New York Agricultural Experiment Station.

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SOME NOTES ON THE BREEDING OF RASPBERRIES.

R. D. ANTHONY,
UNDER THE DIRECTION OF
U. P. HEDRICK.

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*Absent on leave. † Connected with Grape Culture Investigations.
BULLETIN No. 417.

SOME NOTES ON THE BREEDING OF RASPBERRIES.

R. D. ANTHONY,
UNDER THE DIRECTION OF
U. P. HEDRICK.

SUMMARY.

The breeding of raspberries was begun at this Station nearly a quarter of a century ago. At first the work was largely confined to the red raspberry and a number of excellent seedlings were secured from various combinations of Marlboro, Loudon and Superlative. Since 1910 greater attention was paid to the black-cap and purple raspberries. About 3300 seedlings were tested.

It was to set at rest any doubts which might remain as to the hybrid origin of the purple raspberry, Peck's *Rubus neglectus*, and to secure better varieties of this popular sort that the breeding of the purple raspberries was undertaken. The work has shown beyond a doubt that these originated as hybrids of the black-cap and red raspberry. Some very promising seedlings have been secured.

Pure seedlings of Columbian, an F₁ hybrid, failed to break up as much as would be expected. None showed any tendency to propagate by suckers nor did any have fruit of the color of either parent. In cane color and glaucousness some of the seedlings approached more nearly the parent types.

Hybrid seedlings were produced by crossing two black-caps with a red raspberry. With one cross the seedlings were all purple; among the 289 seedlings of the other cross were 10 yellows. None propagated by suckers.

In order to find which varieties are the best parents, a study was made of the performance of various varieties. The record of Marlboro, Herbert, Cumberland and Smith No. 1, a seedling black-cap of unknown origin, is given.
A study of the inheritance of color of fruit would indicate that several of our black raspberries are heterozygous for color and that probably several color factors are present. The same thing holds with the red raspberry though the higher number of yellows would indicate fewer color factors. Selfed seedlings of Columbian gave one yellow, one black and forty that were probably varying degrees of purple. A black-cap which was pure for color produced only purple when crossed with a red containing a factor for yellow, but when both were heterozygous yellow hybrids were produced.

Glaucousness, the presence of bloom on the canes, is probably a dominant character. Both the Columbian seedlings and the F₁ hybrids gave glaucous and non-glaucous bushes in a ratio very nearly three to one.

The F₁ hybrids could also be separated in the ratio of three with rough bark to one with smooth bark.

The analysis of the inheritance of spines is inconclusive though certain similarities in the results secured from the purple seedlings suggest the desirability of further study along this line.

Three of the Columbian seedlings produced some unusual abnormalities in the flower clusters. There were many gradations from perfect fruits to those in which the drupelets were replaced by small, sepal-like leaves. In other clusters the fruits varied from perfect to entirely sterile forms which did not have the leafy growth.

All the purple raspberries having Smith No. 1 as the female parent were standard plants but nearly one-third of the Cumberland seedlings were dwarfs. The factor for dwarfing is evidently one of rather rare occurrence.

From a correlation which was found between leaf coloration and fruit it would seem that it is entirely possible to tell all yellow raspberries from either the red or purple sorts by the absence of any tinge of red on the leaves. It is probably true also that the bark of the young canes of the yellow varieties is entirely lacking in any touch of red or purple color.

The Herbert red raspberry and the Blowers blackberry were pollinated by the flowering raspberry, *Rubus odoratus*. The Blowers seedlings were lacking in vigor and all died the first year. The Herbert seedlings made a strong growth and in 1915 blossomed freely. A study of these leaves no doubt as to their hybrid origin. In *Rubus odoratus* we may have a go-between through which we
may mix the blood of several of our species. This work of hybridization will be continued with many other species, of which there are now nearly fifty growing on the Station grounds.

HISTORY OF THE WORK.

The breeding of red raspberries was begun at this Station as early as 1892. In 1897 and '98, Marlboro, Loudon and Superlative were used as parents—which proved a fortunate selection, as five seedlings out of a total of nearly 1200 have since been named and distributed. Two of these five, June, a seedling of Loudon by Marlboro, and Marlond, from the reciprocal cross, have proved unusually promising early varieties. The other three, Louboro and Donboro, seedlings of Loudon by Marlboro, and Marlative, a seedling of Marlboro by Superlative, are still under test but will probably never be as popular as the two preceding.

During the testing of these seedlings, additional work was not undertaken and it was not until 1906 that other seedlings were bred and then only to test out a few pure seedlings of the five named above.

In 1910 a new series of crosses was begun with the red, black and purple raspberries. June was crossed with other reds and also used as a pollinator for a black-cap. With the black raspberries, various combinations were made among Cumberland, Eureka, Hilborn, Palmer and a seedling of unknown origin called Smith No. 1. Columbian, the only purple used, was self-pollinated. In 1912 before these seedlings fruited, several of these crosses, including the Smith No. 1 by June, were duplicated and, in addition, Cumberland was crossed with June. The first series fruited in 1913 and the other in 1915. In all, 3300 seedlings were tested.

ACKNOWLEDGMENTS.

From 1910 through the fruited season of 1913 the work was carried on by Richard Wellington, then Associate Horticulturist. Since his resignation in 1913 the task of continuing the work and preparing the material for this report has fallen upon the author.* Without the aid of O. M. Taylor, Foreman in Horticulture, and

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* A preliminary report was made by Wellington at the Tenth Annual Meeting of the Society for Horticultural Science at Washington, D. C., November, 1913.
several of the Assistant Horticulturists it would have been impossible to care for this large number of seedlings and to secure the necessary records.

**PURPLE RASPBERRIES.**

The purple-cane, or purple-cap, raspberry was first called *Rubus neglectus* about 1869 by Peck, then New York State Botanist. As botanists became more familiar with these raspberries, the wide range in type which they showed and the fact that they were found only in limited numbers and then in the presence of both the red raspberry and the black-cap, led many to surmise a hybrid origin. The possibility of hybridizing the black-cap and the red raspberry was soon proved and the similarity of such hybrids to *Rubus neglectus* strengthened these doubts as to the correctness of Peck’s species.

About 1873 Professor William Saunders, Director of the Central Experimental Farm, Ottawa, Canada, fruited 24 seedlings obtained from a cross of the Doolittle black-cap by the Philadelphia red raspberry. These were all purple-fruit planted plants propagating by tips. These hybrids seem not to have attracted much attention and but little further work of this type was attempted for many years.

The popularity of the purple raspberries has been increasing rapidly during the last ten years and in some regions they have largely supplanted the black-caps. This has been due to their heavy production and their nearly complete immunity to the anthracnose which has been destroying the black-caps. When we consider that but two varieties, Columbian and Shaffer, are responsible for this development and that these are but chance hybrid seedlings, we realize what an opportunity there is here for the fruit breeder. It was for this reason that this Station in 1910 undertook to remove all doubts as to the origin of the purple raspberries and to produce improved sorts. The study of over fifty pure seedlings of Columbian and over eight hundred crosses of the black-cap by the red raspberries has now progressed far enough to show conclusively the hybrid origin of Peck’s *Rubus neglectus*. Some of these seedlings give promise of new varieties much superior to any now under cultivation.

The pure Columbian seedlings have presented some interesting problems in their failure to break up in the F2 generation as much as would be expected, most of the characters still showing intermediate types with very few cases where they approach at all closely to either parent. Out of half a hundred none could be described as a
pure red raspberry, though several were somewhat similar to the red parent both in color and in cane characters; nor did any show a tendency to propagate by suckers as does the red raspberry, though some failed to tip readily. In cane color and glaucousness there was more of the expected splitting up, some seedlings having the deep purple-red canes of the Columbian while others had green canes, some having a bloom such as is found on the base of Columbian canes while others were non-glaucous as in the supposed red grandparent. Recent correspondence with a private fruit breeder * who is growing a number of seedlings of Shaffer from unprotected flowers has led the author to suspect that this variety will be found to possess a quite different gametic composition from Columbian and this suggests the advisability of selfing other purples, especially some of the F₂ seedlings.

In producing the F₁ hybrid seedlings, June, a Station seedling red raspberry, has been used as the male and two different black-caps, Cumberland and Smith No. 1, have been used as females. Practically every crossed seedling shows clear evidence of its hybrid origin. The Smith No. 1 seedlings were all purple, though the color showed varying degrees of intensity; but among the 289 Cumberland seedlings there were nine yellows which were intermediates in their bush type and one which might readily have been classed as a black-cap bush. The question of the inheritance of color of fruit will be discussed later. None of the seedlings of either cross gave any indication of propagating by suckers.

An unusually large proportion of these crossed seedlings was very promising. The bushes were more vigorous than either parent and bore a crop of large, firm fruit, somewhat later than the parents. Some fruits were rather unattractive because of their dark color and dull look caused by a thick pubescence but many were of a rich, glossy purple.

For those wishing to breed purple raspberries the best mode of procedure would seem to be to cross the most desirable reds and blacks rather than to attempt inter-crossing among the purples or to grow pure seedlings of any purple sorts. For such persons the chances of reward are excellent and as results can be secured in from three to four years — a comparatively short time for the fruit breeder — this offers an attractive field.

* Letter December 6, 1915, from Henry Tiedemann, Hammond, Ind.
PERFORMANCE OF CERTAIN VARIETIES USED AS PARENTS.

A short time ago Hedrick and the writer in a discussion of some grape-breeding studies* called attention to the advisability of finding those varieties which are desirable parents as a means of hastening the production of improved sorts. This same factor needs emphasis in the breeding of raspberries. In a comparative test in the commercial plantation Cumberland would probably be ranked ahead of Smith No. 1, yet, when these were both pollinated by the same red raspberry, 12 per ct. of the resulting Cumberland seedlings were saved as worthy of a second test — a high proportion as breeding work goes — while 24 per ct. of the Smith No. 1 seedlings were saved. It is for this reason that the following rather meager information is given for the varieties which have been used most extensively.

Marlboro.—During the first fifteen years this variety was used in a large number of crosses and more than one hundred seedlings having Marlboro as a parent or grandparent have been marked as worthy of retainering for further testing. Many of these have since been discarded but several are very promising. In general, Marlboro seedlings are early — frequently earlier than the parent — of good size, sometimes too soft for long shipment and frequently lacking in high quality. Yellow seedlings may be expected in small numbers.

Few Marlboro seedlings are rampant plant makers and the bushes are more inclined to be stocky than sprawling. This variety appears to possess a factor for spinelessness, a few spineless plants appearing in several of its crosses. June, one of its seedlings out of Loudon, is more nearly spineless than most raspberries. In 1915 sixty-six seedlings of Marlboro by June were fruited. This combination of parent and progeny seems to have accentuated this factor, since 27 plants were graded as spineless or with only a few at the base of the canes; of the others, 28 had spines only on the mid-rib of the leaf, while 4 had a few and 4 a medium amount on the canes.

Of the above seedlings, 29 per ct. were marked worthy of a second test. This speaks well for Marlboro which was both a parent and a grandparent.

Plate I.—A Typical Purple Hybrid.
PLATE II.—ONE OF THE MOST PROMISING RED RASPBERRY SEEDLINGS.
(June X Herbert.)
PLATE III.—A PROMISING BLACK-CAP SEEDLING.
(From Smith No. 1.)
PLATE IV.—SPINE TYPES AMONG COLUMBIAN SEEDLINGS:
C. The parent; 1. very spiny; 2. few spines; 3. an intermediate.
Plate V.—Three Types of Abnormal Clusters:
1, Varying amounts of imperfectness; 2, leafy type; 3, only the terminal perfect.
Plate VI.—Abnormal Fruits:
Row 1. Perfect fruit (A) and leafy type.
Row 2. A sterile fruit (A) and intermediate forms.
PLATE VII.—ONE OF TALLEST DWARFS COMPARED WITH A STANDARD PLANT OF SAME PARENTOGE.
Plate VIII.—Rubus strigosus × Rubus odoratus.
Herbert.—In 1913 fifty-five pure seedlings of Herbert were placed in the test plantation. Many of these lacked vigor and the following summer 25 were dead. Most of the remainder fruited in 1915. The plants as a whole were low-growing and all but a few were lacking in vigor. On the other hand those plants which fruited had unusually large, conical berries. Some of these were too soft but a few were excellent. One yellow seedling was found.

Since only 7 per ct. of these pure seedlings were saved for further testing, it would seem that Herbert should be combined with some vigorous variety which needs larger size. The most promising red raspberry seedling now on the Station grounds was secured by crossing June with Herbert.

Cumberland.—This variety has been used in crossing both with other black-caps and with the June red raspberry. Excluding those which possessed any of the Smith No. 1 blood nearly seven hundred seedlings of the first type have been grown, and of these only 7 per ct. were worthy of a second test; while the seedlings of Cumberland and Smith No. 1 gave 19 per ct. for further propagation. Although the hybrid seedlings were better than the straight black-caps, they were much poorer than other hybrids without Cumberland blood.

Crosses of Cumberland with the Palmer and Hilborn black-caps and with June have given yellow seedlings.

Under a later heading will be discussed the appearance of a dwarf type among the Cumberland hybrid seedlings.

Smith No. 1.—This variety was sent to the Station for test in 1908 as a chance seedling of unknown origin. In 1909 and 1910 it was one of the best and most productive black-caps on the grounds and for that reason it was used in the breeding work. During the following years the plants were severely injured by unusually dry summers and the destruction of most of the bushes was completed by an attack of anthracnose. So far its seedlings have not seemed noticeably susceptible to either summer drought or anthracnose.

One of the most interesting points in the work of the last five years has been the high proportion of promising seedlings secured from this variety. Out of more than five hundred pure seedlings 23 per ct. were retained for a second test. More than a thousand seedlings were obtained by crossing with other black-caps and of these 30 per ct. were saved while seedlings of Cumberland and of Hilborn gave 7 and 4 per ct. respectively. Among the hybrid purples 24 per
ct. of the Smith No. 1 seedlings were retained while only 12 per ct. of the Cumberland seedlings escaped the brush pile.

Many of the Smith No. 1 seedlings bred in 1910 and retained for more extensive testing fruited a second time in 1915. All who have had the pleasure of studying these are agreed that they are a most remarkable lot because of their production, size, fine appearance, firmness and good quality.

All of the hybrid seedlings of this blood — over six hundred — are purple and among the 1400 black-cap seedlings all but two were black. Among the large number of crosses involved, it is entirely possible that these two were foreign plants which became mixed with the Smith No. 1 seedlings. If this is the case, we must consider this variety as homozygous for the black color factor.

The pure seedlings which fruited first in 1915 were very uniform both in bush and fruit characters. They made a vigorous growth and had stocky, dark reddish-purple canes well covered with bloom and plentifully supplied with stout spines of medium length. The fruit was large, firm and inclined to be somewhat conic on many bushes.

INHERITANCE OF COLOR OF FRUIT.

Black-caps.— It is very evident that several of our black raspberries are heterozygous for color. Yellow-fruited seedlings have been secured from Cumberland, Hilborn and Palmer but in such small numbers as to indicate several pairs of color characters. From the evidence at hand it would seem that Smith No. 1 is a pure black.

Red raspberries.— Cuthbert, Herbert, Marlboro and June have given yellow seedlings. The following is the result for those crosses of which we have complete records.

<table>
<thead>
<tr>
<th>Cross</th>
<th>Seedlings</th>
</tr>
</thead>
<tbody>
<tr>
<td>June x Cuthbert</td>
<td>60 red</td>
</tr>
<tr>
<td>Marlboro x June</td>
<td>66 red</td>
</tr>
<tr>
<td>Herbert selfed</td>
<td>55 red</td>
</tr>
<tr>
<td>Total</td>
<td>181 red</td>
</tr>
<tr>
<td>Ratio 26:1</td>
<td></td>
</tr>
</tbody>
</table>

There may be either two or three color factors involved here.

Purple raspberries.— The selfed seedlings of Columbian would indicate a partial coupling of the red and black color factors. According to Wellington there were 31 purples, 7 "red wine," 2 doubtful
plants red, 1 yellow and 1 black. The "red wine" plants evidently possessed a color factor other than red which resulted in somewhat darker fruits, and as the reds turned purple when fully ripe they probably contained a black factor. Since Columbian is supposed to be a seedling of Cuthbert, the yellow is not unexpected. With the present meager information an explanation of the black cannot be attempted.

From the first generation hybrid seedlings it would appear that a black-cap which is pure for color will produce only purples when crossed with a red, even when the latter contains a factor for yellow.

The cross, Cumberland by June, was evidently a combination of two plants both heterozygous for color. As a result, we have 165 purples, 7 yellows with a bush type approaching the red raspberry and one which might be described as a yellow black-cap. If these two types of yellows are due to different color factors, our problem is much complicated, but if they are the same we would seem to have a relatively small number of color factors involved.

**INHERITANCE OF CERTAIN CANE CHARACTERS.**

*Glaucousness.*— Among the purple seedlings there was a considerable number without the bloom which is found on so many black-caps and to a more limited extent on some of the reds. Columbian, which has glaucous canes, gave the two types in very nearly the ratio of three glaucous to one non-glaucous. The F₁ hybrids from Cumberland by June and Smith No. 1 by June also approached reasonably close to a 3 to 1 ratio. Evidently the non-glaucous cane is a recessive character.

*Rough and smooth bark.*— Many red raspberries have the bark roughened by the exfoliation of some of the outer bark. This is much less noticeable among the black-caps. The F₁ hybrid seedlings were studied for this character and it was found that, though Cumberland and Smith No. 1 had smooth bark and June less exfoliation than most reds, the seedlings could be separated in the ratio of three with rough bark to one smooth.

*Spines.*— Wellington found that among the Columbian seedlings there were 16 very spiny, 25 intermediate and 9 with very few spines.
A study of the $F_1$ purples shows the following:

<table>
<thead>
<tr>
<th>Cumberland (many slight spines) $\times$</th>
<th>June (none, or only at base)</th>
<th>Smith No. 1 (numerous strong spines) $\times$</th>
<th>June (none, or only at base)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerous</td>
<td>1.5</td>
<td>Few</td>
<td>3</td>
</tr>
<tr>
<td>Few</td>
<td>1.5</td>
<td>Very few</td>
<td>1.5</td>
</tr>
<tr>
<td>Very few</td>
<td>1</td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

Probably there are several factors which determine the number of spines. Evidently Smith No. 1 transmits a stronger tendency to produce spines than does Cumberland. This tendency appears also in the pure seedlings of this variety.

ABNORMAL DEVELOPMENT OF FLOWER CLUSTERS.

Among the pure seedlings of Columbian three plants developed some unusual abnormalities.* In one the sepals varied in number from the normal five to very numerous and were arranged in single, double or sometimes triple rows. At the same time many berries were entirely sterile, many others imperfect, while several were perfect. Terminal blossoms usually showed greater modifications than the laterals. One case noted on this bush could be described in two ways: Either a terminal blossom elongated and the drupelets were replaced by small, sepal-like leaves from the axis of seven of which appeared leafy blossoms borne on pedicels a half-inch or less in length and producing from a few to several drupelets and at the apex of the elongated flower was a sessile, leafy, abortive blossom; or, the terminal stem was fasciated, the ordinary leaves were reduced to sepals and the eight blossoms just mentioned sprang from an exceptionally short length of stem. That the first view is the more probable is indicated by the fact that the base of the cluster was surrounded by eight sepals all in the same plane. Immediately below this calyx ring three small leaves were present. In the axils of the sepals taking the place of the drupelets, except those bearing the blossoms, there was a short, green, filament-like organ usually terminated with a dried up, thread-like tissue appearing like a dried style or filament. Sometimes this organ appeared like a further reduced sepal. The fruit of this plant was purple and those berries which were perfect were medium in size.

*These plants fruited in 1913 and were described by Wellington. Much of this description is taken directly from his notes.
Another plant was more abnormal than the above, all of the terminal blossoms showing a marked reversion to the leafy type. More of these secondary sepals bore blossoms in their axes — twelve and thirteen being found on two clusters — and almost all of these were sterile, though sometimes from one to six drupelets were formed. Surrounding the base of these modified blossoms were two rows of sepals. This bush was practically sterile, only one fruit with four purple drupes reaching maturity.

On a third bush many blossoms were entirely sterile while the terminal flowers of all the axillary flower clusters produced nearly perfect fruits. The main terminals were surrounded by two rows of sepals. One of the modified blossoms contained 20 secondary blossoms, each borne in the axil of a sepal-like leaf, and at the apex was one more bud; also there were three sepal-like petals with aborted buds. One berry that was picked to pieces possessed 24 drupelets. The fruit was yellow, small, and many were imperfect.

DWARF TYPES.

All the purple raspberries having Smith No. 1 as the female parent were standard plants but among the purples from Cumberland by June appeared some very interesting dwarfs.

These dwarf plants were easily distinguished from the normal ones, even when normal plants lacked vigor and made a low growth. There were nearly as many nodes on the dwarf canes as on the normal ones but the internodes of the former were much shorter, sometimes not even a quarter of an inch long. Many of the leaves were very small but a few were nearly normal. The attachment of the petiole was very brittle and the leaves snapped off easily. The canes were thickly covered with soft spines while most of the standards had but few stiff spines. Those dwarfs which were the most vigorous made a thick, bushy growth somewhat like the red raspberry yet they could not be said to form suckers. Many dwarfs were under a foot in height and the tallest were hardly two feet.

In the entire population there were 46 dwarfs and 178 standards. The dwarfing was accompanied by lack of vigor in most plants so that there was a higher percentage of mortality here than with the normal plants. Taking this into consideration, we see that this is reasonably close to a 1 to 3 ratio. Selfed seedlings of Cumberland have never been grown here but several years ago a number of June
seedlings were planted. An unusually dry summer destroyed the majority of them so that notes were not taken of individual plants and all not showing vigor were discarded. In this way no note was made of any dwarfs though they may have been present in considerable numbers. Pure seeds of June are now in the stratifying bed for next year's planting.

The factor for dwarving is evidently one of rather rare occurrence as this is the first time it has been noticed among the Station seedlings.

A CORRELATION IN LEAF AND FRUIT COLOR AMONG RASPBERRIES.

Over one hundred and fifty red raspberry varieties and seedlings fruited on the Station grounds in 1915. In examining these it was found that on all plants the terminal leaves on the young canes had the upper surface more or less tinged with red. On some this tingeing extended down the cane for three or four leaves, on others only the first leaf would be colored. The gland-like tip of the leaf serrations on these young, expanding leaves was red or tinged with red as was also the tips of the leaf serrations on the older leaves farther down the cane.

Yellow raspberries have originated on the Station grounds in two ways: from crosses of red sorts and from crosses of the black-cap and red raspberry. In either case the opening leaves on the young shoots lack this reddish tinge noticeable on the red raspberry and the gland-like tips of the serrations of both the young and older leaves are a light greenish yellow.

Among the hybrid purples these leaf marks are not as clearly distinguishable. In some of the latter the young leaves lacked the reddish tinge on the upper surface though in some it was nearly as marked as in the red raspberries. All the purples which were examined, however, did have the glandular tips of the serrations of these young leaves tinged red although on some only the serrations nearest the apex showed this. The purples also showed a greater tendency for these markings to vary on different canes on the same plant. On the older leaves of all the purples the gland-like tip of the serrations was red and this was the most easily determined character to separate the yellows and the purples.

It would seem from the above that it is entirely possible to tell all yellow raspberry plants from either the red or the purple sorts by a
study of leaf coloration. Although this point has not been as care-
fully studied, it would also appear that, during the dormant period,
the bark of the younger canes of the yellows is entirely lacking in any
tinge of red or purple. Some purple raspberry bushes can be dis-
tinguished from red raspberries by the lesser amount of coloring on
the upper surface of the young leaves but many have practically the
same amount as the red raspberry.

AN INTERESTING HYBRID.

In the spring of 1913 the flowering raspberry, *Rubus odoratus*,
was crossed with the red raspberry, the blackberry and the dewberry.
Only a few seeds were secured from the dewberry crosses and the
same was true of all other crosses where the flowering raspberry was
the female. With the Herbert red raspberry and the Blowers
blackberry a plentiful supply of seeds was secured. The Herbert
seedlings made a strong growth and nearly one hundred were planted
for fruiting but the Blowers seedlings were very lacking in vigor and
although thirty small plants were set out all died before the beginning
of the second season. The Herbert seedlings blossomed freely in 1915.

A study of these seedlings leaves no doubt as to their hybrid origin.
The cane characters are clearly those of *R. odoratus* and the individual
blossoms are scarcely distinguishable from those of this species; on
the other hand, the leaves are palmate as in the red raspberry. The
flower panicles were unusually large and bore a profusion of blossoms
but many of these failed to set fruit and the others had but a few
drupelets. As these plants blossomed at a time when no other rasp-
berry flowers were open, they probably received no cross-pollination.

These hybrids are interesting because they suggest that *Rubus
odoratus* may serve as a go-between through which we may mix the
blood of several of our Rubus species.

In this connection it is worth while calling attention to the desira-
bility of much more extended effort in producing hybrids not only
among our cultivated species but also with the many wild ones,
especially those which recent explorations have brought to us from
Asia and South America and which possess so many new and strik-
ing characters. There are now growing on the Station's grounds
nearly fifty species of Rubus. Many of these will be discarded but
all those showing valuable characters will be intercrossed. The
proportion of viable seeds which can be secured in such crosses is very low and the chances of obtaining the desired combination of good qualities are very few. This is the fate of many of the plant breeder’s dreams but the remarkable success of two raspberry hybrids, the Loganberry and the purple raspberry, would encourage even the pessimist to continue along these lines.