

agreement with the supposition of simple inheritance of the character, but needing to be checked by additional observations.

The individuals in table 1 belong to a wide variety of races, but are mostly Americans of mixed European ancestry. Both positives and negatives have been observed in the following groups though the numbers are too small to make the proportions significant: English, Russian, Russian Jewish, Dutch, Polish, Negro (presumably hybrids with whites), Japanese.

The data here recorded have been collected by many observers. Since the members of a given family are usually recorded by the same observer, it might be supposed that the correlation between relatives is a spurious one, due only to differences in classifying intermediates. This supposition is negated by the absence of a correlation between husband and wife, who are also usually recorded by the same observer.

Another possible interpretation of the data is that there is no truly genetic element, the correlations being dependent on family habits or customs, or on imitation in some form. This supposition is not supported by two sets of data: the effect of the father and of the mother on the ability of their offspring is equal; and there is no indication of a striking difference in frequencies of the two classes in the various national and language groups included among those studied.

*Summary.*—The ability to turn up the edges of the tongue, present in about 65 per cent of the persons studied, is conditioned at least in part by heredity.

<sup>1</sup> It should be added, however, that other individuals with slight speech defects have been found to be positive.

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## INFLUENCE OF FEMALE STOCK ON THE FUNCTIONING OF SMALL POLLEN MALE GAMETES

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In the many cases of natural or induced heterozygous small pollen conditions in maize it is now considered axiomatic that the small pollen grains do not function in competition with the normal, large grains. This is true whether the production of small pollen grains is associated with a detectable cytological deficiency or occurs in a stock in which the chromosomes show no visible abnormality.

In the case of small pollen-1,  $sp_1$ , Mangelsdorf<sup>1,2</sup> found that less than one per cent of the  $sp_1$  pollen grains effected fertilization in competition with

normal. He demonstrated, however, that the  $sp_1$  grains are capable of germination and affecting fertilization when screened to eliminate competition with the normal large pollen grains. In our investigations on the small pollen condition we have found, on the whole, that less than one per cent of the  $sp_1$  pollen grains function in competition with normal.<sup>3</sup>

Consequently, it was surprising to find, in 1938, results of some crosses of  $su \times \frac{sp\ su}{++}$  that could be explained only by assuming a considerable proportion of the  $sp_1$  pollen grains had accomplished fertilization. The pollinations were made on two different sweet stocks, Purdue 39 and Connecticut 81. Four sets of paired pollinations were made on these two inbreds. In every case the Purdue 39 had a considerably higher percentage of sweet seed indicating that the  $sp_1$  pollen grains were able to function better when applied to this stock. In one case there was 53 per cent of  $su$  kernels. Here there was no competitive effect between the  $+$  and  $sp_1$  pollen grains. The total counts for the pollinations on the two inbreds were as follows:

	<i>Su</i>	<i>su</i>	TOTAL	PERCENT <i>Su</i> (C. O. CLASS)
Purdue 39 $\times \frac{sp\ su}{++}$	2714	1744	4458	39
Conn. 81 $\times \frac{sp\ su}{++}$	7089	1478	8567	17

In each of the pollinations on these two inbreds there should have been only about 6 per cent of sweet seeds (the crossover ratio between  $sp$  and  $su$ ) had there been no functioning of  $sp_1$  pollen grains. Both per cents, 17 for C81 and 39 for P39, are much too high for the crossover ratio and indicate a functioning of the  $sp_1$  pollen grains. These figures also show that Purdue 39 silks function as a more favorable host to the small pollen grains than the Connecticut 81, if our interpretation is correct that the higher percentages are due to the functioning of the small pollen grains.

To test this point, the four different classes of seeds from the two pollinations were planted in 1939 and pollen of the plants was examined to determine how many were segregating  $sp_1$ . The following results were obtained:

	POLLEN <i>sp</i> / $+$	POLLEN $+$ $+$	TOTAL	PER CENT <i>sp</i> / $+$
P39 $\times \frac{sp\ su}{++}$ <i>su</i> seed	447	68	515	87
C81 $\times$ " <i>su</i> seed	302	233	535	56
P39 $\times$ " <i>Su</i> seed	9	439	448	2.0
C81 $\times$ " <i>Su</i> seed	18	527	545	3.3

Thus we see the *Su* seeds produced a very small per cent of plants with segregating pollen. This was expected since *Su* was linked with *Sp* and the only segregating plants from these seeds would come from a crossover be-

tween these two loci, and a functioning of the *sp Su* pollen grain after the crossover. Hence the percentage obtained would never be more than the per cent of recombination. The counts are too small to say whether the percentage of 2.0 is significantly different from 3.3.

In the case of the *su* kernels more segregating plants were expected since this is the linkage class of *sp* and *su*. Also a higher percentage was expected from the cross using Purdue 39. The *su* seeds from this cross produced plants, 87 per cent of which had segregating pollen, while the *su* seeds of the C81 cross produced only 56 per cent of segregating plants. These figures verified the assumption that the excess percentages of *su* (C. O. class) seeds in the original cross were really functional small pollen and did not represent an increase in crossing-over. It is possible to obtain the true recombination per cent in each cross by multiplying the original value by the per cent of non-segregating plants found (the true crossovers). When this is done the crossover per cent becomes 5.1 for the P39 crosses and 7.5 for the C81 crosses. These fluctuations from the normal 6 per cent C. O. value are probably not significant.

The pollen examinations showed conclusively there was considerable functioning of *sp<sub>1</sub>* pollen in competition with normal. They also showed a greater functioning when applied to Purdue 39, than when applied to Connecticut 81. The nature of this difference is a matter of speculation. Do the silks of Purdue 39 afford a better environment for the germination of *sp<sub>1</sub>* pollen grains? If so, is it possible by using this inbred as a female stock to secure the functioning of other small pollen male gametes? Other inbreds might conceivably be as favorable or more favorable than Purdue 39.

No explanation of this condition is available at present.

<sup>1</sup> Mangelsdorf, P. C., *Proc. Nat. Acad. Sci.*, **17**, 698-700 (1931).

<sup>2</sup> Mangelsdorf, P. C., *Jour. Hered.*, **23**, 289-295 (1932).

<sup>3</sup> Singleton, W. R., *Proc. 6th Internat. Genetics Congress*, **2**, 182-184 (1931).