

On Gametic Coupling and Repulsion in Primula sinensis.

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(Communicated by W. Bateson, F.R.S. Received March 2,—Read
March 30, 1911.)

In *Primula sinensis* the short style is dominant to the long style, and the magenta colour of the flower is dominant to the red colour.

Some years ago a series of experiments was made, in which a red short-styled race was mated with various long-styled plants carrying the factor for magenta colour. In F_2 from these crosses, only three kinds of offspring were obtained, namely: (1) magenta, short-styled; (2) magenta, long-styled; (3) red, short-styled. No red long-styled offspring were produced.* This result shows that, in the gametogenesis of the F_1 , complete *repulsion* took place between the factors for the two dominant characters, magenta and short style.

In another series of crosses which have been made recently, a short-styled race carrying the magenta factor was crossed with two races of long-styled reds. The results obtained in F_2 show that, when the cross is made in this way, a *partial coupling* occurs between the factors for the two dominant characters.

One of the long-styled races used in these experiments was a red, with double flowers and green stigmas. In the two F_2 -families raised from the crosses of this race with the short-styled race, the partial coupling observed is almost entirely certainly of the form 7:1:1:7.

The numbers obtained are:—

	Magenta, short style.	Magenta, long style.	Red, short style.	Red, long style.	Total.
$F_1 \times \text{self} \dots\dots\dots$	33	3	1	10	47
<i>Expectation</i> 7 : 1 : 1 : 7...	32·5	2·8	2·8	9·0	47·1

In these two families there is no indication that either of the characters under consideration has any special inter-relation with any other character, the distribution of singles and doubles in the four types of offspring giving the normal ratio 9:3:3:1. The numbers obtained are:—

* The experiments are described in detail in the 'Journ. Genetics,' 1911, vol. 1, No. 2.

Magenta, single.	Magenta, double.	Red, single.	Red, double.	Total.
27	9	9	2	47

Short style, single.	Short style, double.	Long style, single.	Long style, double.	Total.
24	10	12	1	47

The second long-styled race used was a dark red with red stigmas. In the families obtained from the crosses of this race with the short-styled race, the distribution of the offspring in the four classes is much less simple than in the preceding case; there is an excess of magentas and of short-styled plants, and the form which the partial coupling takes is not certain. The only family raised from the F_1 self-fertilised, containing as it did a large number of plants with colourless flowers, was too small to give any indication of the form of the coupling. The reciprocal crosses between the F_1 and the recessive parent race give results which are almost exactly intermediate between the expectation based on the series 7:1:1:7 and that based on the series 15:1:1:15. It is further to be noticed that in these families there is clear evidence that the factor for magenta is partially coupled, not only with the factor for short style, but also with a third factor, which has the effect of suppressing the development of pigment in the stigma, giving rise to the dominant green stigma. The partial coupling which is shown in this case is of a much lower type than that which obtains between magenta and short style, and, as in previous experiments,* does not exactly conform to any known series.

The fact that the magenta factor takes part in two systems of coupling, one of which is of an undetermined form, renders the results complex. Further data are required for their complete analysis, particularly in regard to the effect which the two systems of coupling, in combination, may have upon the distribution of the factors for short style and green stigma among the offspring. When the offspring are classified according to these two characters, the numbers observed are irregular, there being an excess of plants bearing the dominant characters.

* 'Journ. Genetics,' 1911, vol. 1, No. 2.

The numbers which have been obtained are set out below:—

I.

	Magenta, short style.	Magenta, long style.	Red, short style.	Red, long style.	Plants in which the magenta factor has no visible effect.	Total.
$F_1 \times \text{self} \dots\dots\dots$	5	1	1	2	21	30
$F_1 \varphi \times \text{red, long style, } \sigma \dots$	18	2	3	13	13	49
Red, long style, $\varphi \times F_1 \sigma$	35	1	3	27	58	124
Total : $F_1 \times \text{red, long style}$	53	3	6	40	71	173
<i>Expectation</i> : 7 : 1 : 1 : 7	44·6	6·4	6·4	44·6	—	—
„ 15 : 1 : 1 : 15	47·8	3·2	3·2	47·8	—	—

II.

	Magenta, green stigma.	Magenta, red stigma.	Red, green stigma.	Red, red stigma.	Plants in which the magenta factor has no visible effect.	Total.
$F_1 \varphi \times \text{red, red stigma, } \sigma$	12	8	5	11	13	49
Red, red stigma, $\varphi \times F_1 \sigma$	27	9	13	17	58	124
Total	39	17	18	28	71	173

III.

	Short style, green stigma.	Short style, red stigma.	Long style, green stigma.	Long style, red stigma.	Total.
$F_1 \times \text{self} \dots\dots\dots$	16	7	4	3	30
$F_1 \varphi \times \text{long style, red stigma, } \sigma$	19	10	11	9	49
Long style, red stigma, $\varphi \times F_1 \sigma$	45	25	19	35	124
Total : $F_1 \times \text{long style, red stigma.}$	64	35	30	44	173

Another instance of complete repulsion between two factors has been met with this year. The factors in question are: (1) a factor which effects

the partial suppression of colour in the stem, and gives rise to the dominant light stems (pallifying factor), and (2) the factor, previously mentioned, which completely suppresses colour in the stigma.

The repulsion between these two factors was observed in the progeny of a cross in which a plant having red stems and red stigma was mated with a plant which was almost devoid of colour in the stem and had the dominant green stigma. The F_2 from this cross contained a long series of forms, and included plants having stems much darker in colour than those of the red-stemmed parent. The green-stemmed parent was therefore without the pallifying factor. Certain individuals of the F_2 were tested by self-fertilisation, and three of them, all having light red stems and green stigmas, gave F_3 families in which the complete repulsion between the pallifying factor and the factor for green stigma was shown, in the fact that none of the offspring with dark stems had red stigmas. The numbers obtained in the three families are shown below.

	Light stem, green stigma.	Light stem, red stigma.	Dark stem, green stigma.	Dark stem, red stigma.	Total.
	11	8	5	0	24
	95	40	45	0	180
	31	18	12	0	61
Total	137	66	62	0	265
Expectation ...	132.5	66.25	66.25	0	265

I am greatly indebted to the authorities of the John Innes Horticultural Institution for allowing a large number of plants to be grown there. The assistance thus extended to me has enabled me largely to increase the scope of my experiments upon *Primula sinensis*.
