading.	Georget'wn Rockport, Malden.	Johnston, Warwick.	* Suffield, Granby, Salisbury, Norfolk, S. Windsor, Manchester.	Scotland, Norwich.

MAINE.	N. HAMPSHIRE.	VERMONT.	MASS.	R. ISLAND.	CONN.
<p>× Augusta? Rockland.</p> <p>× Claremont, Walpole.</p>	<p>× Charlotte, Monkton, N. Ferrisburg, N. Haven, Middlebury, Castleton.</p>	<p>× Conway, Easthampton, Mt. Holyoke, Rockport.</p>	<p>× Conway, Easthampton, Mt. Holyoke, Rockport.</p>	<p>× Hartland, Suffield, Danbury, Monroton, Westville.</p>	<p>× × × North Haven.</p>
<p>Hallowell.</p>	<p>× Grand Isle, Westmore, Windsor.</p> <p>× Colchester, Charlotte, Bristol, N. Haven, Middlebury, Fair Haven, Rutland.</p>	<p>× Florida, Sunderland, Rockport?</p>	<p>× × × North Haven.</p>	<p>× × × North Haven.</p>	<p>× × × North Haven.</p>
<p>Monson, Harmony, Cambridge, Farmington, Livermore, Manchester, Auburn, Danville.</p>	<p>× Ft. Kent, Heron, Orono, Rockland, Houlton?</p>	<p>× Lunenburg, Peacham, Barnard, Windsor.</p>	<p>× W'mstown, Mt. Wash'n, Conway, Shelburne, S'thampton, Canton, Mt. Holyoke, Amherst, Westford.</p>	<p>× Litchfield, Granby, Farmington, Meriden, Branford, New Haven.</p>	<p>× Litchfield, Granby, Farmington, Meriden, Branford, New Haven.</p>
<p>× Harmony, Cambridge, Newry, Strong, Livermore, Lewiston, Danville, Rockland.</p>	<p>× Franconia, Hanover, Keene, Hinsdale, Winchester.</p>	<p>× Burlington, Charlotte, Middlebury, Rutland, Rupert.</p>	<p>× N'rthampton, Deerfield, Westfield, Granville, Southwick, S. Hadley, Amherst, Worcester, Lexington.</p>	<p>× × × Johnston, Diamond Hill.</p>	<p>× Pomfret, Scotland, Lebanon, Norwich.</p>
<p>× Cambridge, Hebron, Fayette, Manchester, Augusta, Brunswick.</p>	<p>× Franconia, Lebanon, Hanover, Amherst.</p>	<p>× Newport, Craftsbury, Peacham, Barnard, Woodstock, Brattleboro.</p>	<p>× W'mstown, Pittsfield, Stockbridge, Danvers, Deerfield, Easthampton, Mt. Holyoke, Agawam, Andover.</p>	<p>× Bristol, Southington, Southbury, Oxford, Hamden, Westville.</p>	<p>× Bristol, Southington, Southbury, Oxford, Hamden, Westville.</p>

***	***	***	***	***	***	***
Harmony, Farmington Hebron, Auburn, Kennebunk, Richmond, Brunswick, Rockland.	Houlton, Faten, Bucksport, E. Machias, Calais.	Tranconia, Hannover, Christfield Concord, Nashua, Exeter, Portsmouth.	Crawford II., Conway, Gilmanton, Concord, Nashua, Exeter, Portsmouth.	Rutland, Pawlet.	Newport, Lancenburg, Barnet, Windsor, Bellows Falls, Braintree, Concord.	Methuen, Beverly, Malden, Newton, Kingston, Taunton, Warren, N. Bedford, S. Kingston, Exeter.
Cryptidium acutic.						Thompson, Scotland, Norwich.
						Cornwall, Granby, Simsbury, S. Windsor, Manchester, N. Guilford, Oxford, Bridgeport.

ADDENDA.

P. 9. Orchids are perennials.

P. 21. When the pollen is in a lump, as in the Lady's Slippers, it is, strictly speaking, a *pollen-mass*; when it has a stalk and disc, as in the Showy Orchis, a *pollinium*; distinctions usually ignored by writers.

The rostellum in *O. spectabilis* consists of two pouches very slightly connected.

P. 26. Wooster's *Alpine Plants* says of the root in Orchis: "it consists of 2 solid masses. One bulb or tuber is destined to be the successor of the other and is plump and vigorous; the other or decaying one is always wrinkled and withered. From the withered one has proceeded the existing stem, and the plump one is an offset from the centre of which the stem of the succeeding year is destined to proceed. The situation of the plant is changed about $\frac{1}{2}$ inch every year; and as the offset is always produced from the side opposite to the withered bulb or tuber, the plant travels always in one direction."

P. 37. The sterile stamen of the Kam's-head Lady's Slipper bulges in two lobes as if it originally covered two hard substances.

P. 41. The beak or nose-shaped protuberance in Hooker's *Habenaria* is not between the discs, as my former statement implied, but higher up. The line dividing the stigmas in *O. maculata* here becomes a prominent ridge, and is so viscid that I have found pollen-grains on it. There is a protuberance in the Bracted *Habenaria*, much like a rostellum in shape, that is not seen in *Peristylus viridis* (P. 44).

BIBLIOGRAPHY.*

*Publications containing references to, or descriptions of Orchids found in
New England.*

SIMPLE LISTS.

The Portland Catalogue of Maine Plants.

Pub. by Port. Soc. Nat. Hist. Pamph. Portland, 1868.

Plants found in New Hampshire only on Alpine summits.

Geology, N. Hampshire, Vol. I. Concord, 1874. Prof. J. W. Chickering.

List of Plants collected in Salem, Mass. and its vicinity.

Proc. Essex Inst. Vol. III. Salem, 1860.

Catalogue Plants growing without cultivation within five miles of Yale College.

William Tully, M.D.

From Appendix, Baldwin's Hist. Yale College. Pamph. N. Haven, 1831.

LOCAL FLORAS AND LISTS WITH OCCASIONAL STATIONS.

Catalogue of the Flowering Plants of Maine. Geo. L. Goodale.

Proc. Portland Soc. Nat. Hist. Vol. I. Portland, 1862.

The Flora of Franconia in Springtime. W. C. Prime.

Lonesome Lake Papers, N. Y. Journal of Commerce, June, 1882.

Flora of Hanover, N. H. and vicinity. Prof. H. G. Jessup.

Pamph. — 1881?

Catalogue of Vermont Plants. Wm. Oakes, Joseph Torrey.

Thompson's Nat. Hist. Vt. Burlington, 1843-1853.

Catalogue of Vermont Plants. G. H. Perkins, C. C. Frost.

In Archives of Science, Vol. I. McIndoes Falls, 1872.

Catalogue Plants of Middlebury, Vt. Edwin James.

Hall's Statist. Acct. Town Middlebury. Middlebury, 1821.

General Catalogue of the Flora of Vermont. G. H. Perkins, Ph. D.

Pamph. Montpelier, 1882.

* The reader will find in Pritzels "Iconum Botanicorum Index," a book found in any large library, a very full list of works containing plates of Orchids described in this monograph.

- Catalogue of Plants growing without cultivation in State of Mass. Edward Hitchcock.
- Report on Geol., etc., of Mass. Amherst, 1833.
- Catalogue of Berkshire Co. Plants. Chester Dewey.
- Catalogue of Plants growing without cultivation in the vicinity of Amherst College. Edward Hitchcock.
- Pamph. Amherst, 1829.
- Catalogue of Plants growing without cultivation within thirty miles of Amherst College. E. Hitchcock, C. C. Frost.
- Amherst, 1875.
- Florula Bostoniensis. Plants of Boston and vicinity. Jacob Bigelow, M. D.
- Boston, 1814. New Editions, 1824, 1840.
- List of the Plants of Malden and Medford.
- Pamph. Malden, Mass., The Middlesex Institute, 1881.
- Flora of Essex Co., Mass. John Robinson.
- Published by Essex Inst. Salem, 1881.
- Flora of Lynn. Cyrus M. Tracey.
- Lynn, 1856.
- Trees and Flowers of Cape Ann and of Pigeon Cove and vic. C. W. Pool, H. C. Leonard.
- Boston, 1873.
- Flora of Georgetown. Mrs. C. N. S. Horner.
- Georgetown Advocate. Feb. and March, 1876.
- Catalogue of Plants of New Bedford and vicinity. E. W. Hervey.
- Pamph. 1860.
- Flora of Worcester Co., Mass. Prof. Wm. Jackson. — 1884.
- List of Plants of Litchfield, Conn., and vicinity. Jno. P. Brace.
- Silliman's Journal, Vol. IV. I. Series, 1822.
- Catalogue of Flowering Plants growing without cultivation within thirty miles of Yale College.
- Published by the Berzelius Society. Pamph. New Haven, 1878.
- A Catalogue of Wild Plants growing in Norwich and vicinity. G. R. Case, Wm. A. Setchell.
- Pamph. Norwich, Ct., 1883.

DESCRIPTIVE ARTICLES.

- Remarks on *Habenarias orbiculata*, *dilatata*, and *Hookeri*.
- Annals N. Y. Lyceum, Nat. Hist. Vol. III. 1828-36.
- Remarks, chiefly on the synonymy of several N. A. Plants of the *Orchis* tribe. Asa Gray.
- Am. Journal Science, Vol. 38. I series.

- Statistics Flora of the Northern United States. Asa Gray.
Am. Journal Science, Vol. 23, 1857.
- Review of Darwin's Fertilization of Orchids through the Agency of Insects. Asa Gray.
Am. Journal Science, II. Series, Vol. 34, Nov. 1862.
- The Orchids of America.
Phila. Times, Nov. (7?), 1882.
- Notes on the Flora of Vermont. Geo. H. Perkins, Ph. D.
Burlington Free Press, 1883.
- Native Plants adapted for Winter Culture. Mrs. T. L. Nelson.
Transact, Mass. Hort. Soc., June, 1882.
- Herbaceous Plants of Mass. Chester Dewey.
Zoolog. and Bot. Survey Mass., Boston, 1839.
- Beautiful Plants Growing Wild in the Vicinity of Boston. E. B. Kenrick.
Gardener's Mag., Vol. I., Boston, 1835-6.
- On Pogonia ophioglossoides. J. H. Scudder.
Proceedings Boston Soc. Nat. Hist., Vol 9, April, 1863.
- Remarks on Cypripedium.)
Remarks on Habs. virescens and } Asa Gray. Amer Jour., Vol. 36, Sept., 1863.
tridentata.)
- Notes on Cyp. spectabile.) Vol. 15, Nov., 1881.
" " " } Am. Naturalist. " Oct. "
" Arethusa.) Vol. 12, July, 1877.

BOOKS AND ARTICLES WITH DESCRIPTIONS AND ILLUSTRATIONS.

- Botanique Nova Genera. A. Von Humboldt.
Paris, 1815
- British Flower Garden. Robert Sweet.
1st and 2nd series, London, 1823-31.
- Flora North America. W. P. C. Barton, M.D.
Philadelphia, 1821.
- Flora Boreali Americana. Sir W. J. Hooker.
London, 1840
- Flore des Serres. Louis Van Houtte.
Ghent, 1854-5.
- Illustrations of Orchidaceous Plants. Thos. Moore.
London, 1857.

- Native Flowers and Ferns of the United States. Thos. Meehan.
I. series, Boston, 1879; II. series, Phila., 1880.
- Wild Flowers of America. G. L. Goodale and I. Sprague.
Boston, 1880.
- Among our Footprints. W. Hamilton Gibson.
Harper's Magazine, Dec., 1881.
- Beautiful Wild Flowers. A. B. Hervey & I. Sprague.
Boston, 1881.
- Wild Flowers and Where they Grow. Misses Harris & Humphrey.
Boston, 1882.
- Flowers of the Field and Forest. A. B. Hervey & I. Sprague.
Boston, 1882.
- Field, Wood and Meadow Rambles. Amanda Harris & Geo. F. Barnes.
Boston, 1882.

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