TWO DIFFERENT RARE EVENTS OCCURRING SIMULTANEOUSLY IN THE HOUSE MOUSE

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IN an inbred line in which Caracul (*Ca*, linkage group VI) had been segregating as a backcross for eight generations, there appeared two males which, from their breeding behaviour, were apparently homozygous for this factor. They were members of the same litter, the first produced by their parents. The latter bred seven Caraculs and four normals in three litters, in good agreement with the expected 1 : 1 ratio. The anomalous males (10/130.370c and 10/130.370d) were given several unrelated does besides their first mates from the inbred line, and bred consistently by all of them as homozygous Caraculs, producing no normals out of over two hundred progeny. A summary of these and other relevant data is given in the table.

There is no possibility of mistaken identity. The inbred line segregates in six factors (*Ca*, belted, *bt*, misty, *m*, brown, *b*, silver, *si*, and Fused, *Fu*), which are not found in this combination elsewhere in this laboratory. The anomalous males' phenotypes and breeding performance were such that they could only have come from this line, and their parents bred as expected for all six factors.

Neither does it seem likely that *Ca* was segregating in an unusual fashion in this line or that any other waving factor was present. The eight previous generations produced severally and in the aggregate ratios of Caracul to normal none of which differed significantly from the expected 1 : 1, and three sibs of the anomalous males, mated to normals, also produced good 1 : 1 ratios.

An explanation which at first appears plausible is that the "non-Caracul" parent of the males in question was in fact Caracul. If so, the mating producing them would have been an intercross for Caracul, and the production of two homozygous males out of eleven offspring would not have been surprising. Certainly the ratio seven Caraculs to four normals is not significantly different from 3 : 1. However, the "non-Caracul" parent was scrupulously examined and no trace of curly hair was found. Unfortunately it died before any specific tests of its genotype could be made. But the records showed that it had been outcrossed to an unrelated non-wavy female in a test for another factor. Three young had been classified for waviness and appeared normal. Five others had been killed at five days old but had not been specifically classified for wavy. However, if they had had wavy whiskers this would probably have been noticed. Thus this mating probably produced no wavies out of eight progeny, a result

which, had the “non-Caracul” actually been a Caracul, could only have occurred by chance with a probability of 1 in 256.

It must therefore be concluded that an unusual genetic situation has occurred.

TABLE
*The segregation of Ca and bt from two anomalous males
and from their parents*

	Segregation of Ca and bt					Total segregation (including offspring not classified for bt)		
	Ca +	Ca bt	+	+	Total	Ca	+	Total
Parents of males were $\frac{Ca +}{+ bt} \text{♀} \times \frac{+ bt}{+ bt} \text{♂}$ and gave . . .	4	2	...	3	9	7	4	11
Male 10/130.370c Ca bt m b si Fu (Ca + + + + +) × sister btbt gave × five unrelated non-bt females gave	20 ... 20	2 ... 2			22 ... 22	31 108 139		31 108 139
Male 10/130.370d (Ca + m b si +) × related btbt gave × four unrelated non-bt females gave	7 ... 7	8 ... 8			15 ... 15	44 45 89		44 45 89

The following explanation appears, at first, to be sufficient :
A mutation may have occurred in the production of chromosome VI in two of the gametes from the non-Ca parent. These mutant gametes may have carried either Caracul, or another dominant curling factor, here given the symbol “K”, closely linked to Ca.
However, on further inspection of the data, it is apparent that a mutational explanation suffices for only one anomalous male’s performance. For as regards the bt locus, the two males bred very differently (see table). 370d produced eight belted offspring by its related btbt mate, thereby demonstrating that it possessed a bt chromosome from the btbt parent in which the Ca or K mutation is supposed to have occurred. But its sib 370c, by a similar mate, produced only two belted offspring out of twenty-two classified for this factor, a very poor fit to the half expected. Moreover, the belt of one of these

offspring was poorly expressed and the bearer could be construed as a heterozygote. There is no record of the appearance of the belt of the second offspring, but heterozygous penetrance of *bt* is sufficiently common for one to conjecture that this mouse was a heterozygote also. If, then, it may be said that 370c produced *no* homozygous belted out of twenty-two, it is not clear what happened to the *bt* chromosome this mouse should have received from its *btbt* father. If a mutational explanation is to be used, one must suppose that two mutations occurred simultaneously in this chromosome, one from normal to *Ca* and one from *bt* to normal.

An explanation for 370c which requires no mutations at all is as follows.

The 370c zygote may never have received the $+bt$ chromosome from its father, and the $Ca+$ one from its mother may have been doubled; or it may have lost the $+bt$ chromosome at some time during the early mitotic divisions. Or, if the two apparently belted offspring which 370c produced were actually homozygotes, one may say that the $+bt$ chromosome was not lost, but that it contained some defect which either tended to prevent it from reaching the gametes of 370c or tended to prevent those gametes containing it from reaching the ova of the *btbt* mate. The two *bt* gametes which did fertilise these ova must then have been *Ca bt*, that is, crossovers. (This supposition is consistent with the known *Ca-bt* value for males, 11.09 per cent., Mallyon, 1951). This suggests that the defect was carried in the segment between the *Ca* and *bt* loci. Since the *bt* received by the sib 370d apparently segregated normally, one may suppose that the *btbt* father was at worst heterozygous for the defect. It is conceivable that the same agent was responsible for the mutation to *Ca* or *K* in one chromosome of the *btbt* mouse and for the defect in the other.

To sum up, the anomalous facts are as follows. Two *Ca* males from a coupling backcross of *Ca* and *bt* produced nothing but *Ca* offspring. One male, mated in a backcross, segregated 1 : 1 in normal and belted, while the other, similarly mated, gave only two doubtful belted out of twenty-two classified. These, and the explanations discussed here, may be graphically represented as follows :

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REFERENCE

- MALLYON, S. A. 1951. A pronounced sex difference in recombination values in the sixth chromosome of the house mouse. *Nature*, 168, 118.