

No. 15. — *The Hybridization of Lilies.* By FRANCIS PARKMAN, late Professor of Horticulture at the Bussey Institution.

TEN or twelve years ago, I began a series of experiments in hybridizing lilies, and have continued them at intervals to the present time, with results some of which are worth recording.

My first attempt was to combine the two superb Japanese lilies, *L. speciosum* (*lancifolium*) and *L. auratum*. The former was used as the female parent. Four or five varieties of it, varying from pure white to deep red, were brought forward in pots under glass. This was necessary, because *L. speciosum* does not ripen its seed in the open air, in the climate of New England. When the flowers were on the point of opening, the anthers were carefully removed from the expanding buds by means of forceps. As the pollen was entirely unripe, and as pains were taken to leave not a single anther in any of the flowers, self-impregnation was impossible. The pollen of *L. auratum* was then applied to the pistils, as soon as they were in condition to receive it. Impregnation took place in most cases. The seed-pods swelled, and promised an ample crop of seed; but the experiment was spoiled by the bad management of the man in charge of the greenhouse, in consequence of which the pods were attacked by mildew.

In the next year, I repeated the attempt, with the same precautions. This time the seed was successfully ripened. Being sown immediately, a portion of it germinated in the following spring, and the rest, a year later. In regard to this seed, two points were noticeable; first, it was scanty, the pods, though looking well, being in great part filled with abortive seed, or mere chaff; and, next, such good seed as there was differed in appearance from the seed of the same lily fertilized by the pollen of its own species. The latter is smooth, whereas the hybrid seed was rough and wrinkled. About fifty young seedlings resulted from it, and their appearance was very encouraging, because the stems of nearly all were mottled in a manner characteristic of *L. auratum*, but not of *L. speciosum*. Here, then, was a plain indication of the influence of the male parent. The infant bulbs were pricked out into a cold frame and left there three or four years, when, having reached the

size of a pigeon's egg, they were planted in a bed for blooming. This was in 1869. Towards midsummer, one of the young hybrids showed a large flower-bud, much like that of its male parent, *L. auratum*. The rest, about fifty in all, showed no buds until some time after; and when the buds at length appeared, they were precisely like those of the female parent, *L. speciosum*. The first bud opened on the seventh of August, and proved a magnificent flower, nine and a half inches in diameter, resembling *L. auratum* in fragrance and form, and the most brilliant varieties of *L. speciosum* in color. In the following year, it measured nearly twelve inches from tip to tip of the extended petals, and in England it has since reached fourteen inches. A colored plate of it will be found in the "Florist and Pomologist" of March, 1876, and engravings of it have appeared in the "Gardener's Chronicle" and other horticultural publications. The stock has been placed in the hands of Mr. Anthony Waterer, the distinguished nurseryman, who has given it the name of *L. Parkmanni*. In this one instance, the experiment had been a great success; but of the remaining fifty hybrids, not one produced a flower in the least distinguishable from that of the pure *L. speciosum*. The influence of the alien pollen was shown, as before noticed, in the markings of the stem, and also in a diminished power of seed-bearing; but this was all.

In the next year, wishing to see if the male parent would not make his influence appear more distinctly in the second generation, I fertilized several of these fifty hybrids, with the pollen of *L. auratum*, precisely as their female parent had been fertilized. The crop of seed was extremely scanty, but there was enough to produce eight or ten young bulbs. Of these, when they bloomed, one bore a flower combining the features of both parents; but, though large, it was far inferior to *L. Parkmanni* in form and color. The remaining flowers were not distinguishable from those of the pure *L. speciosum*.

While making these experiments with *L. speciosum* and *L. auratum*, I made similar attempts to produce hybrids of other lilies. In the spring of 1867, I planted twenty or more strong bulbs of *L. superbum* in a favorable spot, and, when they began to bloom, fertilized them with the pollen of *L. speciosum*, *L. auratum*, *L. tigrinum*, *L. chalcedonicum*, *L. umbellatum*, *L. Thunbergianum*, *L. longiflorum*, and *L. tenuifolium*. All the anthers were previously removed before ripening, by slitting the sides of the still unopened bud and extracting them

with forceps. There were no other plants of *L. superbum* in the garden, or in the neighborhood: so that in this case, as in the former, fertilization by the pollen of their own species could not take place. Seed-pods, large and well shaped, were formed in abundance; but when they ripened in October, some of them contained nothing but chaff. Others had a few imperfect seeds, while others gave a fair supply of seed as good as could be desired. It was sown in pans, germinated in due time, and produced several hundred young bulbs; but when these came into bloom, not a single flower of them all was in the least distinguishable from the pure *L. superbum*. Of eight different male parents, not one had impressed his features on his hybrid offspring. Not only in their flowers, but in their leaves, stems, and bulbs, the young plants showed no variation from their maternal parent. In the following year, I set some of them apart from the rest, and applied to them, as to their mother before them, the pollen of several species of lilies. This time, the seeds were extremely scanty. A few, however, were produced; but the plants and flowers that resulted from them, were, to all appearance, *L. superbum* pure and simple.

Another subject of experiment was *L. umbellatum*, which I fertilized with the pollen of *L. auratum*. Seed was produced in abundance, and the young plants began to bloom in the second year. Many of them were not to be distinguished from the pure *L. umbellatum*. Others showed unmistakable marks of their hybrid origin in the defective condition of the organs of reproduction, the anthers being abortive or wholly wanting, as were also, in a few cases, even the pistils. In some instances, the corolla was deformed, some of the petals being absent, and others small and ill-shaped. But while the influence of the alien pollen was shown in these defects, no features of the male parent appeared either in form, color, scent, or manner of growth.

No lily seems to offer better prospects to the hybridizer than *L. longiflorum*. The species itself is not a good seed-bearer in our climate; but one of its varieties, known as *L. longiflorum Takesima*, bears seed very freely. This variety is also distinguished by superior vigor of growth, and by the dark markings of its stem. The pure white of the large trumpet-shaped flowers seemed peculiarly fitted to receive impressions of color from an alien parent. I therefore fertilized them with the pollen of a deep red variety of *L. speciosum*. The operation was performed under glass and with the greatest care. The seed was

abundant, and being sown immediately it all germinated in the following spring. When the flowers opened, two years later, they showed no sign whatever of the male parent. The pure white was without tint or spot; neither did the foliage and stem show the slightest trace of foreign influence. The plants were in pots. I removed a number of them to the greenhouse, and, having no pollen of *L. speciosum* at hand, fertilized them with that of *L. auratum*. Several refused to bear seed, while others produced it freely. The young plants resulting from this last experiment, bloomed in the greenhouses of the Bussey Institution in the spring of 1874. Neither *L. speciosum*, their grandfather, nor *L. auratum*, their father, had produced any effect whatever on the pure white of their petals. They showed differences of habit, among themselves, some being very tall and vigorous, and others compact and bushy, with a tendency to bloom in clusters, but these may have been mere seedling variations, with which the hybridization had nothing to do. Yet distinct evidence could be seen of the action of the alien pollen. Some of the anthers were small and abortive, and some of the pistils were imperfect; but what was more to the purpose was the changed color of many of the former. The white petals had completely resisted the foreign influence; but the yellow anthers had undergone a marked change. About half of them were turned to a chocolate color, approaching that of the anthers of the male parent, though not so deep.

I determined to try the effect of impregnation in the third generation, and applied the pollen of both *L. auratum* and *L. speciosum* to ten or twelve of the young hybrids whose organs of reproduction appeared to remain perfect. Not one of them would bear seed. In the present summer, 1877, I repeated the experiment on a larger scale, and fertilized about fifty flowers, after removing the anthers before they had ripened. Nine of these produced seed-pods, all of which were small and deformed, except two. These two contained, along with chaff, a few seeds of promising appearance. The remaining seven were full of chaff alone. The reproductive power had been nearly destroyed by hybridization repeated through three generations. What will result from the few seeds obtained, remains to be seen.

Some lilies refuse to be fertilized by the pollen of certain other lilies. Thus I have found that *L. speciosum*, so readily fertilized by *L. auratum*, will give no seed to the pollen of either *L. Browni*, *L.*

longiflorum, *L. Canadense*, *L. tenuifolium*, or *L. umbellatum*. Yet the converse does not always hold true, for several of these last-named species will bear seed when fertilized with the pollen of *L. speciosum*.

A great number of subtle influences may modify the results of experiments in hybridization; yet those described above were so various, and extended over so many years, that the general facts to which they point may, I think, be regarded as assured. An eminent botanist has suggested to me that the tenacity with which lilies fertilized by lilies of other species retain their characteristics unchanged, may be explained by supposing that the offspring are really no hybrids at all, but results of *parthenogenesis*, that curious phenomenon which sometimes occurs in the lower orders of animals, and by which a single impregnation continues to take effect in several successive generations; in other words, that a lily of which the flower was fertilized in any one year by its own pollen may bear seed in the next year without being fertilized again. There are two good reasons for believing that parthenogenesis had nothing to do with the cases in question. In the first place, some of the lilies subjected to experiment were young plants that had never bloomed before, and consequently could not have been fertilized before. In the next place, every species fertilized by me with the pollen of another species showed, with the single exception of *L. superbum*, evidence of hybridity, which, though slight, was convincing. This evidence consisted in markings of the stem resembling those of the male parent, in a changed color of anthers, also resembling that of the male, and in the frequent occurrence of abortion in both anthers and pistils, with consequent sterility. That the seedlings were really hybrids, there can be no reasonable doubt, though nobody would have suspected it from casual observation. The conclusion is that lilies, or at least the principal species of the genus, when hybridized, produce offspring which show the features of the male parent very slightly or only in exceptional cases. These exceptional cases are, nevertheless, so remarkable at times, that the rarity of their occurrence ought not to discourage the hybridist.



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