The article closes with a contrast of the composition of corn stalks and pumpkins showing that they are in some sense complementary in the feeding of animals-the pumpkins being able to supply in good part the albuminoids lacking in the corn stalks. B. D. H.

Botany and Porticulture.

Hybridization, No. 2.

BY BYRON D. HALSTED.

The crossing of varieties of the same species is much more prevalent than that between different species, and on this account the artificial hybridization of the horticulturist and agriculturist is largely confined to variety hybridization. In fact, if we take a glance at the plants which are cultivated, we find them to be made up of variety this, and variety that, while the original plants from which they sprung, are often either unknown or unattended.

It is the object of the present paper to endeavor to make as plain as possible, the process of artificial hybridization, and in order to have some plants to work upon, let us go into the apple orchard.

The essential feature in hybridization, is the impregnation of the female element in the flower of one variety, as the Wagner apple here, by the male element of another, as that of the Baldwin, which stands in the next row. We will now look at the blossom of the first mentioned variety; its parts you know are, beginning at the outside, the green calyx; next the showy circle of petals of the corolla. Then comes a number of little stalks, the stamens, in the enlarged tips of which the male element is produced as a dusty powder called pollen. At the center of the flower is the pistil, the female organ of the flower. Now, if we let this flower be as it is, the pollen of the stamens is liable to fall upon the stigma of the pistil, and close fertilization will result; i. e., the female organ of a flower is fertilized by the pollen of the same flower; and, of course, by the same variety; when this is continued by a plant from year to year, it may be styled, " in and in breeding.'

Though we do not doubt that a cross between this Wagner and the Baldwin often is secured by the wind; it may be, as they are so close together; but more probably through the many insects which we see going from flower to flower, and tree to tree; yet we must be sure in our work that this does take place, and nothing else. As you see, the pollen grains in the little sacks at the tips of the stamens ripens very soon after the petals spread themselves to attract the bees; then it is necessary that these male organs be removed from the flower while it is still folded as a bud. This can be done by turning out the petals, and using a fine pair of forceps. You may practice on some of the outer flowers of this cluster, and then we will prepare the center one for hybridization, as it is the one which usually grows, if any in the cluster.

All the stamens, at least their pollen sacks, are removed; but should we go no further, we would only know that the flower was not close fertilized. Should an apple be produced, it might be a Wagner simply, the female organ being impregnated by the pollen from some of those flowers just above it, or perphaps from a neighboring tree of the same variety, or again it might be a cross with any other variety in this whole orchard now in bloom. We must protect this flower which we have deprived of

its stamens; and this we can readily do by tying a little cloth bag carefully over it. These sacks can be made rapidly and inexpensively by any one who can use a sewing machine, by folding a small piece of good sheeting and stitching it on two sides. "A pucker string" of twine is excellent to draw the mouth close around the twig, after the stem and flower has been inserted.

We now have the Wagner or female portion under our control. Let us go to the Baldwin tree, and secure some of the pollen of its flowers from contamination by wind or visiting insects; because our object is not simply to see if we can produce a cross, but to hybridize the Baldwin on the Wagner in such a way that the doubt that we have succeeded will be reduced to a minimum. We will take some of these central buds that look the strongest, and secure them in some sacks also, and this done we must wait upon nature to mature the sexual organs which we have guarded, and propose to unite. This may take from two to four days, depending much upon the weather, and some on the varieties under consideration.

Some horticulturists collect the pollen before it is mature, and let it ripen in a close box. It is necessary to do this if the pollen is to be carried a great distance, a practice which is important, because in this way there is often secured a healthy combination of climatic or other peculiarities.

But to return to our hybridization; we will suppose the organs are mature, and we carefully remove the sack from the Baldwin flowers, and with our forceps we secure our ripened stamens in a little box like one used for gun caps. We now go to the Wagner tree, on a mission the bees above our heads are selfishly performing so thoroughly, and take away the sack from our flower, and quickly take some of the pollen from the box, and place it upon the stigma of the pistil, and adjust the sack as before. It only remains now to see whether or not an apple forms, and to remove the sack after all danger from surrounding influences has passed. If success has crowned our efforts, some mark must be placed on the twig where the new fruit is forming, that the result may not be lost.

As hybridization is a sexual union, you must always get your result first as seeds, and then as seedlings. The seeds of the hoped for apple here, may be planted next spring, and only after a few years can we know how much our lesson has added to the pomology of the land. That the results may be such that our time will have been well spent, and that you will feel encouraged to further trials in hybridization, is my earnest hope. There is a promising field for pecuniary gains in the production of new varieties of almost every kind of crop. Heretofore most of this work has been done in Europe; but we see signs of its progress here. The great investigator, Darwin, (an account of whose work follows,) has set an example sure to be followed by able workmen in science.

MOORE'S EARLY GRAPE .- We are rejoiced to herald the introduction of a promising new grape. In Moore's Early we have a large berried, full bunched, sweet and sprightly flavored grape, at least three weeks earlier in ripening than the Concord. What this means, all know who have lost their vintage every year or so from the early frost. This new comer is indeed an acquisition, and appears to mark another step in the history of grape culture in America, as promising the of grape culture in America, as promising the boon of this fruit to the dwellers of the far North. "For the first article on this subject see "Darwin's New Book" June Scientific Farmer.

Darwin's Cross and Self-Fertilization of Plants.*

BY PROF. W. J. BEAL.

Foreign-Crossed Stock Ahead.

In the case of *Mimulus luteus* (monkey flower), a small herbaceous ornamental plant, Mr. Darwin found for three successive generations that the crossed plants exceeded in height those which were self-fertilized, but in the fourth generation one of the self-fertilized plants beat its crossed opponent. "This victorious self-fertilized plant consisted of a new white-flowered variety, which grew taller than the old yellowish varieties. From the first it seemed to be rather more fertile, when self-fertilized, than the old varieties, and in the succeeding self-fertilized generations became more and more self-fertile. In the sixth generation the self-fertilized plants of this variety, compared with the crossed plants, produced capsules in the proportion of 147 to 100, both lots being allowed to fertilize themselves spon-taneously." This instance appears analagous to the vigorous self-fertilized morning-glory which appeared on the sixth generation. In the eighth self-fertilized generation some flowers of Mimulus were self-fertilized; other flowers were crossed with those from distinct plants of the same lot, and "others were crossed with a new stock of plants from Chelsea. The Chelsea crossed seedlings were to the intercrossed in height as 100 to 56, and in fertility as 100 to 4; and they were to the self-fertilized plants in height as 100 to 52, and in fertility as 100 to 3. These Chelsea-crossed were also much more hardy than the plants of the other two lots." This remarkable result brings out with great force the idea italicised in my previous article*, that crossing a variety or species with a foreign stock, often produces

Results Wonderfully Favorable.

This is the great leading point conclusively proved by experiments cited all through the book. It towers above all others in such a way that it cannot be easily overlooked. There is need of many other experiments in the same direction in different portions of our country, and especially are experiments needed in crossing with foreign stock all of our garden vegetables which store up nourishment in roots, as beets, turnips, salsify, carrots, parsnips, radishes and the like. Here is a new field not yet worked, and one well worth a good trial. In case of trees and shrubs, and other plants too, it is an easy matter to have pollen sent by mail from a distance. The writer is trying this with apples and grapes.

In case of the Minu/us above mentioned the third generation of self-fertilized plants were allowed to fertilize themselves spontaneously. Another lot were grown beside them from crossed Another lot were grown beside them from crossed seeds. "The crossed plants produced a large number of capsules, whilst the self-fertilized pro-duced very few and poor ones." The seeds in the crossed-capsules excelled those self-fertilized as 100 exceeds 34. Experiments were made with these two lots of seeds showing "in a decisive manner the superiority in constitutional vigor of the crossed over the self-fertilized plants." The flowers of self-fertilized plants in the experiments made became more uniform than those which were crossed. This was quite marked with Mimulus, Ipomæa and Dianthus. Mr. Henslow raises the query, why is this when wild flow-ers are so uniform? These are certainly many times abundantly crossed and often appear much alike even when growing in different localities quite remote from each other on a great variety of soils.

Obstacles Show Quality.

In comparing the crossed with the self-fertilized plants Mr. Darwin usually placed one of each at the same time on different sides of the same pot. Mr. Henslow objects on the ground, if not crowded, the self-fertilized plants would be relatively better. In some cases, also, Mr. Darwin places two lots of plants in crowded

masses in the same pot or box. In the third generation of *Petunia Violacea* "both lots grew extremely crowded; the crossed were twice as tall as the self-fertilized." Other examples of a similar nature are given in the book. Mr. Darwin, in Volume II of his Animals and Plants under Domestication says, "It is important that the two lots struggle with each other, for if sown with plenty of room and good soil, there is often but little difference in their growth." In other words the self-fertilized are more easily overcome by surrounding obstacles. Like pampered animals, they cannot endure great hardships. In cultivating plants on the farm and garden in many cases they are grown so close as to crowd each other. If so, seeds of crossed plants are generally the best, and most profitable to sow.

Effect of Locality.

Another fact mentioned in the case of Eschoscholtzia is not a lone instance. In South America the seif-fertilized flowers are sterile, while if seeds are sown in England the self-fertilized plants are the most productive and do the best. All these things show the great need of many more experiments, and the danger of drawing conclusions too hastily from limited experience. As Darwin says, "The fertility of a plant is a most variable element, depending on its age, health, nature of the soil, amount of water given and temperature to which it is exposed.' To some extent we are groping in the dark. We do not know all the conditions about any one experiment.

Mr. Henslow brings up another point which should demand the careful attention of men of science. Many of our worst weeds are self-fertile. In a large majority of cases weeds are foreign invaders - natives of other countries. but this is not the case with all weeds. In some cases, the superior vigor of foreign weeds may be, and doubtless is to some extent due to a change of location. Why do our weeds thrive so well? The tallest cabbage plants are not always the best. In his experiments Mr. Darwin cut down and weighed the fully-grown plants. Six self-fertilized plants of the third generation when they had formed heads weighed 142.25 ounces; six plants from pollen of fresh stock weighed 649 ounces. That is, the six "crossed plants averaged 108.16 ounces, whilst the six finest self-fertilized plants averaged only 28.7 ounces, or as 100 to 22." Here again, we see an "enormous benefit" in favor of crossing a variety with foreign stock of the same variety, which had grown for a few years under different conditions.

Differing Results.

The scarlet runner bean (Phaseolus multiflorus), in one case when covered up yielded about onethird and in another case about one-eighth "of the number of pods which the same number of uncovered plants growing close along side produced. This lessened fertility was not caused by any injury from the wet," as some of the pro-tected flowers were artificially fertilized and produced well. Dr. Ogle had tried a similar exper-iment with a total failure of fruit when the flowers were protected. *Phaseolus vulgaris*, a closely related species, proved highly fertile when insects were excluded. In England the varieties of the sweet-pea rarely or never cross when grown near each other. This may not be true in other places, as in Italy "it is the fixed opinion of gardeners there that the varieties do intercross," that they cannot be kept pure unless that they cannot be kept pure unless protected or sown in separate places. Let every person take warning from such examples and not draw hasty conclusions from one illustration or experiment, or the behavior of a single speci-In some place a man does not see any men. bees working on a certain kind of plant, when straightway he announces that bees do not work on that species. Perhaps the bees did work at other times of days; if not, perhaps they worked in other seasons or in other locations. Examples could be found to illustrate the above supposed cases. Pisum Sativum, the common pea in England was perfectly fertile without the aid of insects.

(Concluded next month.)

Garden Gossip. No. 3. Friends of the Family.

Among the last of our spring visitors come two, widely dissimilar in appearance and in song. One, showy and obtrusive; the other, plainly dressed and shyly modest. The Oriole, in his flaming suit of orange sings in the elm to his partner, swinging in the hanging nest at the end of a long, slender, pendant branch of the old tree. He calls on her to admire him. Her name, re-minding one of the queer appellation of some Alabama negress, would appear to be "Twilldy." You may hear him call her so a hundred times a day. He thinks himself a great singer and braggart that he is, cries to his wife pronouncing the syllables distinctly, "Twilldy! Twilldy! I'm a "primo tenore." He is clearly convinced that his coarse whistle is the perfection of melody; as you have seen a musical tyro practicing on a cracked clarionet, entranced with his doleful, deplorable toots and blasts. But Mr. Oriole is a great insect catcher. Let him whistle his fill then; let him brag. Dressed in her sober colored suit, retiring in

her habits, the Cat-Bird appears in late spring. Each year a pair of these friends come and build in a little thicket close to the house, delighting us with their singular variety of song. She is a cousin of the Mocking-Bird of the Gulf States, and like her, graceful in shape and motion. While both are wonderful in their imitations, the vocal powers of the latter are by far the most showy and brilliant. She is Nilsson in opera; when the lights burn brightly and the orchestra weaves its harmonies, and the singer, stimulated by applause, flushed with triumph, pours out the most ravishing tones of her enchanting voice-that is the Mocking Bird. But our friend sings gently, subdued, as if rehearsing to herself her happiness; as a young mother sits and softly sings by the cradle of her first born. She seems to say, "Happy? yes! come and see my thicket; spiræas — arbor vitæ — rose acacia — Norway spruce. But — gently ! — softly !—look !—see ! here are my treasures; my little ones. O bliss! ecstacy !'

You sneeringly say this is sentimental, do you? Well, better by far for you to tolerate sentimentality than to permit cruelty. Teach your children never to rob a bird's nest; never to murder these friendly creatures with a shot gun. Tell them that the most noted murderer who ever in Suffolk county expiated his guilt, began his career when, a lad, he fastened up a kitten, nailed through the paws to die a death of lingering torture by starvation,-a fitting preparation for that fearful ordeal he forced himself to pass in after life, when he attempted to conceal his guilt by burning his victim.

Sentimental, do you say? Why, my dear sir, only yesterday I apologized to a toad. What do you think of that? Apologized earnestly, honestly. I'll tell you how it was. You see I was hoeing in the garden. The poor fellow, whom I had known from infantile toad-hood, when he was so small as to have been no doubt daunted when confronted by a good-sized moth, had en-sconced himself in a little shallow cavity which he had made in the soft ground. He had now, by dint of good living and a clear conscience, arrived at aldermanic proportions. He had worked for me, catching insects' for a long time. I paid him no wages but found him in board. He lived under a plank. Well sir, he sat there in the hole, probably thinking of cut-worms for supper, when I, not knowing of his whereabouts, struck him a cruel blow on the head with the edge of the hoe blade. A pang shot through me as I saw my poor old friend laid on his back feebly kicking with one leg; and the very phrase in which immortal Uncle Toby apostrophized the fly sprang to my lips. "O! poor devil!" said I, "that is too bad. I did not mean to do it." I felt that opodeldoc or arnica or any other lotion or plaster or medicament would be of no avail. If it would have relieved him, I stood ready to buy out the stock of an apothecary. The apology

with strict attention to diet, recover. I use the word "friend." A toad is a good friend to the gardener.

You never heard the poetry made by the old sailor, one bright, moonlight night — the wind fair — the vessel homeward bound? Probably not. The lines were composed as a test of ability to make perfect rhymes.

"Time and the ship they slides along; A faithful friend is hard to find; But when you find one just and true, Then never part him for a better yet."

"Never part him." Do you know the full force of that word "part," in the mouth of a sailor? You never hear on board ship of a cable "breaking," of "broken" halliands. They are "parted." The word conveys the idea of the rending, the tearing apart of the fibres of the tough, twisted cordage; of the chain's massive links. O! sad, bitter word when we apply it to our dear ones torn from us. It means a rending of the heart strings.

A friend "just and true." Mark the felicity of the phrase. Have you many such? Have you one? If so, then are you indeed a happy man. T. F. P.

South Framingham, Sept. 5, 1877.

SEEDLING PEARS .- Col. Eliphalet Stone, of Dedham, has favored us with a box of seedling pears. Those which he thinks are from the Seckle, are of superior quality, perhaps fully equal to the original, and all are of a fine flavor, equal to the original, and all are of a nine havor, and good external appearance. It is quite un-usual to get so many excellent varieties from the Seckle seed, and perhaps others, a name, it would of necessity become a popular sort. The first half dozen that we eagerly devoured on opening the box, seemed the nicest tasting of any pears we had eaten this season. Colonel Stone writes : Stone writes :

"I send you a few 'crumbs of comfort' in the shape of Seedling Pears. The lower layer will not be ripe probably for a week. The small pears are probably seedlings from the Seckle. You will find two done up in paper, one ripe, and the other part, there are probably seedlings and the other not ; those are probably seedlings of the Belle Lucrative, which they very much resemble in looks and taste. I have other varieties that are remarkable in this remarkable collection."

KEEPING ROOTS.-To keep roots sound and plump, Mr. Benjamin P. Ware, of Marblehead, a successful gardener, cuts off the fine roots close to the body, and pares away the crown of the turnip or beet sufficiently to destroy all buds or rudiments of buds. The thus doctored roots are then placed in barrels of sand or covered with earth in the cellar to prevent wilting. Remov-ing the buds and rootlets prevents that corkiness so common with these roots when kept till late in winter, which is caused by the support of sprouts and rootlets using up much of the more tender and edible substance of the roots. Turnips and beets thus treated are as nice for the table in late winter or early spring as when first harvested.

TRANSPLANTING. - In the setting out of shade and ornamental trees, as well as of fruit trees, there is a great loss in not doing it in a thorough manner. All trees, when transplanted, should have all the fibrous roots remaining that we possibly can secure, and unhurt set in the hole. These should be carefully placed and covered with the fine earth, so that there may be no airspaces left, but all should be thoroughly imbed-ded in the soil. To secure this, it is a good plan, when the roots are all covered, to pour on pailsful of water before filling up the hole even with the surface. But above all, dig a large and deep hole, and be sure that it is well filled with good earth, below and beyond the circumference of the tree roots. We have before us now some maple trees, some of which were placed in holes I think helped him; for although my friend was thus prepared, and others where, although the threatened with congestion of the brain, he will, work was done sufficiently well otherwise, this