

JOHN INNES HORTICULTURAL INSTITUTION  
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13th. May 1939

Dear Professor,

Enclosed is a copy of the dog report as sent to Catchside for printing. I hope you approve. Minor alterations could, of course, be made in the proofs.

I hope to come up to the Galton Lab either this week or next and will then get your advice on my drafts of placards for the Edinburgh exhibit.

Yours sincerely,

*K. Maclure*

RESEARCH ON DOGS.

IN January 1937 the Committee on the Genetics of Dogs reported to the Society that the foundation stock, a dog and bitch of each of the breeds Manchester Terrier and lemon and white <sup>l</sup>Wes~~h~~ Cocker Spaniel, had been purchased and that the first litter of the cross Terrier by Spaniel had been raised at the Galton Laboratory.

Since that date a number of other litters have been obtained including five from backcross matings and one  $F_2$ . Thus it now seems worth while to review the information that has accrued from these animals, especially as some of the segregations have not conformed to simple expectation, thus rendering essential more extensive test crosses.

Though seven litters have been raised from the initial ~~crosses~~ Terrier by Spaniel at the Galton Laboratory and Spaniel by Terrier at the Institute of Animal Genetics, Edinburgh, the number of  $F_1$  bitches placed out for further breeding has not been quite so large as was hoped. The proportion of bitches in the litters has been somewhat below the expected half, though not significantly so, and of these some animals have died. There are, however, five females from the former and two from the latter cross now placed with cooperators. It is hoped that these numbers will be augmented in the near future. In addition to these bitches, three  $F_1$  dogs have been retained for the purpose of raising  $F_2$ s. ~~As due course.~~

Both of the initial crosses have shown segregation. ~~in~~ The cross Terrier by Spaniel has given results which indicate segregation for two easily classifiable factors, in addition to sex, and there is the possibility of two more. There are eight bitches and twelve dogs so far in this  $F_1$ , of which nine have been devoid of white, except for small patches on the feet, muzzle and chest, the remaining eleven being white with more or less extensive coloured areas. The sixteen animals, seven

females and nine males, raised at Edinburgh have all been of the former type with very little white in their coats. Thus there is good reason to postulate a recessive gene for piebald, as is found in many other mammals. The Spaniels are homozygous for the recessive, the Terriers being heterozygous and homozygous not pied respectively.

The other clear segregation in the Galton Laboratory  $F_1$  is for the presence of tan markings. Among nineteen animals available for tan classification there have been nine with black areas on which tan points could be seen, especially over the eyes in the ears, round the feet and beneath the tail, while the remaining ten were black without any tan. As all the Edinburgh dogs seem devoid of tan, it would appear that the presence of tan points is due to a recessive. The Terriers were black and tan, so being recessive, while the Spaniels must be homozygous and heterozygous not tan respectively.

A third possible factor in the London material is one for the presence or absence of coloured speckles on the white areas of the body. Such speckling is characteristic of Spaniels and is perhaps absent in the Terriers, though the absence of white areas on their coats makes diagnosis difficult or impossible. So far eight of the London  $F_1$  have shown marked speckling, the other nine having little or no markings of this kind (three died too young to be classified as speckle does not develop under the age of three weeks). The character is, however, difficult to classify with certainty and the results must be treated with caution at present.

Table 1.  
Cross Manchester Terrier female by Cocker Spaniel male  
(self, black and tan) (pied lemon and white)

Litter	Total	Manchester Terrier female		Cocker Spaniel male			
		Female	Male	Self	Pied	Black	Black and tan
1	5	1	4	2	3	1	4
2	5	3	2	1	4	4	1
43	37	15	22	15	22	5	22
Total	201	8	12	9	11	10	9

All are black and short haired

*See for over body  
of  
see table  
in original  
Dwy report.  
(K11)*

Table 2

Cross Cocker Spaniel female by Manchester Terrier male  
( lemon and white pied) ( self black and tan)  
long hair short hair)

Litter	Total	Female	Male	Short hair	Long hair
1	4	1	3	2	2
2	7	3	4	2	5
3	5	3	2	3	2†
Total	16	7	9	7	2† 7

All were self black

In the Edinburgh material another segregation has been observed. All the London F<sub>1</sub> have short hair but at Edinburgh 7 have short and the other seven long hair ( two were unclassifiable owing to premature death). Thus it would appear that the Spaniels carry a recessive long haired gene while <sup>for which</sup> the Terriers may or may <sup>not</sup> be heterozygous for it.

Table 3

Cross Edinburgh F<sub>1</sub> female by Manchester Terrier male  
(self, black short) (self, black and tan, short)

Litter	Total	Females	Male	Short hair	Long hair	Black	Black and tan
1	6	3	3	5	1	3	3
2	7	1 5†	1	2	3†	3	4
Total	13	4 5†	4	7	3†	6	7

All are self

The backcross litters so far obtained have confirmed some of the above interpretations. The first of these to be considered are two of six and seven respectively from the mating of a smooth black <sup>self</sup> bitch from the Edinburgh F<sub>1</sub> back to her smooth black and tan self father. No piebalds appeared in these litters ( the father is homozygous self - see above) but seven had tan points and out of ten classified for hair three were long. This is in keeping with the supposed constitutions of the animals as inferred from the F<sub>1</sub>. The bitch is heterozygous for long hair and recessive tan. Thus the segregations would represent 1:1 and 3:1 respectively.

The other three backcross litters of eight ( five females), six( 1 female) and ten ( 5 females) were from the matings of smooth

Table 4

Cross London F<sub>1</sub> females (two) by Cocker Spaniel male  
(short, pied, black and tan) (long, pied, lemon)

Litter	Total	Female	Male	Black	Black and tan	Brown	Short	Long hair
1	8	5	3	3	3	2	6	2
2	6	1	5	1	3	2	5	1
3	10	5	5	3	6	1	6	4
Total	24	11	13	7	12	5	17	7

All are pied

piebald tan marked bitches of the London F<sub>1</sub> back to their lemon pied long haired father. All were piebald as expected, but nineteen had black as the chief coat colour, only 5 having brown. Of the blacks twelve had tan points. The tan segregation agrees with a 1:1 such as would be expected from crossing recessive daughters back to their heterozygous father. The brown segregation is clear, <sup>but</sup> though there is a definite shortage of brown animals as compared with the simple expectation of 1:1. It may be said that the lemon of the male is due in part at least to a recessive brown present in the Spaniels but not in the Terriers. There may possibly be duplicate factors for brown, so giving a 3:1 on backcrossing. There have been seventeen short and seven long haired animals in these backcrosses. A 1:1 might have been expected on the basis of a single factor as the father is long and his daughters necessarily heterozygous (see also the Edinburgh results). Though, as in the case of brown, there is shortage of recessives, the observed segregation is a more tolerable fit with such expectation. Whatever the genetical complications there can be no doubt about the recording <sup>as</sup> and this character is very clear at three weeks of age.

Table 5

Cross pied London F<sub>1</sub> female by London F<sub>1</sub> male  
(pied black smooth) (self, black and tan, smooth)

Litter	Total	Females	Male	Self	Pied	Black	Black and tan	Short	Long
1	5	1	4	3	2	2	1	4	1

The evidence with regard to speckling in the backcrosses is far from clear, and more data must be obtained before any definite opinion may be formed. There is also some indication of a factor for head spotting and this will be followed up further.

The single  $F_2$  litter requires little comment since it agrees well with expectation based on the  $F_1$  data. Browns are expected to form proportion of such animals but none appeared in the five of this litter. This is not surprising in view of the backcross results.

There has, as yet, been little evidence of simple differences in structural characters, such as ear length and carriage, though of six available animals of the Edinburgh backcross, two were classified as having pendulous and four semi-erect ears.

There may be a congenital lethal showing in the Edinburgh backcross. Of the first litter two died out of six, and of the second five out of seven. A post mortem on a nine day old pup showed, in sections prepared from the heart, abnormalities of the myocardium, and, in sections from the kidneys, malformation of the tubules. Bacteriological examination for the presence of pathogenic organisms proved negative.

#### SUMMARY

Thirteen litters have so far been obtained four from the cross Terrier by Spaniel, and three from the reciprocal, five from backcrosses of  $F_1$  bitches to their fathers and one from interbreeding  $F_1$  animals. Clear segregations have been observed for (a) piebald as opposed to self colour, (b) tan markings as opposed to their absence (c) brown as opposed to black colour (d) long as opposed to short hair. The first two show good agreement with unifactorial expectation, but the others show a shortage of recessives, at least in some litters, <sup>This</sup> possibly indicating <sup>es</sup> duplicate factors. Factors for coloured speckles and coloured head spots on pied animals are suspected.