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CONTENTS:

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ABSCISSION.[1]

BY FRANCIS E. LLOYD.

Among the ever recurring phenomena which characterize the lives of plants, perhaps none is more impressive than the usually sudden and complete loss of foliage by trees and shrubs on the approach of winter, unless it be the untimely occurrence of the same change ensuing upon an untoward drought or some equally unfavourable climatic disturbance. The uncouthness and semblance of death attaching to a leafless tree when it should be enfolded in a robe of verdure strikes a sad note, however little one may appreciate the exact nature of the importance of leaves in the economy of the plant. And, when one enters a tropical region, it is the everlasting verdure which at once wakens the interest.

But the fall of the leaf is only one of a series of similar behaviours, in many instances leading to an increase in individuals rather than a mere riddance of parts which are unable longer to resist the conditions imposed upon them. The multiplication of simple plants, such as the algae, by a separation between contingent cells, the breaking away of pieces of stem, of leaves, brood-bodies and the like, so commonly occurring, but usually unobserved, in the mosses (Correns, 1); the shedding of leaves in plants which, like *Bryophyllum* and *Begonia*, use them as a means to propagation by the growth of new plantlets from the leaf-margins or elsewhere; the separation of staminate

[1]The text of a lecture delivered under the little "Abscission in Flowers, Fruits and Leaves" before the Ottawa Field-Naturalists' Club, Jan. 27, 1914. Although of a general nature, it includes the results of original observations on a series of about 30 species, with especial reference to the mechanism of abscission. The details of this phase of the work are reserved for another paper, and a brief preliminary account only is given here. All the work on the cotton, (*Gossypium herbaceum*), here reported was done at the Alabama Polytechnic Institute (account of Adams Fund) or at West Raleigh, N.C., (accounts of Bureau of Plant Industry, U.S. Dept. of Agric. and of McGill University).

flowers in the hydrocharids in order to effective pollination—these exemplify the same activity leading to renewed life rather than to the mere sloughing of parts moribund or dead.

The processes by which these results are brought about and the conditions leading to them constitute the subject of this essay. There is also the purpose of presenting a general summary of the problem of abscission as at present understood. It will be deemed unnecessary to make an extended historical review of the development of our knowledge, which, from lack of space, must in any event be excluded.[2] Only pertinent references, therefore, will be made during the progress of this discussion. Unless specific mention is made, it will be understood that the more highly organized plants are meant.

THE PARTS OF PLANTS WHICH MAY BE SHED.

Aside from the outer layers of the stem, namely, the epidermis and dead cortex, with included tissues, the parts of the plant which may be shed by the process of abscission are transverse segments of the stem, including one or more internodes, either with or without attached flowers; or any lateral organs, either foliar or floral.

Beginning with leaves as the most familiar examples, we notice further that either the leaf as a whole falls away from the supporting stem, or, when compound, the individual leaflets fall separately (Ash, Horse Chestnut, Boston Ivy, etc.). The instances of *Ampelopsis Veitchii* and *Citrus* sp. may be especially mentioned since in these forms the apparently simple leaves are separated both at the base of the leafblade and at the base of the petiole. *Ampelopsis Veitchii*, however, produces trifoliolate leaves on older shoots, and certain *Citrus* sp. have also compound leaves, so that the single blade may be regarded as a terminal leaflet or as a fusion product of three. In the cases which I have studied (*Ampelopsis*, *Vitis*, *Fraxinus*, *Aesculus*, *Negundo*) leaves and leaflets present no difference in the method of separation, in concurrence with earlier students (Tison, Loewi, (3) in *Citrus*), so far as attention has been paid to the matter.

The position of the plane of separation varies, but is to be found near the base of the organs in question. In the case of the petiole, it may occur at a point further removed from the stem, and thus leave the leafbase clasping more or less completely the axillary bud (*Smilax*, *Philadelphus*, *Platanus*). In *Smilax*, the leaf is cut off above the tendrils, so that, although these are of foliar origin, they are allowed to remain supporting

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[2] This material may be in large part found in the detailed paper of Tison (2).

the plant. Aside from special cases of this kind, there is some variation of position, as noted by Loewi (3, page 998) in the leaf of *Cinnamomum*, in which the abscission plane was found, in a very few instances, to lie in the neighbourhood of 2 mm. above the expected position. In *Hamamelis* there are two parallel separation zones a short distance apart. The leaf is first set free by the upper one in the autumn, and in the early spring following a short segment is thrown off (Tison 2). Practical identity of position is attained only in those forms possessing a differentiated layer of tissue, such as that in *Polygonum*, *Syringa* and *Zizania*, in which it happens that the abscission plane lies, but why it should do so is not clear. On the other hand we can very surely say that in many, if not in most instances, there is no slightest suggestion in the histological structure of the organ of a specialized abscission layer (*e.g.*, *Vitis*, *Spiraea*, *Philadelphus*, *Hydrangea*), and we may say, with Loewi, that abscission is a physiological response, adaptive if you please, to stimuli, and is not conditioned by a predetermined structure.

The falling away of the leaf, far from being an economical process, is a necessary response to conditions imposed. To be sure, acids of silica and lime usually assumed to be useless, occur in double the usual quantity in falling leaves, while there is a decrease, due to movement into the stem, of nitrogen salts. The conclusions of Ramann, (4) do not, however, accord wholly with those of Combes (1911), who has held that a migration of substances prior to leaf-fall does not occur, nor are those remaining in the fallen leaf to be considered *a priori* as non-utilizable. Much, he maintains, remains which might have been used. The leaf may in this respect be compared to dead and exfoliated bark, which also is not devoid of useful materials. Foods (starch, sugar) are certainly lost in floral parts and in fruits which have suffered abscission—*e.g.*, starch is lost with the corolla of *Gossypium*.

The abscission of cotyledons normally occurs in the aroid *Cryptocoryne ciliata* and in the mangrove (*Rhizophora*) (Goebel, 6). These plants are viviparous; their embryos withdraw the overplus of foods from the cotyledons, which, after abscission, remain within the fruit. The seedling then shifts for itself, finding anchorage in the soft mud of the shore line habitat. There are, however, other viviparous seedlings which are released from the parent plant without separation of the cotyledons (*Podocarpus*, Lloyd, 7).

Such adaptive behaviour may be matched by examples of disharmony. The "calamander," a sort of teak (*Diospyros hirsuta* L.), of Ceylon, is one such. Abscission of the cotyledons intervenes so constantly during the earlier stages of seedling development as to make it very difficult, if not impossible, to grow the tree from the seed.[3] The usefulness of the seed is thus defeated.

Again, many plants are unable to shed their leaves at all. *Eupatorium adenophorum*, like a multitude of others, does not do so in nature, nor, as found by Wiesner (1905, through Loewi), even under experimental conditions. This disharmony is not confined to herbaceous plants, as I have found it to occur in the perennial shrub *Parthenium argentatum*. This plant, neither in its native health nor under a variety of experimental conditions, is found to lose its leaves save by a long delayed method of wear and tear, somewhat hastened it may be by a clumsy development of corky tissue continuous with that of the stem, but developing first from a centre at the leafbase. (Lloyd, 8).

ABSCISSION OF SHOOTS.

Not a few trees are able to shed, by a process similar, if not identical,[4] with that in leaves, their smaller, and in some cases, even their larger branches. The Central American Rubber Tree (*Castilloa elastica*) is a striking illustration, and has been described by O. F. Cook (9). The young tree produces no permanent branches till the third or fourth year. Those which develop before that time are long and semi-pendulous, measuring scarcely one inch in diameter at the base and reaching a length of ten or twelve feet. These are all shed, being released by a softer layer of tissue, arranged in the form of a socket, quite at their basal extremities. The loss of twigs by poplars, willows and other trees is comparable with, if not as striking as, that of *Castilloa*. The shedding of twigs produced from axillary buds which grow at once, instead of entering a resting condition, occurs in the camphor tree (in Alabama), which, in respect of general appearance of the abscission, is very similar to *Castilloa*. The mechanism of abscission in its living tissues (cortex) is identical with that of the leaf, as v. Hoehnel observed in *Populus*, *Salix*, beech, etc., and as Loewi also found to be the case in *Cinnamomum Camphora*. *Euonymus atropurpureus*, which is grown in this part of the world as a small ornamental tree, also sheds its twigs, more especially those which happen to be exposed to the denser shade of overhanging branches. Loewi observed this behaviour in potted plants, attributing it to too

[3] My attention was drawn to this instance by my colleague, Professor Willey. See Wright, H., Ann. Roy. Bot. Gard. Peradeniya, vol. 2 (?).

[4] It is obvious that when large masses of wood, etc., are involved, some sort of fragmentation must take place, but a really satisfactory account of the underlying causes is not yet available. See, however, v. Hoehnel, 10, 11.

high a relative humidity, though it occurred also in cut branches, but more slowly, when exposed to drier room air.

The abscission of internodes and of shoot-tendrils (such as those of *Vitis*, *Ampelopsis*) offers another case in point. The tendrils may either persist and serve as a permanent mechanical support for the plant, or they may be shed from the more distal portions of the new stems, as occurs at the end of the growing season. The behaviour may be very well observed in *Ampelopsis Veitchii*. The internodes of the apparently chief shoots are equally marked in this respect. In both ordinary shoots and in tendrils, the plane of abscission lies near, but not precisely at, the base of the internode affected, and is not marked by any histological differentiation. In certain instances the abscission-plane is oblique, or even decurrent, such deviations being found where morphological displacement has occurred. According to the more generally accepted view, the tendril in *Ampelopsis* and *Vitis* is a chief shoot. Its normal position is therefor directly opposite a leaf, from the axil of which the supplanting shoot of the second order arises. However, the tendril frequently, and even usually may, in particular individuals (*Ampelopsis quinquifolia*, according to my observation), suffer an upward displacement of as much as 20 mm., and in such event the abscission plane of the internode above the secondary shoot will be oblique in a degree commensurate with the amount of displacement of the tendril. (Figure 1.) The fact of this morphological disturbance is of great importance in understanding the position of the abscission-plane in the cotton peduncle, as we shall presently see.

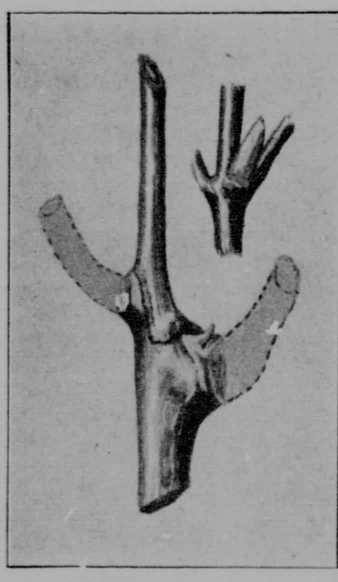

Figure 1 Oblique abscission of an internode in consequence of the upward displacement of the tendril which normally occurs directly opposite a leaf. The normal relation is shown in the upper figure. (*Parthenium argentatum.*)

The only other further example of shoot abscission to be here cited is that of the clumps of spines in certain cacti, of which *Cereus Thurberi* serves as an excellent example. The fleshy fruits of this species are covered by an armour of spines arranged in clusters, and, as the fruit matures, they are sloughed off. The mechanism involved has not, to my knowledge, been studied. It would be useless to speculate on the "biological significance" of this procedure.

THE ABSCISSION OF FLOWERS AND FRUITS.

The structure aggregates which, specialized with reference to reproduction, take the form of flower-shoots, and, with the progress of events, of fruit shoots, simple (supporting a single flower) or compound, may or may not normally be shed.[5] The cotton, peach and tomato, under, at present, little understood conditions, sometimes lose a very large proportion of their flowers before anthesis, to the great prejudice, as it is assumed, often not out of harmony with the facts, of the expected crop. Farmers and horticulturists frequently lose 50 per cent. or more of the theoretical returns for the labour expended.

Abnormal shedding of the entire and perfect flower *while open* is, for reasons not comprehended, relatively rare, though it is known to occur in cotton, as I have myself observed. *Mirabilis jalapa*, the well known Four-o-clock, does so phenomenally under untoward conditions, and has been studied particularly by Hannig (12), who furnishes in his paper a list of some twenty or thirty other species which may behave similarly. On the other hand, normal abscission intervenes, to remove staminate flowers after pollination has occurred, in the cucurbits, and before, and as a *conditio sine qua non* to it, in the hydrocharids. The eel-grass is a classic example, whose staminate flowers are loosened in the morning (Wylie, 13) and, floating on the surface of the water, open and bring their pollen by the chance of currents and surface tension into contact with the stigmas of the pistillate flowers. A still more remarkable behaviour is that of the closely related *Enalus acoroides*, of the eastern tropical shores. This has been more fully studied by Nils Svedelius (14), who points out, however, that Zollinger was the first to record the floating of the staminate flowers. These, according to Svedelius, are released at low tide. Having come into contact with the pistillate flowers, which reach to the surface only at this time, they are grasped by the petals, and in spite of the rise of the tide, are held firmly, and pollination proceeds below the water surface.

Just as abscission occurs before and during anthesis, conditions may be such as to induce the shedding of the developing fruit. The "boll-shedding" of the cotton intervenes chiefly during the earlier stages of development of the fruit or "boll,"

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[5]With various form of dehiscence this paper has nothing to do.

as it is acceptedly called, as shown by figures derived from a study of Egyptian cotton by Balls (15) and of the Alabama upland plant by myself. Balls found that upwards of 90 per cent. of the bolls shed did so within three of four days after flowering. From a statistical examination[6] of 579 shed bolls at Auburn, Ala., it emerged that the distribution of shed bolls, according to age, shows that the vast majority of bolls are shed at the ages of from three to seven days inclusive, and have at shedding a diameter of 12 mm. or less. In fact, 95 per cent. are shed before the end of ten days. (Figure 2).

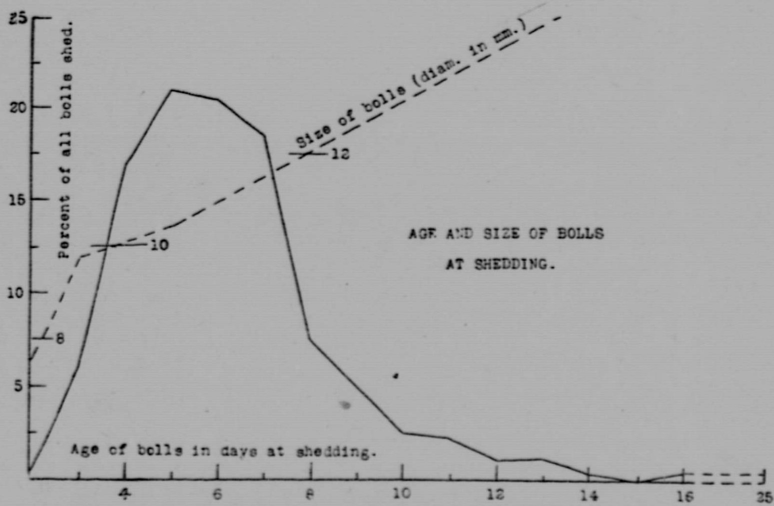

Figure 2. Graphs for age and size of bolls at shedding in percentage of the total shed. (*Gossypium herbaceum*).

The so-called "shelling" of grapes, which may greatly reduce the crop just at the period of maturation, appears to be the result of a definite abscission process comparable to the shedding of the cotton boll, except that the plane of separation occurs at the base of the ripened ovary and not at the base of the pedicel.

There are instances of indehiscent fruits in which exceptional behaviours may be seen, of which that of *Polygonum virginianum* and of the wild rice (*Zizania* spp.), may be quoted.

[6] Based upon data collected by my then assistant, Mr. C. S. Ridgway, who has kindly referred them to me.

The former, according to Reed and Smoot (16) is peculiar in having a layer of compressed pith cells enclosed in the vascular cylinder which remains unbroken until touched, although the cortex already shows complete abscission. Impact sufficient to break the vascular tissue allows the expulsion of the fruit, to a considerable distance. Those who have become familiar with the wild rice recall the fragile character of the stem below the spikelet, which breaks away at a slight touch. It needs not to do more than recall the various behaviours of plants which, like the compositae, set free their one-seeded fruits, sometimes singly, as in *Adenostemma* (Yapp, 17) and indeed in the majority of the family, and sometimes in groups, as in *Parthenium*, in which each of the five achenes is accompanied by two sterile flowers, while all the remaining staminate flowers are set free *en masse* (Lloyd, 8).[7]

Since the abscission of flowers and fruits results from a transverse or oblique cutting off of the stem, we should expect that the plane of separation would fall at or near the base of an internode. According to Hannig, however, this takes place immediately beneath the flower at the top of the pedicel in several species (*Nicotiana*, *Salvia*, etc.), and in the middle of the pedicel in others (*Solanum*, etc.). In still other species, the abscission plane falls just above a very small bract, these, therefore, according with the general rule. It may be mentioned in this connection that while separation near the base of the chief axis of the inflorescence may take place (*Mirabilis* and *Oxybaphus*, Hannig; *Impatiens Sultani*), it is no less worthy of note that, in many plants, even after the usefulness of the inflorescence has passed, their chief axes remain as permanent encumbrances. I have been able to find the traces of them in *Parthenium argentatum* after the passage of five years or longer. Among our own plants one easily finds similar examples, *e.g.*, *Rhus*, *Negundo*, *Syringa*, etc. And there are very many plants (palms, agaves, ferns, etc.) to which the leaves cling indefinitely, until they are worn or rotted away.

A case requiring special explanation is to be found in the Cotton (*Gossypium*), in which the plane of abscission may pass transversely through the base of the pedicel, or may extend downwards along the internode below, even as far as the next node. The diagram (Figure 3c) presents these diversities in graphic form. It has long been a puzzle to those concerned with this plant to account for this peculiarity, recorded in a bulletin on the diseases of the cotton by Atkinson (18) in 1897. To

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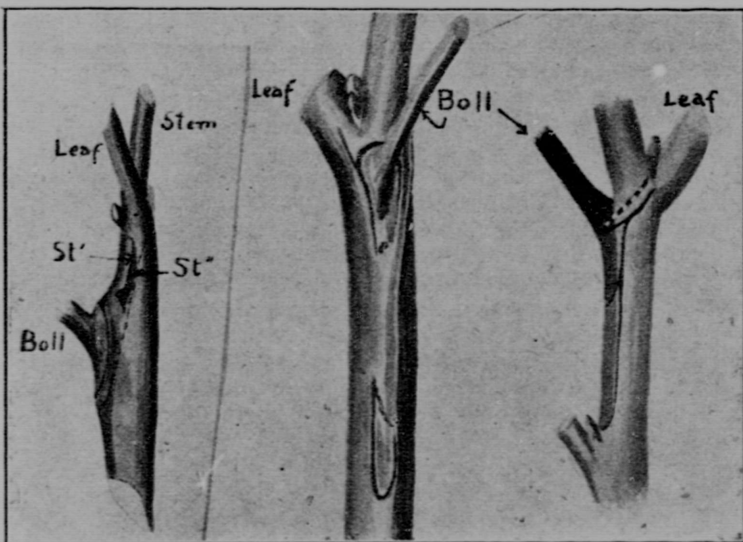
[7] The separation of such parts may be passive and involve no special abscission mechanism of living cells.

understand it, the morphological character of the flowering branch, as modified by dorsiventral development and by disharmonic growth in a longitudinal sense as between the upper and lower moieties of the axis, must be comprehended. The flowering branch is sympodial, but this is frequently much masked by displacement due to elongation of the nodal segments. That such elongation occurs is proved by the position of the stipular ridges* and occasionally by the actual longitudinal renting in twain of the stipular blade, and the distant separation of its two moieties by intercalary growth in the axis. In



A B C

Figure 3. (a) The position of the abscission layer in the peduncle of cotton when it is downwardly displaced; (b) the same when, instead of total displacement, the base of the peduncle is elongated; (c) diagram to indicate possible positions of the abscission layer as determined by the elongation of the peduncle base. In (a) and (c) the stipule of the hidden side is indicated by a broken line. (*Gossypium herbaceum*).

extreme cases of this kind, what appears to be an internode is really a much extended node, in which event the peduncle, which is the chief shoot, will be downwardly displaced as a whole (Figure 3a) (it may be to the lower limits of the stipular ridge), or its base will be correspondingly drawn out (Figure 3b). If

* Cook, O. F., (20) has discussed this point, but does not draw any unequivocal conclusion, inclining the view that the flowering branch is monopodial, which myself found it difficult to avoid, until the evidence forthcame.

this displacement does not occur, the abscission plane of the peduncle is transverse through the base; if displacement has intervened, the abscission plane runs down the false internode, as it may be called, and, in extreme instances, as far as the node below. It should be stated that the displacement in question is always greater on the upper side of the dorsiventral shoot in such a manner as to cause a slight axial rotation of the peduncle. We must, therefore, conclude that abscission in the cotton is always through the base of the peduncle, and when it is decurrent it is so because the base of the peduncle is stretched out in consequence of the extension of the nodal zone. The position of the plane of separation is marked by a low ridge. There is, indeed, especially visible in flower buds and quite youn gbolls a slight groove parallel and close to the base, but this has no constant relation to abscission, contrary to Ball's statement.

THE ABSCISSION OF FLORAL PARTS.

The separation of the parts of the flower may, on similar grounds, be compared with that of tne leaf. It occurs normally toward the close of anthesis, and, indeed, may be taken as its index, just as the unfolding of the flower-bud marks the beginning of this critical period. The whole matter is too complex and varied for brief presentation, so that it must suffice to make a mere summary. With the culmination of flowering, any of the organs taken separately, or any structural segregate of them, may be found to fall away. The sepals (*e.g.*, in *Sanguinaria Impatiens*, *Cruciferae*, etc.), petals, stamens, anthers or styles may do so, or the corolla as a whole in the sympetalae, or the corolla and androecium in one piece (*Malvaceæ*) synchronously with, but independently of, the style, and so on. Conversely, these parts may be variously adherent, and wither *in situ*, affording another case of disharmony. Witness the frequent adherence of the calyx (Rosaceae), of the androecium (Leguminosae) and even the corolla (*e.g.*, many Orchids, etc.), specific instances being afforded by the previously cited *Cereus Thurberi* by *Echinocactus Emoryi*, and by *Habenaria* among the orchids.

The position of the abscission plane, as in the leaf, is near the base of the organ or complex of organs involved. Its direction is, however, subject to more variation than it is in the leaf, and may run much more obliquely. For example, this direction in the corolla of the cotton flower varies from transverse (which is rare) to an obliquity of 45 per cent., which is usual. The style of this plant calls for special notice in this connection. Separation of this organ begins during the second afternoon of anthesis, and may usually be detected at about 3 o'clock. But instead of being confined to one level, it occurs at several, so that one may describe the process as a fragmentation of the lower part of the style. In the course of a short time, the raw edges of the fissures become brown by oxidation, thus discovering them to the eye. The separation of the corolla proceeds at the same time, although the actual cadence is evident only on the following morning. The abscission plane in the tobacco corolla is irregular and lies a millimeter above the base of the tube (Kubart, 19), while in the epigynous forms it is found above the ovary, and so not at all near the morphological base of the elements of the corolla.

It is only rarely that in leaves there is any externally visible structural indication of the position in which abscission will ensue, and it frequently happens that grooves which are sometimes taken for such indications bear no relation at all to the process. It is probable that in the case of the corolla, or of the individual petals, it is more frequently the case that a more constricted region is made use of. Fitting points this out especially in *Geranium*, *Erodium*, etc., describing it as an extremely narrow, isthmus-like reduction of the blade—a very usual condition. Nevertheless, such a reduced region is entirely wanting in many other species, so that it seems hardly probable that there is any necessary connection between the two phenomena.

PERIODICITY IN ABSCISSION.

We consider, under the head of periodicity, more especially that of leaf abscission. It is true that external conditions affect also that of floral organs, and, to the careful studies of Fitting (20) and Hannig (12) more especially, reference will be made beyond. The apparent synchrony between the fall of the leaf and the end of the growing season being the most widely recognized, it is convenient to discuss this especially.

I say apparent, since, in a large measure, we are deceived in temperate and boreal regions, as well as in the tropics, by the continuity of verdure in its entirety. The constant dying-off of leaves escapes attention, albeit a little careful observation will discover the fact. During, or soon after, the unfolding of the buds in spring, the bud-scales suffer abscission, and as the new shoots advance in age the earlier formed leaves in their turn drop off. Nevertheless, the majority of the leaves produced during the season are, under normal seasonal conditions, shed within a rather short space in the autumn, the exceptions to this rule being the so-called evergreens, in which the life of the leaf is extended over a longer period, namely, two seasons or more. Obviously, in these the longevity of the leaf is predominant, seasonal responses being seen in the growth of stem and new leaves in the spring. In the tropics various factors may be effective at various times, which may also be said of the warmer desert regions, where rain may induce the production of foliage at any time of the year. (*Fouquieria*, Cannon, 22).

The loss of foliage in areas of marked seasonal change is a response to environmental stimuli, found in conditions which are usually and on the whole unfavourable for growth or for the physiological processes which take place in the leaf. If it happens, as in exceptional years it will, that such or analogous unfavourable conditions intervene at unusual times, general defoliation will ensue just as promptly and completely as at the usual time. Only last year (1913) in Nebraska, an almost unprecedented period of high temperatures and meagre rainfall, together with low relative humidity, caused, in addition to a far-reaching prejudice to crops, a marked shortening of the usual vegetative period. Herbaceous plants hastened to fruitage, and "early leaf maturity and leaf fall was common among native and exotic forest trees." During the late summer, after the drought had been broken, refoliation occurred, but the new leaves were small (Pool, R. J., 23). Klebs (24), cites a similar occurrence in Germany during the summer of 1910, caused by dryness in July and August, followed by refoliation, and speaks of the case as a natural experiment on a large scale to support his contention that the periodicity of trees expressed in leaf-fall is a response to external conditions, and not, as Volkens (25) has argued, especially in regard of tropical plants, a periodic phenomenon independent of the external environment, and dependent on inherited and inherent causes. The basis for this view was Volkens' failure to observe any relation between the march of climate and defoliation, as, *e.g.*, in *Ficus fulva*. Klebs insists, however, that the time of defoliation may be shifted by disturbance in surrounding conditions, and cites, among others, the fact that tropical plants could be made to shed their leaves in the very short time merely by a reduction of light.

However the attack on this problem may turn out, it is worth while to indicate that a conclusion, such as Volkens arrives at, is a sort of mental anæsthetic, which, like the vitalistic theory, lulls the mind and inhibits vigorous and critical attack. As Klebs very rightly puts it, every life-process depends in some degree upon the external world, and it is only by experimental methods that we can hope to come at a right analysis of this complex relation.

(To be continued)

A PLEA FOR THE PUBLICATION OF A NEW ILLUSTRATED FLORA OF THE PROVINCE OF QUEBEC.

In the annual report of "The Quebec Society for the Protection of Plants" for 1911-1912, the following statement appears: "Many years ago Abbé Provancher published a work entitled '*Flore du Canada*' in two volumes, which has been out of print for some years, and is now very difficult to procure. No work on systematic botany has taken its place in Quebec, consequently this phase of the study of plant life has been, to a large extent, neglected in the French schools of the province. I would, therefore, suggest that the society request the Government of the province not only to reprint a revised edition of Provancher's work, but also to publish a school edition of the same. The publication of these two editions would give a stimulus to the study of plants, and indirectly would tend to a better knowledge of weeds on the part of the rising generation."

As an admirer of Abbé Provancher, and one who, moreover, has followed closely in his footsteps for the past ten years, I beg leave to express an opinion on the matter.

There is no doubt that the name of Provancher has a prominent standing in the history of Canadian science. Under struggling circumstances, without special training or laboratory facilities, far from technical libraries, he, however, accomplished a stupendous amount of work and cleared the ground most efficiently for future workers.

The "*Flore Canadienne*" was a most extraordinary achievement for the time, and, although fifty years have passed,—fifty years of feverish activity—even though it is now largely obsolete on account of the steady advance in botanical studies, we must admit whatever our language is that no other book, as yet, has attempted to displace it.

Nevertheless, the proposal of reprinting Provancher's work is a rather sad acknowledgment of inability; to state my opinion briefly, I consider that such a reprint, if the essential features are preserved, would be a step backwards.

In the course of the last half century the systematic botany of North America has benefited by the labour of a host of serious workers. Unknown regions have been penetrated, thousands of new species established and the nomenclature more than once disturbed and subjected to new investigations.

Mentioning only the Province of Quebec, the careful survey of Prof. M. L. Fernald and his Harvard friends has shown, in the Gaspé Peninsula, the existence of an altogether unknown flora akin to that of the Rockies. Of this fact, of course, Provancher had no suspicion.

Such genera as *Isoetes*, *Potamogeton*, *Juncus*, *Carex*, *Rubus*, and especially *Crataegus*, have revealed an amazing wealth of species. Everybody knows the hawthorn, and appreciates it more or less, but very few would suppose that the American species now number about 1,000. The joint work of C. S. Sargent and J. G. Jack have shown the limestone ridges of Montreal and the contiguous shales to be one of the richest regions in the whole world in forms of *Crataegus*. Although there is much yet to do in the genus, it can already be foreseen that the new Flora of Quebec will be bound to include as many as 60 or 70 species.

I do not wonder now about my perplexities while first trying to separate the Longueuil *Crataegi* with Provancher as a guide. It was only when I opened the pages of the seventh edition of Gray's Manual, and when I was made acquainted with Mr. C. S. Sargent, that I began to understand something regarding them.

Provancher believed the distribution of plants in Canada to be zonal, according to latitude, and, consequently, to be approximately identical from the Atlantic to the Pacific; this belief he had in mind when he entitled his work "Flore Canadienne." This generalization has not proved successful. We know to-day, by the collections of Macoun and others, that the prairie region, the Rockies, the Pacific slope, have each a distinct flora, and a "Canadian Flora" embodying the whole of the territory, would be an immense enterprise.

Properly speaking, Provancher covers but the central portion of the Province of Quebec. The list, with analytical keys, annexed by Abbé Moyen to his own "*Traité de Botanique*," though more complete, is yet fragmentary, and must undergo the very serious criticism of lacking the descriptions necessary to every one except the trained specialist.

I think that the demand is for a new "Flore Illustrée de la Province de Quebec," embodying the Ungava territory, and brought up to the present state of botanical science.

Such a publication is no easy task. Difficulties are numerous, and foremost among them would be the cost of production, including the necessary illustrations. These latter alone would cost a large sum. I hardly think that any private enterprise in this line would be possible. It seems that the Provincial Government should take charge of the work, through one of its departments, subsidizing it as the work goes on.

BROTHER M. VICTORIN,
of Christian Schools.

Longueuil College, P.Q.,
March 24th, 1914.

PUBLICATIONS OF THE CARNEGIE INSTITUTE OF WASHINGTON LATELY PLACED ON THE SHELVES OF THE REFERENCE ROOM, CARNEGIE PUBLIC LIBRARY, OTTAWA.

Botanical Features of the Algerian Sahara. By Wm. A. Cannon.

Handbook of Indians of Canada. Ed. by F. W Hodge.

Determinate Evolution in the Color-Pattern of the Lady Beetles. By R. H. Johnson.

Studies in Heredity as Illustrated by the Trichomes of Species and Hybrids of Juglans, Oenothera, Papaver and Solanum. By Wm. A. Cannon.

The Conditions of Parasitism in Plants. By D. T. Macdougal and W. A. Cannon.

Studies of Inheritance in Rabbits. By W. E. Castle.

Distribution and Movements of Desert Plants. By V. M. Spalding.

THE CARDINAL GROSBEAK IN WINTER IN NORTHUMBERLAND COUNTY, ONTARIO.

A specimen of the Cardinal Grosbeak was observed at Brighton, Northumberland County, on the morning of February 22nd last. The day was very cold, with strong wind and snow-drift. The bird was quite tame, and was evidently a female on account of lack of bright plumage. Those who called my attention to the bird did not recognize it, neither did I at first, never having seen one alive in a wild state. I suspected the species, however, on account of the large, ivory, reddish beak and a red cast in the plumage and in the tail feathers. On my return home I looked up the description of the species, and was at once satisfied that I had diagnosed it correctly. I suppose this is about as far east an Ontario record as we have.

I may mention that the migration of Warblers in this section this spring has been an exceedingly slim one. I have seen scarcely any in their usual haunts—only the yellow and one other.

C. J. YOUNG,
The Rectory, Madoc, Ont.

REVIEW OF A REVIEW.

To the Editor of The Ottawa Naturalist:

It is to be regretted that the *slips* alluded to in a review of the "Check List of the Fishes of the Dominion of Canada and Newfoundland," in the May issue of the Naturalist, are not pointed out by the reviewer. In the *introductory remarks* of the book it is stated that "it is subject to amendment in regard to species to be added to the list as records or discoveries reveal them; and not only so, but in regard to species, and such are apparently few, to be eliminated from the list as having no right there." But that given by "C," as an instance of an *occasional slip*, can hardly be regarded in that way, because the occurrence of *Thymallus tricolor montanus* is queried in the text, and the foot-note does not suggest that the so-called grayling *is*, as "C" puts it, that species, for the words are these: "A little salmonoid in rivers of southern Alberta, locally called the grayling, *may be* this sub-species." Besides, even if this salmonoid turns out to be a species of whitefish *(Coregonus williamsoni)*, as "C" says the Alberta Fishery Commission stated distinctly, and not a grayling at all, yet as *Thymallus tricolor montanus* occurs over the Albertan border, in Montana, its mention in the list, with a query, is quite in keeping with what the list purports to be, as is explained by the following remark in the introduction: "Species which occur close to our borders . . . . although not actually recorded from our waters, are provisionally admitted." This is what has been done sometimes in other lists of the kind, and thereby a purpose may be served in stimulating research on the part of any who seek to ascertain what the entire geographical range of a species in particular may be. It might then be hazardous for "C" to state positively that the Montana grayling does not occur in southern Alberta lest it might be found there, and its provisional mention with a query in the list does not, therefore, appear to be amiss. Indeed, it is quite likely to be found north of the United States boundary, for it is doubtless a post-glacial survivor, and the clear, cold streams of southern Alberta, flowing down as they do from the mountains, seem well adapted for the requirements of this little fish as a habitat. If, then, *slips* occur in the list, that singled out by "C" as an *example* does not seem well chosen.

The book itself must stand or fall according to its merits, and if it is lacking "in completeness of matter" and in "compact description and arrangement" it has, nevertheless, been complimented by eminent authorities and has been applied for widely by naturalists. In point of fact, it was never meant to be descriptive, so that to dispute its value because it affords no information concerning "the spawning period and the nature of the eggs" is surely beside the mark. The aim of the book is uniformity in its subject matter, not description, and its object is clearly stated in the introduction as the following quotation will show: "The technical name, governed by the rules of priority; the vernacular name when the fish has one . . . .; the environment concisely, and the geographical distribution of each fish are given."

Concerning the figures, if "C" had examined the specimens in the Canadian Fisheries Museum, from which the photographs which he criticizes were taken, he would have seen that the majority of the figures are from mounted specimens of the fishes themselves—a minority only being from casts (which, moreover, are actual impressions of specimens), viz.: the steel-head salmon and the five species of *Oncorhynchus* of the Pacific slope; whereas "C" says they "are in *very many cases* from defective coloured casts." [*Italics mine*].

ANDREW HALKETT.

A WELL-EARNED HONOUR.

Many members of the Ottawa Field-Naturalists' Club learned, with much pleasure recently, that the University of Toronto had conferred upon Mr. F. T. Shutt, M.A., F.R.S.C., Assistant Director of the Experimental Farms and Dominion Chemist, the degree of Doctor of Science. Mr. Shutt has always taken a keen interest in the work of our Club, being for many years a valued member of the council. From 1892 to 1895 he was vice-president of the Club, and during the years 1895 to 1897 he occupied the office of president. It was with apprecia-tion, therefore, that notice of such honour reached us early in the present month (June). The degree was conferred on June 5th.

Such an honorary degree, when it comes to one who has really accomplished valuable results in science, is indeed worth having, and not only honours the one receiving it, but also honours the seat of learning conferring it. In the present in-stance, we think the University of Toronto has chosen wisely. Dr. Shutt, during the last 27 years, has given the best part of his life to a study of the science of chemistry in relation to agriculture. His researches towards the economic maintenance of fertility of soils and the factors that influence their nitrogen content; in the composition and relative values of Canadian grown fodders and feeding stuffs; on the influence of environment on the composition of cereals; on the nature and values of insecticides and fungicides; on the suitability of various districts throughout Canada for the growth of sugar-beets; on the quality of Canadian waters as occurring in lakes, streams and springs, etc., have given results of far-reaching importance.

Dr. Shutt has published many papers of a scientific character in various journals and publications and has lectured before many important societies. The results of much of his work has appeared from year to year in the annual reports of the Experimental Farms and in special bulletins which he has prepared.

In 1885, Dr. Shutt received the degree of Master of Arts from Toronto University, and for about two years was Demonstrator in Chemistry at his alma mater. In 1887, he was appointed chemist to the Dominion Experimental Farms, and in 1909, owing to the widening field of work, his title was changed to Dominion Chemist. In 1911, the added responsibility of Assistant Director was given him.

Dr. Shutt enjoys fellowship in the Institute of Chemistry of Great Britain, the Chemical Society of England and the United States, the Royal Society of Canada and the American Association for the Advancement of Science.

The members of the Ottawa Field-Naturalists' Club, who have the privilege of knowing Dr. Shutt, will feel a deep sense of pleasure in the conferring of this well-earned honour, and we take this opportunity of extending to Dr. Shutt our congratulations and best wishes for a continuance of the very useful work he is doing in the upbuilding of Canadian agriculture.

A. G.

EXCURSION TO ROCKCLIFFE.

The first excursion of the season was held at Rockcliffe on Saturday afternoon, May 2nd. Mr. Arthur Gibson, President of the Club, presided, and the following leaders of branches were in attendance:—Entomology, Messrs. Gibson and Sladen; Geology and Ornithology, Dr. Williams; Zoology, Mr. Halkett; whilst the Botanical Branch was represented by Mr. Carter, a member of the Council. After exploring the park, the excursionists assembled at the log-cabin, where short addresses were delivered by the leaders.

Dr. Williams told about the bird-boxes which have been placed in trees of the park for nesting purposes by the Ottawa Improvement Commission, under the direction of the Club.

He then spoke of the birds which had been observed, which were these: A sharp-shinned hawk, a northern flicker, a herring gull, numerous examples of the American crow, several American robins, and presumably a pair of song-sparrows, the observation of which was not favourable enough for definite determination. Judging from the size of the sharp-shinned hawk, Dr. Williams considered it to be a female, and that it evidently was hunting for small birds. It flew past the party several times and, according to him, its speckled brown breast, short wings and comparatively long tail were sufficiently well noted to identify the species. He remarked also on the perching habits of the flicker (an unusual thing among woodpeckers), and the example seen alighted on a dead branch near the top of a tree and afforded an opportunity to several members of the Club to observe it carefully through field-glasses. Other names applied to the northern flicker, given by Dr. Williams, are: The golden-winged woodpecker, the high-holder and the yellow-hammer; and besides the birds, he also spoke about the geological features of the park.

Mr. Carter spoke about certain of the trees in the park, viz.: White pine, hemlock spruce, balsam fir and white cedar. He described the leaves of the trees, remarking that those of the white pine are long and needle-shaped, five in number, and spring from a common centre; those of the white spruce are short, stiff, needle-like, four-sided, pointing in all directions; while the leaves of hemlock spruce are flat, lighter in colour beneath, and pointing in two directions only. The leaves of this latter are quite soft and are often used by campers and hunters to make camp beds. Unlike the white pine and the white spruce, the cones of the hemlock spruce are persistent. The leaves of the white cedar are in four rows on the two-edged bracklets and so closely packed and overlapping each other as to resemble shingling. The cones are persistent, with the scales pointless and seeds broadly winged all round.

Mr. Sladen, followed by Mr. Gibson, spoke of the insects observed during the afternoon, the former chiefly of a specimen of solitary bee, and the latter of two species of butterflies, the Mourning Cloak and the Large Tortoise-shell, both of which hibernate beneath logs, flat stones, or other objects which afford shelter during the winter months. Specimens of the Hedgehog Caterpillar were collected and the life habits of this arctian, or woolly-bear, described. Interest was also shown in the young tent caterpillars, which were about to hatch from the egg-clusters on the trees.

A. H.

BOOK NOTICE.

ANIMAL COMMUNITIES IN TEMPERATE AMERICA. A study in animal ecology—designed to serve as a reference work and text-book. By Victor E. Shelford, Ph.D., of the Department of Zoology of the University of Chicago. Illustrated with 300 figures, maps and diagrams; 380 pages, 8 vo, cloth; price, post-paid, $3.22. University of Chicago Press, Chicago, Ill.

A copy of this recently published book has been received. Following the introduction, the work is divided into fifteen chapters, in addition to which there is an Appendix (methods of study), a Bibliography, an Index of Authors and Collaborators and an Index of Subjects. The chapters are again divided into sub-sections, as, for instances, Chapter I on "Man and Animals" —i, Introduction; ii, The Struggle in Nature; iii, Man's Relation to Nature; iv, The Economic Importance of Animals. Chapter II on "The Animal Organism and the Environmental Relations"— i, Nature of Living Substance; ii, The Relation of Form or Structure to Function; iii, The Basis for the Organization of Ecology; iv, Scope and Meaning of Ecology; v, Communities and Biota; and so forth.

The book, which is designed to serve as a reference work and text-book, is indeed a most valuable contribution to the subject of field ecology. The material used by Dr. Shelford in the preparation of the volume has been accumulated during ten years of field-study, from the view-point of modern ecology, in various parts of the United States, though most of the material is drawn from the Chicago region. The habitat records include: Lower Invertebrates, 32 species; Mollusca, 95 species; Crustacea, 54 species; Spiders and Arachnids, 80 species; Insects, 457 species, divided as follows: Aquatic Insects, 52 species; Orthoptera, 53 species; Hemiptera, 100 species; Coleoptera, 175 species; Lepidoptera, 30 species; Diptera, 47 species; Fishes, 75 species; Amphibia and Reptiles, 27 species; Birds, 85 species; Mammals, 28 species.

Much care has been exercised by the author in choosing good illustrations to represent the various types of animal communities and their characteristic modes of life. The printing and the paper used in the book are excellent and the whole subject matter presented in a most interesting manner. Canadian students should find this book of much value in connection with their work.

A. G.

The Ottawa Field-Naturalists' Club.

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