FLORIDA STATE HORTICULTURAL SOCIETY.

stoves could be used to increase the warmth needed. We believe that too much protection from the sun would have a tendency to make an open willowy growth as it does in the dense hammocks. We understand that tents have also been used with great success but at what cost we could not learn.

SOME PROBLEMS IN BREEDING CITRUS FRUITS.

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[SEE MINUTES PAGES 1 TO 6, ITEMS 18 AND 19.]

SUMMARY OF PREVIOUS WORK.

In the report of the Society for 1894 attention was called to the work that was being done at the Sub-Tropical Laboratory in the breeding of citrus fruits; in the same report a preliminary paper on results obtained in crossing Navel oranges was published; and again in 1897 a summary of all the experiments up to that date was given under the title "Experiments in the Origin of New Varieties of Citrus Fruits, Pineapples and Guavas." The work is being continued and is constantly taking more definite shape.

As a result of the crosses made in the spring of 1897 we have now growing in the greenhouses at Washington 904 hybrid citrus seedlings, these being crosses between the different varieties of the orange, lemon, grape fruit, etc., and 248 hybrid seedlings of the different varieties of the pineapple. The work in the hybridization also has been continued this year and about an equal number of crosses made. The results, however, are not yet known. The members of the Society doubtless understand that considerable time is necessary for the completion of such work, as the hybrids secured must be fruited and thoroughly tested before anything can be known as to their desirability. The first hybrid secured, resulting from crosses made in the spring of 1893, will fruit for the first time next year. In the course of these experiments several important lines of improvement suggested themselves to us and the work is now being directed largely in accordance with these suggestions. It is my purpose here to direct the attention of the Society to the various lines of improvement of citrus fruits which are thought to be at present most desirable.

CHARACTER OF HYBRIDS.

The question of hybridization, though generally understood, is so complex that few comprehend the possibilities in this line. It is a common understanding that where two plants of different varieties or species are crossed the resulting offspring is in most cases intermediate between the two parents. In the case of hybrids resulting from a cross of different species this is usually the case, but hybrids resulting from crossing related sorts or varieties are more liable to be variable in character in the first generation. Some may resemble the father most, others may show more of the char-
acteristics of the mother, and possibly still others may be intermediate between the two parents.

The work of hybridizing plants to obtain intermediate sorts is somewhat precarious, and yet if the varieties to be hybridized are selected intelligently desirable results are almost sure to follow, provided the work is conducted on a sufficiently extensive scale.

A fact that should be borne in mind in hybridizing is that the offspring, while more or less intermediate, is not always a perfect blend of the characters of the parents. In very many cases hybrids regarded as intermediate will have individual characteristics of both parents side by side but not blended. Such characteristics form a sort of mosaic and hence the term "mosaic hybrid," used by some writers. This is the case where variegated flowers result from crossing two flowers of pure colors. For instance, crossing red and white carnations almost invariably produces a variegated flower of these two colors, but seldom produces a light pink, the true blend of these two colors. In like manner the leaves may resemble one parent, while the habit of growth, the fruit, etc., may resemble the other. In fact the most valuable results which can be expected depend upon this segregation of the characteristics of the parents rather than upon a blending of the characters.

In crossing the object usually is to obtain the vigor, hardiness, resistance to disease, etc., of one parent, combined with the fruiting qualities of the other, and the results obtained by various experiments in hybridization show conclusively that such combinations of character may be expected.

Another factor of great importance in hybridizing is the testing of seedlings of the second and third generation of hybrids. Burbank, the great California plant breeder, says that this is of the greatest importance, although not commonly recognized. The first generation of the hybrid, as explained above, is very liable to be intermediate between the two parents, but in the second and later generations the various characteristics of the two parents are liable to occur in numerous combinations. By securing a sufficient number of hybrids of these later generations it should be possible to obtain any combination of the parental characteristics desired.

An interesting illustration of what may be secured in this direction is furnished by the results obtained by French grape growers in breeding varieties of grapes resistant to black rot, phylloxera, chlorosis, etc. It will be remembered that a few years ago phylloxera, an insect which infests the roots of the grape, almost destroyed the vineyards of France. It was found, however, that certain American grapes, like Rupestris, were largely immune from the disease, and this led to the fine varieites of Vinefera being grafted on the resistant American stocks. But a "direct producer" was desired and many attempts have been made to obtain one by hybridizing the fine varieties of the European grape with the phylloxera-resistant American grapes. A number of varieties have been produced which are said to be thoroughly satisfactory. Millardet, who has probably been most active in this work, says there is no difficulty in securing hybrids having the phylloxera resistance of the American grapes and the quality of fruit of the European varieties, but that it is hard to secure these features and sufficient productivity also. However, a number of
hybrids are said to combine all these qualities.

Another feature of importance which may be secured by crossing is that of increased vigor, a factor of great value in plant culture, as it enables the plant to better withstand deteriorating conditions and more successfully resist disease. The almost universal testimony of experimenters is that hybrids are almost invariably more vigorous than either of the parents, the growth in some cases being greater than the combined growth of both parents. This increased vigor can be obtained almost invariably and there are but few instances where it is not an advantage.

**DESIRABLE MODIFICATIONS OF CITRUS FRUITS.**

Increased Hardiness—Undoubtedly the greatest need of the citrus industry at the present time is varieties which can better withstand cold. During the past few years the severe freezes have seriously crippled the industry in Florida, Louisiana and California, and should these freezes continue to occur, and there of course is no assurance that they will not, the growing of citrus fruits will have to be abandoned in many places unless hardy varieties can be obtained. As is well known to the members of the Society, there is a great difference in the hardiness of the sorts cultivated at the present time. It is also well known that the so-called trifoliate orange, the fruit of which is worthless except for preserves, is hardy as far north as Philadelphia, growing and fruiting perfectly at Washington, D. C. The writer has never seen a case of injury to the trifoliate orange due to cold except where it was used as a stock for other sorts, in which case the freezing of the scion caused injury to the stock also. Up to the present time it has been understood that the trifoliate orange would not hybridize with the common orange. The experiments made by Mr. Swingle and the writer at the Sub-tropical Laboratory, however, clearly demonstrated that hybrids can be produced between these, and some of these hybrids, secured by Mr. Swingle from crosses made in 1897, are clearly intermediate between the two parents. Some of the hybrid seedlings resulting from a cross of the sweet orange with pollen of the trifoliate orange, show a decided tendency to produce lobed leaves, closely resembling leaves of the trifoliate orange. In view of the fact that hybrids of this nature can be made we have the strongest reason to believe that a hybrid can be produced between the two species combining the hardiness of the trifoliate orange with the quality of fruit of the common sweet orange. The production of such a variety would be of almost incalculable value to the people of Florida, California and the Gulf States. Although there have been but few experiments of this nature, still instances are known where hardy sorts have been produced by crossing tender plants with hardy ones. Macfarlane in his very careful monograph on the structure of hybrids gives two instances of hardy hybrids produced by crossing tender and hardy species. The opposite case of producing sorts better suited to growth in warmer regions by hybridizing with tropical or semi-tropical species, is illustrated by the LeConte and Kieffer pears, and is thus of special interest to horticulturists of the South. It is well known that these two varieties of pears, which made the extensive cultivation of the pear in the South possible, resulted from crosses of the European pear, which bears fine fruit,
with the sub-tropical Chinese pear, which bears an inferior fruit, used only for canning purposes. These hybrids possess the adaptability of the Chinese pear for growth in Southern regions, and produce fruit resembling the European pear in quality. The lines of improvement opened up by the discovery that the common varieties of citrus fruits may be crossed with the trifoliate orange are of almost inestimable importance, and it would seem perfectly feasible to obtain in this manner good varieties of the orange, which could be grown anywhere in Florida and the Gulf States without injury from cold. It is also within the range of possibility to obtain a deciduous orange producing a good fruit, which could be cultivated very much farther north. Lemons could doubtless be rendered very much hardier in the same way. These suggestions may sound like fairy tales to the members of the Society, and yet reasoning from analogous cases, which is the only evidence that can be obtained, there is good cause for believing that such results can be secured. Experiments in hybridization made by Mr. Swingle and the writer during the last few years, have been directed largely with this aim in view, and it is our desire to greatly extend the work in the near future. The experiments should be conducted on an extensive scale and the seedlings obtained should be tested simultaneously in various latitudes in order to obtain evidence as to their hardiness with the least possible delay.

Orange with Kid Glove Rind—Another improvement in the orange which appears to us very desirable to secure, is a fruit having the quality of the common sweet orange and the rind of the mandarin. The loose, easily removable rind of the mandarin is considered by every one a very desirable feature, and yet the mandarin oranges as a whole are not considered as good in quality as the common sweet orange. A fruit combining the qualities of the two in the same manner indicated would therefore be very valuable. Our experiments during the past two years have been largely directed towards securing hybrids of this nature. We have on hand at the present time several hundred seedlings, resulting from crosses of the mandarin, tangerine and King, with various sorts of the sweet orange.

Resistance to Disease—The work of the French grape growers, above referred to, in securing varieties of the grape resistant to phylloxera, clearly indicates what can be accomplished in this direction. It is well known what great differences exist in regard to the susceptibility of the different sorts of oranges to the various diseases. For instance, scab or verrucosis, is very injurious to the lemon and sour orange, attacking the foliage and fruit of both and almost totally preventing the cultivation of these sorts in Florida. The mandarin orange and lemon are affected to some extent, but not sufficiently to cause serious damage. The sweet orange and grape fruit, on the contrary, are almost totally immune. It is therefore possible that experiments in hybridizing the orange and lemon would result in producing a lemon having the rind characteristics of the sweet orange and thus resistant to the scab.

Again I have observed that the Drake Star, a very distinct and and characteristic variety of late orange, is very resistant to attacks of the rust mite, remaining perfectly free from rust while the common sweet oranges in adjoining groves were very badly affected. The Drake Star there-
fore furnishes a basis for securing rust-proof varieties of the sweet orange.

Immunity of the sour orange from foot rot is an excellent illustration of the same character. If it were desirable to produce a variety of the sweet orange resistant to foot rot it could probably be done by hybridizing with the resistant sour orange. As long, however, as budding is generally practiced there is not sufficient reason to warrant the trouble necessary to produce such a sort.

Orange with Edible Rind—Oranges with edible rinds, which could be eaten out of the hand, as in the case of the apple or pear, would be very desirable and great developments in this direction could doubtless be obtained by hybridizing the common orange with the kumquat. We have as yet, however, made no crosses of this nature, and therefore cannot state positively as to the securing of such hybrids.

Seedless Fruits—The question of producing seedless sorts of the orange, grape fruit, and indeed of all varieties of citrus fruits is of the utmost importance. It is very probable that developments in this direction may be attained by crossing with the Navel orange. Necessarily in crosses of this nature the navel must be used as the female parent, as this variety seldom or never produces pollen. The experiments of the writer, however, have conclusively shown that seeds are almost invariably produced in the Navel when it is artificially pollinated with other sorts.

Again, it is a very common tendency of hybrids to be sterile, so that the mere act of hybridization is liable to result in the production of sterile fruits. As the orange is commonly propagated by budding and grafting sterility is in this case no disadvantage.

The improvements in citrus fruits here suggested are probably the most important to be obtained at the present time. The majority of hybrids made by Mr. Swingle and the writer have been arranged largely with a view to securing certain of these modifications, and if the work can be continued as planned we are confident that at least some of them will be obtained.

DISCUSSION.

Prof. Rolfs: I think this one of the most important lines of work that can be taken up, and we ought to give Prof. Webber all the encouragement possible, both in the way of helping him to carry out the experiments, and to secure for his work recognition from the Secretary of Agriculture that he may continue to carry on his experiments. It is a very great piece of work; a piece of work that cannot be done in a few years; it will require, probably twenty-five or thirty years before definite results can be obtained; it is just such work that the Department of Agriculture ought to undertake.

A Member: I second the remarks of Prof. Rolfs; and, further, would have the Society do something at this meeting, not only to encourage Prof. Webber personally, but to put our sentiments and opinions on record, that the Department of Agriculture should continue their experiments in Florida. The Eustis Station has been discontinued, we understand, but we have heard of a station being established at Miami. I am not posted enough to know how far the Department has gone in that direction. It is, perhaps, not the proper time to bring it up, but I would like to have the matter brought before the Society and have it discussed, and take some action showing that we appreciate what the De-
partment has already done and ask for further assistance along these lines.

Mr. Phelps: I think Prof. Webber could have gone a little further in the statements made. I have been at work about sixteen years, and am beginning to see something tangible. I think that time has proven the importance of such experiments in hybridization. I did not plant the seed from the cross fertilizations that I made in 1894, before the freeze until after the meeting of the Society in 1895, but I have fruiting today some trees from a fertilization of Hart's Tardiff and grape fruit. Of course I do not know how far the fruit is a result of general hybridizations, but all of my grape fruits have the skin of the orange, and are taking the form of the grape fruit to a large extent. In one of the larger hybridizations of the tangerine and grape fruit, the cells were smaller and the skin softer and as thin as paper. The orange, I have several of them growing, was tinged with the color of the tangerine, the tinge spread into the inner rind of the fruit, yet it was one of the most perfect fruits that I ever saw. It was not as hardy as the tangerine or grape fruit either. Mr. E. H. Hart said it was the most perfect fruit he ever saw and he was very anxious to get buds of me if my buds were not injured.

Mr. Bacon: Have you given it a name?

Mr. Phelps: It is in the Catalogue of Fruits. There is another that I named Spratt, a hybrid of the blood orange and the tangerine; the rind of that was almost identical with the blood orange and the inner skin was slightly loose. I consider it very valuable, except that it is the most thorny citrus fruit that I ever laid eyes on, and, of course, the fruit was much injured by the wind. I will state that it is perfectly true that the second or third hybridization is much better than the first; but this is going to take more time than I am going to spend in Florida. These new things are not established yet, and we are not able to say how much time it will take; but I believe advancement is being made. In fact, I am not budding any oranges today that are not the results of hybridization. I consider them superior to anything we have; it takes years to establish them, but today my most hardy varieties come from pollenization and I consider them the best.

Dr. Stockbridge: I recently heard Prof. Webber discuss this matter in private and in public, and I think that I can make the statement that his prediction is more important than appears from his paper. He was at the meeting of the National Tobacco Association at Miami. At that time he made a statement that he was perfectly confident in the future of this work and that the practical results would be available within two years' time, and would be most valuable to the fruit growers of Florida—an orange with the fruit of a sweet orange, but with the hardiness of the trifoliate, that would be hardy in all parts of Florida. He also intimated at that time that it was extremely desirable for this Society to take some action looking toward continuation of the experiment work of the Department of Agriculture, which has been discontinued at Eustis.

A Member: I am of the opinion that it would be perfectly proper for this Society to consider some resolution and pass it, to show that we appreciate the work done by the Department in the past and impressing upon the Secretary of Agriculture the importance of having it continued.

The President: The chair is of the opinion that the suggestions are strictly in
order; that such a resolution would be properly entertained at this time.

Mr. Hart: I am quite intimately acquainted with some of the workers in this field and may have had some influence in getting them to take hold of Florida work. The work is decided wholly by the Secretary of Agriculture and his chiefs of departments and it is through them that we must look for whatever we need in this State. Appreciating what has been done in the past and seeing the need of much work in the future, I now present the following resolutions for your adoption.

Resolution was then read and adopted. See Special Resolution to the Secretary of Agriculture.

**GENERAL CITRUS DISCUSSION.**

**[SEE MINUTES PAGES 1 TO 6, ITEM 84.]**

Mr. Phelps: As there is very little time to give for the many states of the citrus question—it has been discussed less at this meeting than any of the past eleven—there are some things, it seems to me, that would be eminently fitting to come before this meeting. The lessons of the last cold spells. There are in these cold spells certain varieties of citrus fruits that are not affected as others. That question has always been up, but has not been discussed at this meeting. In some places there are twenty or thirty trees in a block not touched, others where every leaf is off. You will see in the peach orchards limbs that are killed back three or four feet, and other limbs on the same tree that are not touched. You have to live in the grove and among your trees to know anything about oranges. Certain varieties did not lose a leaf, while other varieties are killed.

As to the grape fruit—I am glad the society has gone back to the good old word—there are certain varieties with every bud split and dying and will, before July, be gone; there are others not touched under the same conditions.

Mr. Hart: I would like to ask if the Tangerona is one of the first?

Answer—The tangerona is tender, but this year there are some from which not a leaf has been taken. It is an early and exquisite orange; few excel it in quality and flavor. Although the earliest orange, it will hold on the trees until April. I don’t know what it will do this year. This year I have used no fertilizer, and yet I have raised two crops of corn that will yield thirty bushels, and I see none but what look exceedingly well today. The grape fruit, that I consider about on equal grounds, as being the best in the state, and the one from St. Petersburg, the Leonardi, have proved their tenderness. Of those we grafted down in the ground three inches, as near as I could get them so, nearly everyone has been killed to the bed; and, I may say, that of oranges that were budded on trifoliata, the new growth of which before that cold, was ten inches long, I now have not one left. Spots that I have never seen hurt showed growth killed to the ground; fully one-quarter of the trees. That which has stood best is a grape fruit that I got from my friend Street, at Ormond. One of my neighbors put out, about two years ago, 600 budded grape fruit trees, that looked