

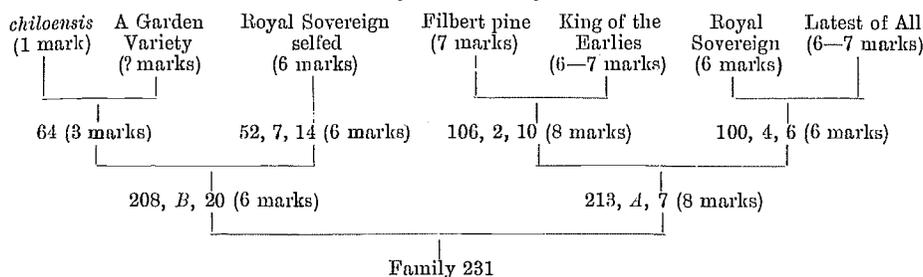
## NOTES ON *FRAGARIA*.

By C. W. RICHARDSON.

### *Flavour.*

My former system of awarding marks for flavour (*Journ. Gen.* Vol. x. p. 41) included both bad and poor plants; with their disappearance I have modified the marking, giving a wider range, so that a plant with fruit of no flavour receives but one mark and a plant, such as Royal Sovereign, with fruit of good flavour six marks.

### *Family 231. Pedigree.*

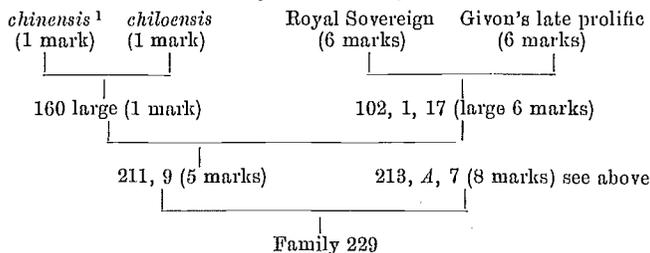


Plants were vigorous and their fruit was marked: 1 plant received 1 mark, 1—2, 3—3, 1—4, 2—5, 3—6, 4—7 and 4 received 8 marks.

This is the first family I have raised which produced no fruit of bad flavour. The degree of excellency ascends fairly steadily.

A closely related family 232 with parents (the first number denotes the family, the letter and last figure the plant) 213, A, 16 × 208, B, 20 gave similar results, but as the number of plants was small the marking was not recorded.

### *Family 229. Pedigree.*



<sup>1</sup> The use of the name *chinensis* seems to be justifiable as these are plants reputed to be Chinese in America, a reference to which I recently discovered in *The Journal of Heredity*. The plants I have, which were obtained from Kew, are a variety of the large species *chiloensis*. The *vesca* and *chiloensis* species afford a good example of the Law of Homologous Series in Variation (*Journ. Gen.* Vol. XII. No. 1), both having Alpine, hairy coloured-flowered, double-flowered, &c., &c., forms.

Plants were very vigorous and their fruit was marked: 2 plants received 1 mark, 3—2, 4—3, 2—4, 4—5, 6—6, 4—7 and 4 received 8 marks. Here again no plants produced bad fruit. The degree of excellency ascends fairly steadily but stops somewhat, about the sixth mark.

When plants are self-fertilised I have found such a large number of the descendants produce small fruit, are lacking in stamina and quality, and are frequently inclined to be sterile that it has been impossible to judge the relative values of the fruit. In all such cases the parent plants were selected for good qualities, so it would appear that self-fertilisation constitutes a bar to the production of satisfactory  $F_2$  families; to what extent the mating of brother and sister plants, or flowers, produces a similar result I have as yet insufficient data on which to express an opinion; but the results of out-crossing seem to be the more satisfactory. Till a family is produced with fruit of uniform and high excellency (say of 8 marks or more) it will be impossible to state accurately the number of factors which are concerned in flavour. Up to the present I have been unable to judge of the values of small fruit derived from such parents as Alpines and *vescas*, but there is marked segregation of flavour. A cross (*vesca* × *virginiana*) × *chinensis* gave a large family which included several with marked *vesca* flavour, but unfortunately a large number of the plants were sterile, or only slightly fertile, so no conclusions could be drawn; the dominance of flavour is however noteworthy as both *virginiana* and *chinensis* are without flavour in England.

#### *Foliage.*

When *vesca* and *elatior* plants are crossed with *chinensis* the resulting hybrids have different types of foliage, *vesca* × *chinensis* resembles *chinensis*, *elatior* × *chinensis*, *elatior*, but in each case the leaves are larger than those of either parent plant. So female-sterile are these crosses that I have never as yet been able to obtain a viable seed from them. The (*elatior* × *chinensis*)  $F_1$  crossed back with *chinensis* gives plants with *chinensis*, *elatior* and intermediate foliage. The leaf colour, shape and substance are not linked. The crosses I have made between *vesca* × *chinensis* and *vesca* × *chiloensis* have produced little or no good pollen and have been female-sterile. From a cross *vesca* × *virginiana*, producing a *virginiana* type of foliage in the  $F_1$ , I have only obtained, by self-fertilisation, some dozen plants; their foliage closely resembles that of the  $F_1$ . Crossed back with *virginiana* the  $F_1$  gave only *virginiana*-like plants; the cross-back with *vesca* has so far failed. *Chinensis* × (*vesca* × *virginiana*) gave a family uniformly dark green but with many different

shapes of leaf. A small  $F_2$  family from hermaphrodite plants closely resembles the  $F_1$  in colour, but some plants have thick, leathery leaves of the *chiloensis* type, whilst others resemble the cross *chiloensis*  $\times$  *virginiana*, a somewhat *virginiana* intermediate. (*Elatior*  $\times$  *chinensis*)  $\times$  *virginiana* gave plants with leaves of *virginiana* shape and type in general, but their colour was intermediate between *elatior* and *virginiana*. This family flowered this year (1922) for the first time and proved very sterile.

The work done by others in crossing *elatior* and *virginiana* (a cross I have attempted to make, without result, very many times) seems to have resulted much as *vesca*  $\times$  *virginiana* in producing descendants of one type resembling *virginiana*. In my cross the  $F_2$  family was so multifoliate that the actual leaf shape was undefined. The fact that these plants crossed with *chinensis* gave various types of foliage points to the necessity of a very close examination of the  $F_2$  plants, before it can be definitely stated that *only virginiana*-like plants are produced. On the evidence it is rash to rush to the conclusion that *virginiana*  $\times$  *elatior*, or *vesca*, produces a parthenogenetic form.

Multifoliate leaved plants, when selfed, do not breed true to the character. A plant of 208 family, with extra leaflets well down the leaf stalk, was selfed in 1920 and young, vigorous plants were placed in the open in 1921; none of these have produced multifoliate leaves up to August 1922. The same plant when crossed back with a garden variety produced a majority (considerable) of multifoliate plants. Any strong-growing cross may have multifoliate leaves, but, as the strength of their inbred descendants departs, so the character also seems to vanish, which is not the case with flower or fruit-doubling, these characters apparently following the ordinary Mendelian rules. The most degraded degenerate of a garden plant may have diminutive coxcomby fruit, but multifoliate plants are generally vigorous.

After many endeavours to arrange leaves in some order for classification I have been obliged, up to the present, to give up the idea—the difference between one leaf and another may be a matter of personal opinion, age of leaf, or time of year. It is possible to say such a leaf is of *chiloensis* type, but it is rash to say such another is of *virginiana* or *vesca* type.

#### *Sterility and Fertility.*

When distinct species are crossed only a small percentage of ovules are fertilised and the resulting plants are almost completely female-

sterile and as a rule nearly male-sterile. When "garden" varieties are crossed with pollen from such hybrid parents the resulting plants may be graded in respect of male and female sterility, and may be represented thus:

0	0	0	1	2	2	2	1	0	in maleness
♂	♂	♂	♂	♂	♂	♂	♂	♂	
0	1	2	2	2	1	0	0	0	in femaleness

in many cases hermaphrodites do not appear, and in others steriles are absent.

A mating *virginiana* ♂ × *virginiana* ♀ gave ♂♂, ♀♀ and ♀♀, a ♂ selfed gave 29 ♀♀ — 7 ♀♀ but some of the ♀♀, held over to the

following year, produced flowers one might call  $\overset{1}{\underset{3}{\phi}}$ , and when examined after another year they were still  $\overset{1}{\underset{3}{\phi}}$ .

(*Elatior* × *chinensis*) × a garden variety set about 20% of seed, of which a small number germinated. Eleven fully grown plants flowered and, after frequent examination for two years, proved to be—3 steriles, 1 slightly female, 1 female, 1 slightly male- and female-fertile and 5 males of various degrees of fertility. The most fertile female when mated to brother pollen set 38.67% of seed, which all germinated (the best flower out of 4). When mated with "bush Alpine" nothing set. When crossed-back with a garden variety 90.3% set and germinated. The plants of the brother × sister mating are robust, and, after one year in the open, seem to be of normal size, but those from the cross-back are extra-strong growers of great size. None of these plants have had time to flower. The same female pollinated with *nilgirensis* set nothing. As 90% of the ovules of a flower frequently produce seed which germinates, it is difficult to find a reason for the *partial* sterility of such a flower when crossed with another species. Still more difficult is it to explain the fertility of a female when crossed with some pollen and her sterility when crossed with other and equally good pollen.

*Runnerless character.*

The cross runnerless, single and white-flowering × runnered, double and pink-flowering gave in the  $F_1$  the expected runnered, single pink. The  $F_1$  selfed, gave 53 runnerless, 130 runnered. When these figures are added to those previously obtained from crossing of single flowered plants, the total stands—97 runnerless and 342 runnered. The figures suggest a 3—1 on the average, but there is great discrepancy between

the various families. This may be due to the fact that there is always a large loss in the  $F_2$  family from sickly plants. I recorded this loss in the single runnerless  $\times$  double runnered which amounted to 85, of which 33 were traceable to the failure of seed to germinate, and this with only 183 surviving plants! Another difficulty arises, as some plants produce flower trusses which change into runners, thereafter sometimes remaining, strictly speaking, runnerless, and at other times producing normal runners. As, I am inclined to think, such flowers invariably occur on very tight and tall-foliaged plants, which necessitate the flower-stems growing to a great length, it seems more than likely that the apparent change to runners is merely an excessive growth of adventitious roots. I have found such root-producing trusses in normal runner-making plants and encouraged them to root, but up to the present in vain. There are too plants producing runners which flower before they are rooted. The bud which produces the flower on the runner is comparable to that in fruit trees which produces the flower on the branch. There seems to be no rule in the  $F_2$ 's as to whether a plant shall flower before it makes runners or make runners first, in the usual way; also their time of first flowering varies from one month to over a year. In connection with the period of time between germination and flowering it is worth noting that seed sown in June flowered occasionally in October (under glass) and regularly the following summer; whereas similar seed sown in September did not flower the following summer, the plants in each case being treated in exactly the same way. *Vesca* and *alpina* seed generally flowers within six months or a year of planting; but I find *elatior* (hautbois) takes twelve to eighteen months, and some American and Asiatic light-leaved plants follow the *vesca* or hautbois example. The light-leaved strawberry is, to my mind, a very fine example of the utility of naming varieties and the futility of grading them into species, sub-species and varieties of sub-species.

To return to the original cross; the double white runnerless and double pink runnerless appeared, but I had to leave my runnerless plants before all of them had flowered (eleven months after sowing), so actual figures are not to hand and in any case would be too small to be of value. The double flowers were frequently of the "hen and chickens" type, a departure from the original white double parent. The introduction of the Alpine strain may account for the overflow of vitality in the flower, as my former Alpine  $\times$  *vesca* crosses produced very strong-growing plants.

*Fruit colour.*

Red, dark red and light red are all dominant to white. Red of the ordinary *vesca* or Alpine density is dominant to dark red (so-called black) and the lighter shades of red. Up to the present I have no facts on the cross light red and dark red. Very light red is constantly confused with white; fruit from supposed white plants should never be gathered till it drops or begins to wither, if accurate information is required as to colour.

*Variation.*

There are, at least, two forms of variegation in the foliage of strawberries, and both fluctuate. Seed sown from the form with white splashed leaves produces yellow, green, splashed yellow and green, splashed white and green and pure white cotyledons. Seed sown from mottled green and yellow produces yellow, green, mottled yellow and green and very pale yellow, but apparently no white, cotyledons. All my pure whites and yellows died off after producing one or two leaves; the "splashed" forms also died, but as only a very few appeared, and the green splashes were small, it is more than probable that green forms with white splashes would survive. Only a small percentage of pollen from variegated plants seems good and I have failed to self any plants, making use of bags, cages and a protected greenhouse. Tested on three flowers of another variety the pollen failed with the exception of two seeds setting on one flower. Whilst one cannot say malnutrition is the cause of variegation in strawberries, plants when well nourished develop chlorophyll in sufficient quantity to cover the entire leaf; but frequently leaves from such plants are badly developed. Owing to the fluctuating character the strawberry is not a good subject for the study of variegation.

I regret to say I have been obliged to give up my long association with The John Innes Horticultural Institution, as I am about to settle in South Africa. Whilst many varieties of *Fragaria* can be grown in my new country, I expect still more will be difficult or impossible to cultivate. I fear too my work on flavour may require some further modifications, as I have reason to suppose rapidity in ripening tends to reduce flavour; that this may not invariably be the case is more than possible. Some flowers seem to lose their scent in South Africa yet others of the same species (e.g. Roses) retain their full fragrance.