

into late November and December. This alone would indicate that these latest bolls of the season had required a much longer period to "make" than the first bolls. Notwithstanding this, it is difficult to see just why growers have so generally accepted the view that the earliest blossoms of the season take longest to "make" their bolls, and that there is a gradual shortening of this period as the later blossoms appear throughout the summer. A number have expressed the view that nature's wise provision must have ordained things in this way, in order that the plants may put on a maximum crop and at the same time better perpetuate themselves before cold weather.

One would reason that the growth-energy of the cotton plant must be greatest at the beginning of the blossoming season, and that this must normally diminish as the activities of nutrition, growth, etc., become taxed with a rapidly increasing crop of bolls toward the end of summer.

Blossoms appearing toward the middle of September are not likely to produce bolls. This is in part a response to the cooler days and nights and otherwise unfavorable weather conditions of this season. Moreover, the plants have nearly reached an equilibrium between boll production and the productive capacities of a particular arrangement of soil conditions. As a result of these soil and seasonal factors, the plants become so enfeebled in growth vigor that further boll production soon ceases.

The little-bolled cottons are earlier and therefore better suited than the big-bolled varieties to the short summers of the extreme edge of the cotton belt in northern Georgia and elsewhere. This character of earliness is probably not always owing to the fact that these may blossom earlier in the season, but also because they are able to "make" their crop of bolls in a shorter period of time.

THE PROBLEM OF FIXATION IN COTTON HYBRIDS.

By PROF. R. J. H. DELOACH, *Experiment, Georgia.*

When this problem is settled, there will be little difficulty in breeding a type of cotton for any specific purpose, if a combination of qualities shown in the present species and varieties will answer such purpose, for in a large number of hybrids, we could be assured of finding among the second and third year hybrids, almost every type ranging from one parent plant to the other. After we have found the ideal for which we are seeking, or breeding, fixing the type is the most important thing to consider, and selection is usually begun with this object, and selection

cannot be dispensed with under any condition. It will always play an important part in our efforts to fix hybrids.

However, when we find the basis for unit characters in hybrid plants, we shall have less trouble fixing our types. Much excellent work has been done by Burbank in producing new and hardier varieties of fruits

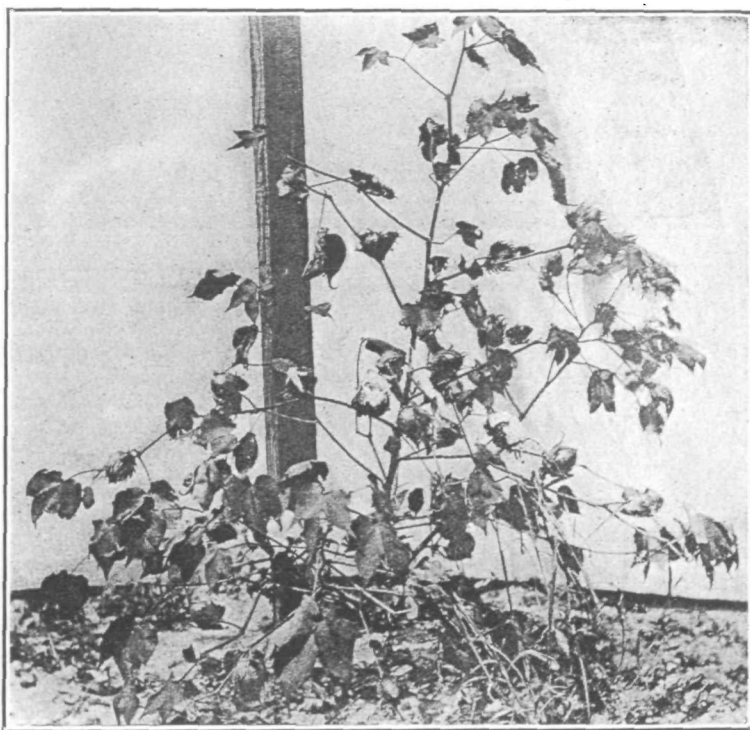


FIG. 1. AN IDEAL GREER'S COTTON PLANT.

and flowers by miscellaneous crossing. In every such case, the question of selection played the most important part in eliminating the unfit and propagating the fit or more desirable plants. He has been successful in recognizing the plants that conformed to his original ideal, and withal, it is possible that he could have done the same work in less than half the time and at less than half the cost, if he had understood the biological factors involved in cross breeding, or if he had known from the first,

which of his plants were fixed. These questions have led to the following considerations.

HAVE ANY COTTON HYBRIDS BEEN FIXED?

Most of the new varieties of cotton have been found in fields of one or another variety, and isolated by expert breeders, but most of the so-

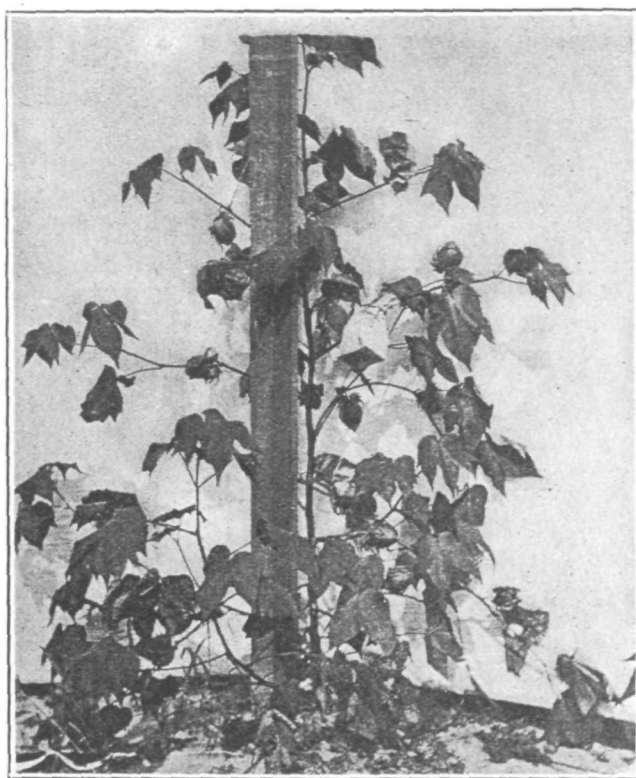


FIG. 2 A HYBRID COTTON PLANT FROM A CROSS OF KILGORE'S \times COOK'S.

called varieties are only slightly improved strains of a given variety. Broadwell's, and Greer's are slight improvements of the King cotton and when grown under the direction of the writer, showed very little difference in type of plant, coloration of flowers, or shape and size of fruit. In a field of Russell's big boll was found an exceptional plant, and when isolated proved to have superior quality of lint and remarkable trans-

mitting power. Was this an accidental hybrid or not? If so, and if the cross were made between Russell's and longstaple cotton, we would expect the offsprings to behave somewhat according to Mendel's law. This selection did not.

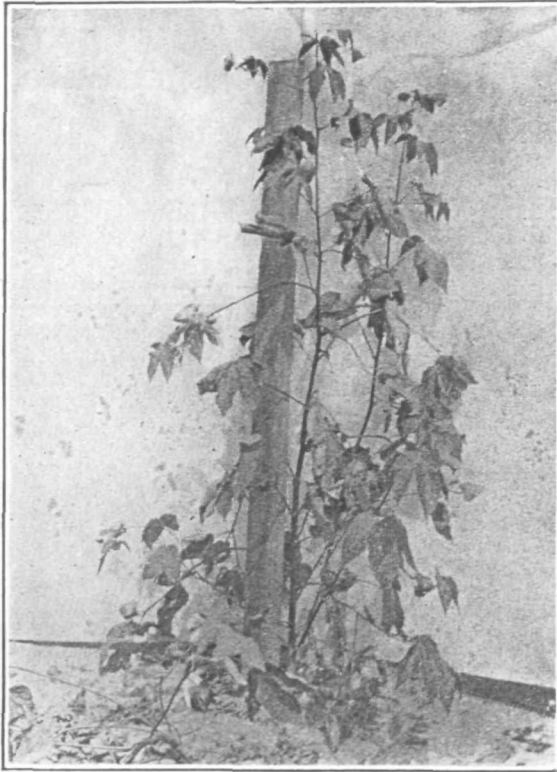


FIG. 3 A STALK OF SEA ISLAND COTTON WHICH FORMED THE BASIS OF THE EXPERIMENT OUTLINED IN THIS PAPER.

Wherever a cotton breeder was known to have crossed two conspicuously different varieties, the problem of fixation proved to be very difficult, is and is probably still in the experimental stage. It would not be so difficult to breed back to either parent, for a dominant would be unmistakable after the second year, or even the second year. But two dominant-recessive plants may look very much alike, and have very different tendencies. Many observations and experiments along this

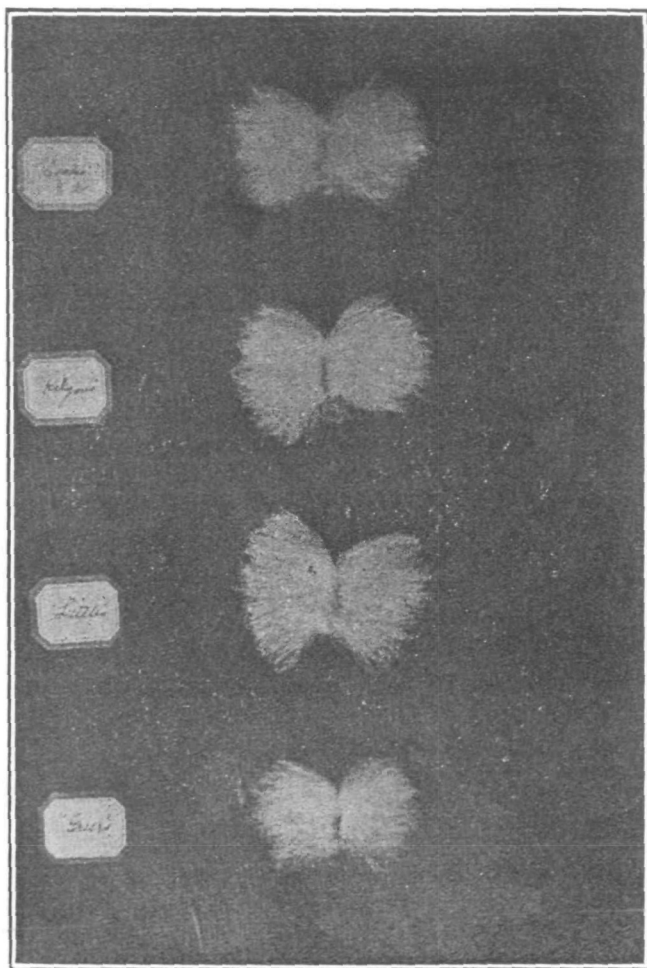


FIG. 4 SHOWING A METHOD OF FIBER STUDY OF COTTON, WHICH MUST FORM THE BASIS OF ALL PERMANENT IMPROVEMENT IN COTTON.

line have caused the writer to accept with some doubt the statement that many new varieties of cotton have been produced by promiscuous crossings, and he would urge that breeders give the details of methods and arrangement of experiments, when new varieties are thought to have been originated in this way.

In most cases it has been found that crosses were made with nearly related varieties, and the result was general improvement, due partly to the mixed varieties, and partly to some special attention to cultivation and fertilization. There was not much room for intervening types, and the slight improvement generally made it almost impossible to tell the difference between the male and female parent type. A cross was made between sea island and short staple upland cottons, and after six years of the most rigid selection by an expert breeder, the hybrid was still unfixed. The long staple uplands now being grown have no history. Southern Hope is said to have originated from a Peruvian cotton, but the method begins with selection. The origin of the Sunflower is unknown. The Columbia was found in a field of Russels' and fairly well fixed by continued selection.

METHOD OF SELECTION.

It is possible that we have restricted our method of investigation too much to the selection of the plants and have not given enough attention to the individual capsules. The writer has shown in Bulletin 83 of the Georgia Experiment Station two very important things in reference to the variation of activity in the individual capsules taken from hybrid plants, viz: 1st, that there is a great difference in the activity of the individual capsules on hybrid plants as shown by the plants that grow from them, and 2d, that every capsule on any given hybrid plant will not always show exact Mendelian proportions. This suggests the necessity for changing our method of research from plant-selection to capsule-selection, or capsule-isolation, not only in the first year hybrids but the second, third and fourth as well. We should not be less rigid in the selection of plants, but concern ourselves with the question of this variation of activity in different parts of the plant.

It was found that a selected second year hybrid from a cross between Sea Island and Upland cottons gave the following results: The plant selected was not altogether unlike the Columbia; five capsules were close fertilized. From these grew 98 plants. 46 were hybrids, 32 the Upland type, and 20 the Sea Island type. The capsules were planted in

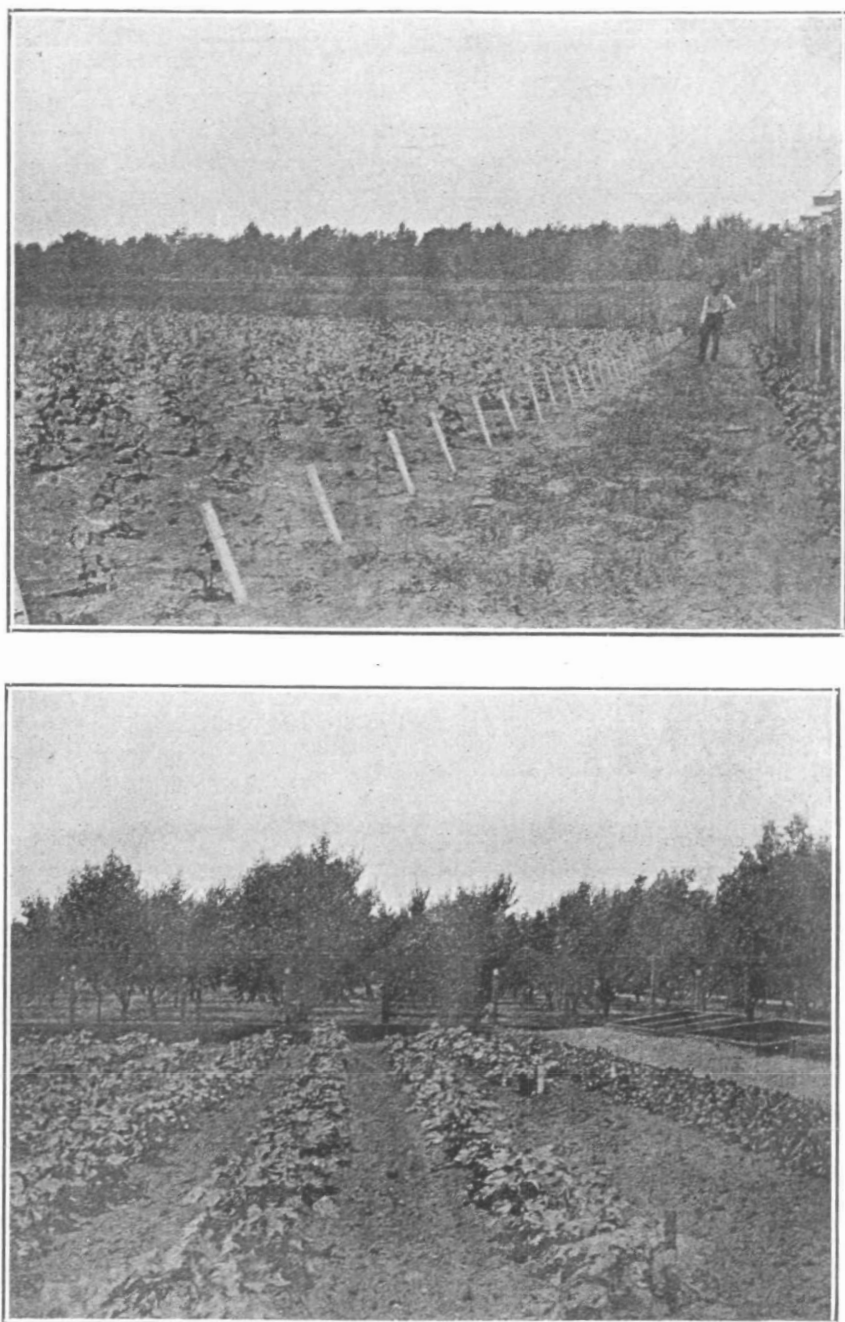


FIG. 5 EXPERIMENTAL PLATS FOR THE STUDY OF HEREDITY IN COTTON, AND WHERE THESE INVESTIGATIONS WERE UNDERTAKEN.
(Georgia Experiment Station)

separate rows, in order to test for variation. The following table shows the details of the results:

| CAPSULE. | SEA ISLAND TYPE | UPLAND TYPE. | HYBRID TYPE. | TOTAL. |
|-------------|-----------------|--------------|--------------|--------|
| 1 | 5 | 14 | 3 | 22 |
| 2 | 8 | 7 | 9 | 24 |
| 3 | 0 | 0 | 15 | 15 |
| 4 | 5 | 8 | 12 | 25 |
| 5 | 2 | 3 | 7 | 12 |
| Total | 20 | 32 | 46 | 98 |

According to a number of experiments, this irregularity is not exceptional, and as suggested above it may be the basis of fixing within a short time cotton hybrids. In the above table, the hybrids approaching nearest to uniformity were those grown from capsule 3, and are to be used another year to further the experiment. This was also the only capsule of the five that did not grow any plants like either of the parent plants which is very significant in a second year hybrid. But it is not more significant than the fact that there is any variation at all in the plants grown from any of the capsules, and should be no greater cause for surprise. It does suggest, however, that the biological activities in hybrid plants are not uniform, and not equally distributed over the plants during the fruiting period.

If the 15 hybrid plants from capsule 3 should prove to be almost or quite fixed, as is believed to be the case, from other experiments, much time can be saved in fixing cotton hybrids by experimenting with the single capsules on a hybrid plant. It would hardly be possible for us to select all plants from the exceptional capsules without selecting the capsules, and isolating them in planting, and to do this, it becomes almost necessary to take all the capsules on a plant. For otherwise we could not be certain that we had taken the best capsule on the plant, or the one that might prove best for breeding purposes. When we find the capsule that proves most reliable for fixation, and isolate it, we have saved much time and have made the problem of fixation a less difficult problem.

Many hybrids grown from the other 4 capsules were almost exactly like the 15 from capsule 3 in appearance, thereby making it difficult to select them except in the manner outlined above. It might be contended that all hybrids so much like the 15 from capsule 3 in appearance, would be as good to select as the 15, but it has not proved to be the case, and

assuming that it would be *safe* to do so, has caused us to have to resort to the prevalent method of selecting for fixation. The other 4 capsules are more unstable than the 3d, and will stay more unsettled, and could not be expected to prove as good to select from as the 3d. In our usual method of selection, we get the stable and the unstable alike, and consequently find it very difficult to fix types.

For further experiments of the nature of the above, the Willet's red-leaf is crossed on the Cook's improved, making it easy to distinguish the hybrids from the parent types.

REPORT OF COMMITTEE ON PRIZE COMPETITIONS.

By PROF. H. W. MUMFORD, *Urbana, Ill.*

The following can scarcely be considered a committee report since time has not been sufficient to submit it to each of the members of the committee.

The purposes of this committee as outlined by the Association are:

"To investigate and report on methods of encouraging the breeding of plants and animals by means of competitions for prizes as between students in agricultural schools and colleges, between colleges, judging teams, etc., and between breeders as at state fairs and shows, with a view to the best use of these agencies in encouraging the breeding of animals and plants along lines of high economic and artistic merit."

The committee is planning to ask those who have inaugurated or superintended prize competitions in various parts of the country which have proved particularly successful to furnish the committee with a detailed report of the plan and results of such competitions. The more unique and successful of these will doubtless be incorporated in subsequent reports of the committee. All will be studied with reference to discovering and classifying the fundamental principles involved in holding successful prize competitions.

Each member of the committee will be assigned some different phase of the subject with which he is most familiar, and will be asked to submit a report to the general committee for its consideration.

The committee has held one meeting at which it was only possible to get together part of the committee. At this meeting a general discussion of the purpose, scope and work of the committee took place.

Professor R. A. Moore of the University of Wisconsin gave the com-