THESIS

ON

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by

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August 12, 1895.

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HOW PLANTS PROTECT THEMSELVES FROM ANIMALS.

A plant that is not adapted to its surroundingsconditions and has not the power to adapt itself to them must perish. All animal life is directly or indirectly dependent upon vegetable life. Consequently as long as animals exist plants must be able to furnish subsistance to animals without themselves being destroyed, or prevent animals from consuming them in some way.

Our common grasses would seem at first sight to be very imperfectly protected. Nearly all herbivorous, as well as many other animals consume large quantities of their foliage, often keeping them cropped close to the ground for grass, yet under these conditions these plants are able to keep in a prosperous condition. And the way that it does it is by practicing economy. The quack grass Plate I., Figure 1, illustrates this point. The root stalk a., is quite large and filled with nourishment. It creeps along under the ground where it is out of harms way and as soon as a shoot makes its appearance above ground it begins to lay up a supply of nourishment in the common root stalk. Consequently when the foliage is destroyed it is prepared to almost immediately replace it. Other plants possess these root stalks in well known forms, as the potato and artichoke. Many plants that do not possess root stalks have the power of storing up nourishment in their roots, as the hickory, oak and chestnut. Some plants have their roots expecially adapted to this purpose, as the Canada thistle and Aristolocia. Many of these plants are almost able to compete with the ingenuity of man, as well as with other plants that are assured with more favorable weapons of defense.

Some of these are illustrated on Plate II. Figure 1 represents the stem of a hawthorn with thorns which are modified branches. Those of the honey locust, figure 2 are much larger and are often branched. Those of the barbery, figure 3 are modified leaves. The gradation between true leaves and thorns being very gradual. These shrubs, as well as many other similar ones prevent animals to a great extent from tramping them under foot or stripping their branches of foliage. When these plants are grown close together they form an impassible barrier to the larger animals. This property is taken advantage of by man and these plants are extensively grown for hedges. There are others as the black berry, Plate II., figure 4 that protect themselves by prickles which are growths from the epidermis of the plant. They are not near as favorable weapons as thorns, nevertheless the animals exercise considerable care when they are broucing or roaming around these plants. These prickles are found in various plants on the leaves as well as on the stem. The teasel thistle, prickly lettuce, and many others offer good illustrations, One peculiarity about the thistle is that stock are very shy of them while they are growing, but as soon as they are cut and have wilted they have lost their power of pricking and stock eat them greedily. The nettle is provided with a very formable prickle. It contains a little formic acid which is injected into the wound making it very painful. Delicate plants often find protection by growing under their stronger and defensive neighbors. Others have the property of climbing up anything that may come in

their reach but perhaps this is as much for the purpose of securing more light and air as to escape from their enemies. Some, as the common door yard weed, knot grass hug the earth so closely that it is difficult for grazing animals to get at them. The stem and leaves are very tough so that it is able to stand a great deal of trampling on. In fact it seems to do better when it receives a moderate amount of trampling, but perhaps this is due to the fact that the trampling destroys other plants and thus leaves the field open for this one.

Much might be said about plants having a disagreeable odor, or taste, and those that are poisonous; but at the same time it must be remembered that the sense of taste and smell differ in different animals and that which is poisonous to one animal is not to another. But if the plant possesses so decided an odor as the tansy, so acid a taste as the sorrel, (I estimated it to contain nearly 1 % of Oxolic acid) or so poisonous a property as the ivy it lessens its enemies materially.

Other things being equal the species that can reproduce itself the greatest number of times is the one that will predominate. So we find that those plants that are deficient in vitality or in other ways make it up by producing a greater number of offsprings. Many grasses, Canada thistles, milk weed, and others, not only produce themselves by their seed, but by their roots. Others produce by runners as the strawberry, white clover and others. Some plants are very persistant in their efforts to produce seed. If such a plant is broken down, effected

with the drouth, or anything that threatens its life, it makes a few preliminary preparations and produces a few seeds before it dies. Perhaps it is partly for this reason that farmers cut their clover just before it goes to seed.

Most plants in order to reproduce themselves by their seed need to be cross-fertilized. Sometimes the wind, sometimes the water, but as a rule insects are intrusted with this office of carrying the poland of one flower to the stigma of another. And as a reward the plant offers to all those that will assist it in cross-fertilization an abundance of food. Not only is food supplied in abundance, but beautiful colors, shapes, and odors, are supplied to guide and direct the insect to the food.

Perhaps what serves to attract the insects attention serves quite another purpose in keeping away grazing animals, for it has been noticed that they have an antipathy of eating flowers.

These are insects that steals the honey by creeping between or growing through the calyx and petals and in this way avoid coming in contact with the authors and stigma. This at once provokes opposition. And we find that many plants have grown thick and woody calyxes, or have filled up the space between the petals with hair bristles, or glands. Others have grown thei their petals or sepals together making gamopetalous or gamosepalous flowers. These are some of the precautions that the plant takes that their friends may enter at the right door and be welcome.

Those insects that climb up the stem are often a long time going from one flower to another and as the poland is often short lived it is apt to get brushed off or die before it is placed on the stigma of another flower. Consequently these insects are declared enemies of plants and few plants can afford to make friends with them. So we find plants provided with very ingenious arrangements for keeping them down. The teasel Plate III., figure 1 affords a good example of this. The leaves are so united at the base as to form a stem in which rain and dew are collected. This cut contains more or less water unless the season is very dry, across which most wingless insects are unable to pass. The catch fly, Plate III., figure 3 has a very peculiar arrangement for keeping insects from climbing up the stem. This is a well defined band of stickey glandular substance about one-half inch broad surrounding the stem and branches leading to the flowers. The feduncle and calyx of the rose are covered with stickey glanda. Other flowers have the outer side of the petals covered with these glands while many plants as the tomato, spurry, and unicorn-plant are nearly covered with stickey glands. The unicorn-plant is often nearly covered with dead insects.

Some plants as the poppies, lettuce, and milk weed are endowed with the peculiar ability when slightly irritated of secreting a milky fluid which soon becomes very stickey. The plant is generally quite tough at the base so that the insect is able to mount and climb to a considerable height, but as it approaches the flowers the epidermis becomes so tender that the insects' claws cut through it. Then the insect finds to his sorrow that he must return or remain stuck fast in the milky fluid.

The tall thistle looks to a careless observer as if it was covered with spider webbs; but on closer examination they prove to be growths of fine hair from the epidermis of the plant. These serve to all intent and purposes the same as spider webbs, catching all insects that try to creep up the stem. Such are penalties of those that do not enter in at the straight and gate but strive to climb up some other way. The same is a thief and a robber.

Many plants offer a second inducement to their friends. This time in the shape of fruits and all the plant asks in return is that the seed be dropped in a favorable place for germination and development. Here it often protects itself from those animals that are to small to carry away the seed by growing a hard, thick, or bitter rhind.

Every one must have noticed how the so called fruits as the blackberries, raspberries, huckleberries, shadberries, strawberries, plums, peaches, apricots, currants, gooseberries, grapes, and hosts of others are adapted to animals. They have an outer fleshy nutricious portion that animals are very fond of, and in swalling it they take along the seed. These are covered with a hard disagreeable shell that prevents them from being digested while passing through the alimentary canal. Birds are the principal animals to assist the plant in distributing its seeds. They often swallow the fruit and retire with it to some secluded spot, often many miles away where it is regurgitated the outer portion pecked off leaving the seed to grow often in the most favorable place, as in the hollow of a stump

where its walls protect it during its young life.

The squirrel is often called the tree planter. It is said by some that he prefers to place nuts in the ground to soften the shell. At least he often does place them in the ground and in such instances it can be easily imagined how he might perish or forget where they were placed and so leave them to develope into trees.

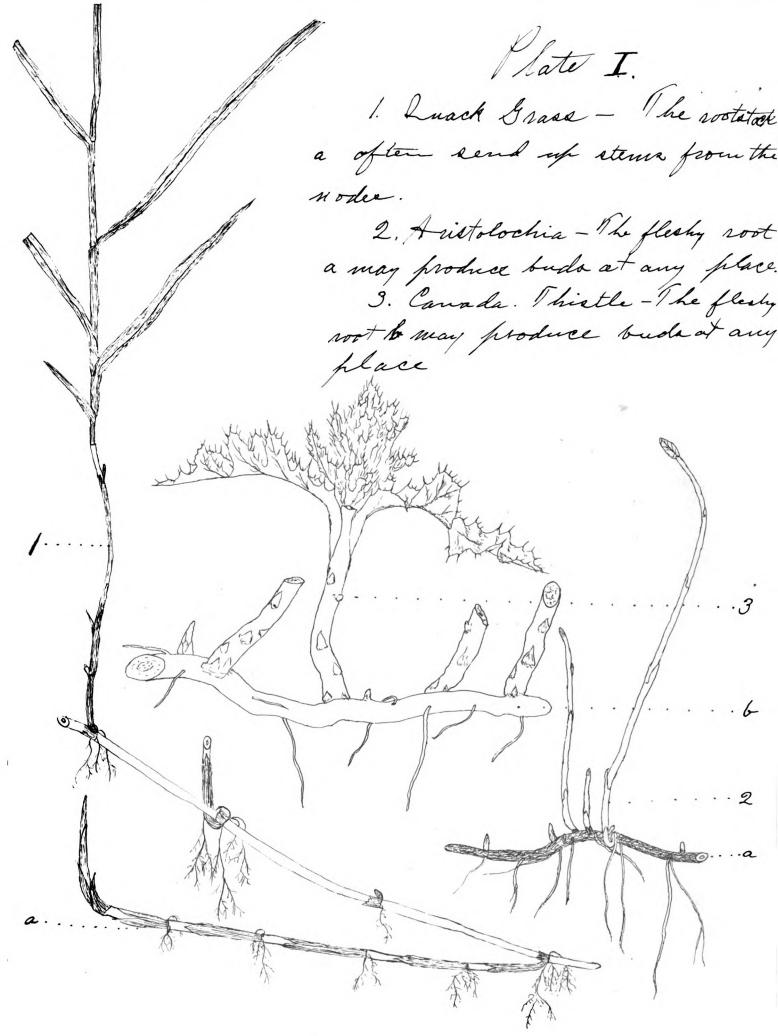
Perhaps we have all tasted green fruit and have noticed the bitter astringent taste and if we have persisted in eating it we have experienced the after effects which are far more distressing These properties are generally sufficient to keep animals from eating them before they have developed. So we might go on finding some plants on the verge of annihilation, others in the hight of prosperity; some in active warfare, others making peaceful alliances; some building Chinese walls of defense, others holding out friendly hands of assistance.

Plate I.

1. Quack Grass — The rootstalk often send up stems from the nodes.

2. Aristolochia — The fleshy root may produce buds at any place.

3. Canada Thistle — The fleshy root may produce buds at any place



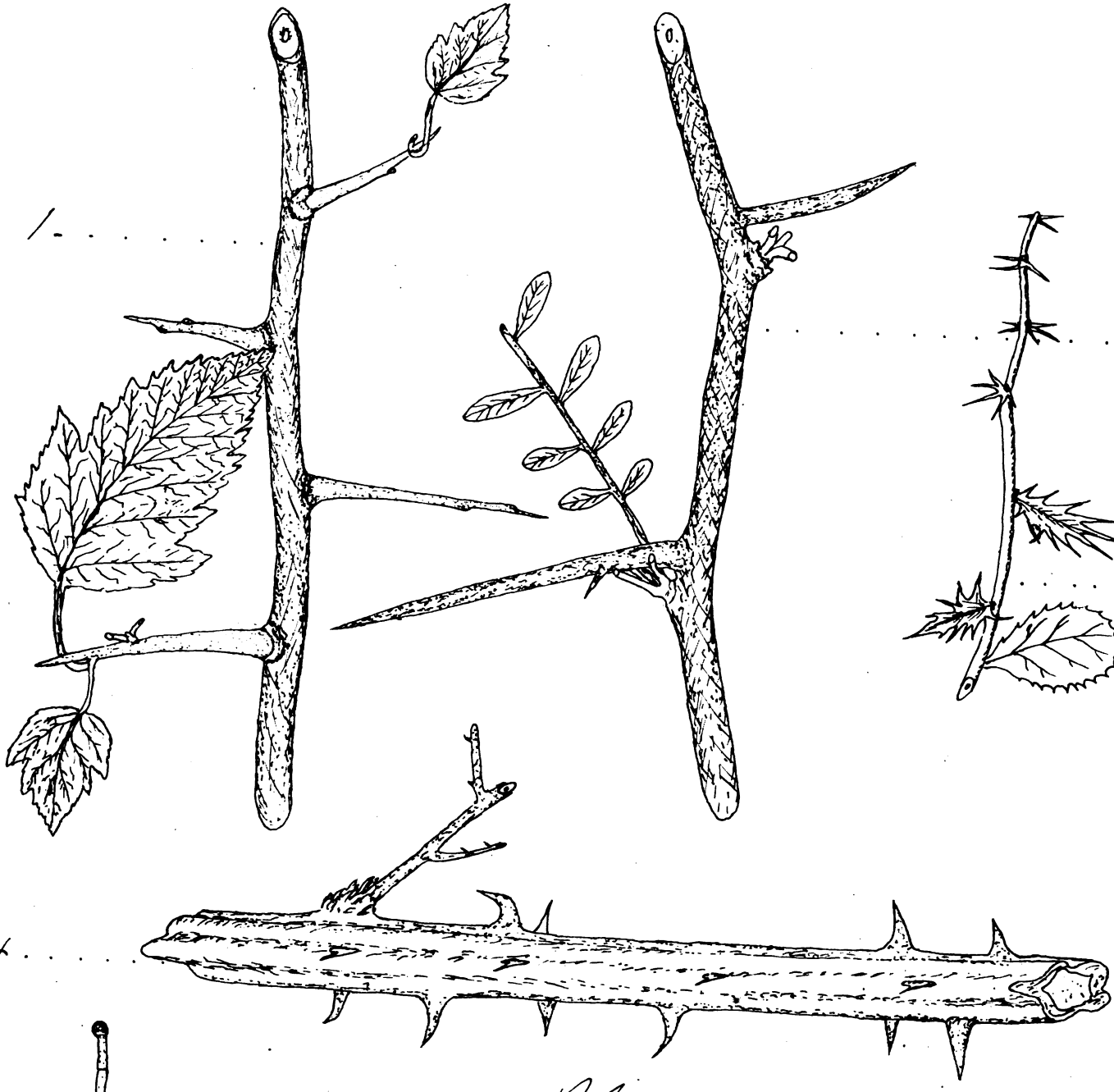


Plate II.

1. Stem of Hawthorn with thorns which are modified branches.
2. Honey Locust—Thorns much longer sometimes branched.
3. Stem of Barbery with spines which are modified leaves.
4. Blackberry—Stem with strong prickels.
5. Epidermis from Tomato plant with three kinds of glands.

Plate III.

1. Teasle with leaves surrounding base of stem.

2. Tall Thistle with fine threads extending from one part of plant to another. a one of these threads highly magnified.

3. Silene Pendula with well defined bands of sticky glandular secretions.