38. On *Heterochromia Iridis* in Swine.

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The wall or spotted eye or the total and partial absence of melanin pigments in the iris stroma is of some frequent occurrence in the animal kingdom, viz. in the axolotle, frog, pigeon, rabbit, rat, cat, dog, swine and horse. So far as I am aware, Eberwein (1920) puts on record 10 cases of albinotic eye out of 196 Meissn-swine, of which 6 have the said eye on both sides (1 is partially albinotic) and 4 have it on one side only. While working at swine for the last three years, I encountered a vast number of examples, upon which the present account is based.

When glancing at the state in distribution of melanin pigments in the iris stroma, we can distinguish the following three types:

i) The duplex type (Hurst, 1908), abbr. "D", which contains melanin pigments in the iris stroma, as well as in the retina.

ii) The simplex type (Hurst, 1908), abbr. "S", which is entirely devoid of melanin pigments in the iris stroma.

iii) The intermediate type (Yoshikawa, 1933), abbr. "M", which is partially devoid of melanin pigments in the iris stroma, showing various intergrades between the above two types, as in Fig. 1.

Fig. 1. Various intermediate iris types in the Yorkshire (a—t), the LY×Y hybrid (u and v) and the Large Yorkshire (w). a, c, n, q, s and u are the right eyes, while the others are the left.

In swine these three types appear in such nine combinations as D-D, S-S, D-S, S-D, S-M, M-S, D-M, M-D and M-M, the first letters referring always to the right eye. Strictly speaking, the latter seven combinations represent all cases of the heterochromia iridis. The so-called red eye, which entirely devoid of melanin pigments in the stromal and retinal layers, was not brought under my observation; consequently it was left out of consideration here.

So far as my observation goes, the iris colour of such *coloured* breeds as the Berkshire, Poland China and Duloc Jersey, and *coloured* hybrids, whether their coat is self-coloured or not, invariably belongs to the D-D type.

In the Yorkshire, one of the *white* breeds, the simplex eye and heterochromia iridis are of very frequent occurrence, as is shown in Table I and Fig. 1, a—t. The essential characteristics run as follows:—

TABLE I. Iris colour in the Yorkshire.

Crosses of different iris types.	D-D		D-S		S-S		S-D		S-M		M-S		M-M		M-D		D-M		Sum	
♀ × ♂	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
D-D × D-D	51	41		1		1	2	1	1	1							2	1	56	46
S-D × D-D	6	7	2	2			1		1								1		11	9
S-S × D-D	12	10	1	4	3	1	2	2		1		2		1			1	1	19	22
D-D × S-S	39	30	10	8	5	8	9	1			2				3	1	2	1	70	49
D-S × S-S		2	1	1	1	1													2	4
S-D × S-S		2			4	4	1		1	1	1	1			1				8	8
S-S × S-S	7	4	1	2	4	1	2	1	2	2	1				1	2			20	11
M-D × D-D	4	5											1						5	5
M-M × D-D	11	11	2				3		1				3	4			2		18	19
S-M × D-D	2	8	1	2	4		1				2				1				10	11
S-M × S-S	7	3	2	1	7	2					1		1						17	7
M-M × S-S	5	2	7	3	6	8	4	1	2	2	3	3	4	2	2	2	3	2	36	25
M-D × S-S	15	5	5	3	4	9	1		2				5		1	3	2	1	35	21
D-D × S-M	23	17		1	3	2	1	1	1	3	1	3	2				2	2	33	29
S-D × S-M					1	1	1		1		1				1				3	3
S-S × S-M	1				1	4	1		2	3	1			3			1		6	11
S-M × S-M	2	2	1	1	6	4		1		1		1	1		1		1		11	11
M-M × S-M	4	3	1		5	2	1		1	2	2	1	6	2	1	3	1		22	13
M-D × S-M	7	9	1	1	3		2	1	2	1	2		1		1				18	13
Sum	196	161	35	30	57	48	28	13	15	19	16	12	23	14	12	10	18	10	400	317
Total Sum	357		65		105		41		34		28		37		22		28		717	
%	49.791		9.066		14.644		5.718		4.742		3.905		5.160		3.068		3.905		100.000	

N. B. For mating were employed 23 sows (D-D 9, S-S 2, D-S 1, S-D 1, S-M 3, M-D 3 and M-M 4) and 5 boars (D-D 2, S-S 2 and S-M 1).

- a) In the cross $D-D \times D-D$, $D-D$ shoats amount to 90.196%.
- b) In the cross $S-D \times D-D$, $D-D$ decreases to 65.000%, in association with the production at 20.000% of $D-S$.
- c) In the crosses $D-D \times S-S$ and $S-S \times D-D$, there are produced 56.875% of $D-D$, 10.625% of $S-S$, 14.375% of $D-S$, 8.750% of $S-D$ and 9.375% of the heterochromia relating to the M -type.
- d) Small as the material is, the $S-S$ type, in the crosses $D-S \times S-S$ and $S-D \times S-S$, tends to increase and amounts to 45.455%.
- e) In the cross $S-S \times S-S$, 35.484% of $D-D$ are obtained, in addition to 16.129% of $S-S$.
- f) In such crosses as $M-D \times D-D$, $M-M \times D-D$, $S-M \times D-D$, $D-D \times S-M$ and $M-D \times S-M$, $D-D$ appears in a large number.
- g) In such crosses as $S-M \times S-S$, $M-M \times S-S$, $M-D \times S-S$, $S-S \times S-M$, $S-M \times S-M$ and $M-M \times S-M$, $S-S$ increases to a considerable degree.
- h) The $M-M$ shoats are rather frequently produced from the crosses relating to $M-M$, such as $M-M \times D-D$, $M-M \times S-S$, and $M-M \times S-M$.
- i) The appearance of two sorts of heterochromia, $D-S$ and $S-D$, shows little difference at rate in the crosses relating to the M -type or not.
- j) In the crosses not relating to the M -type, $D-D$ and $S-S$ are abundantly produced, in company with the reduction of the heterochromia relating to the M -type, especially $M-M$. But the reverse is true of the crosses relating to the M -type.
- k) In swine, both the S - and M -types are of rather frequent appearance on the left side, and such two types of heterochromia as $S-M$ and $M-S$ appear at the same rate.

Noteworthy is it that various iris types different from those of the parents are thus raised.

The Large Yorkshire, another *white* breed, is generally of the $D-D$ type only (Yoshikawa, 1933 and Yoshikawa and Yoshida, 1934). In the hybridization with the non-duplex Yorkshire boar, however, the simplex eye and heterochromia are easily obtained, as is seen from Table II and Fig. 1, u and v. This frequent occurrence of the non-

TABLE II. Iris colour in the Yorkshire hybrids.

Crosses of forms of different iris types.	D-D	D-S	S-S	S-D	S-M	M-S	M-M	M-D	D-M	Sum
	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
$D-D(LY) \times S-S(Y)$	12 10	1	4 3	5 2				1	1	23 16
$D-D(LY) \times S-M(Y)$	6 11	2		1					1	7 14
$D-D(Y \times P) \times S-M(Y)$	2		4 1	1				1		5 4

N.B. LY denotes the Large Yorkshire, Y the Yorkshire and P the Poland China.

duplex iris appears to suggest the appearance of the same type in the Large Yorkshire (Yoshikawa, 1933). In fact I have recently had occasion to demonstrate one case of the heterochromia, S-M, in the *pure* Large Yorkshire male shoat (Fig. 1, w).

As regards other hybrids, I have obtained not only a *white* sow with the M-M type iris from the back cross of the Yorkshire and Berkshire [(B × Y) × B], but also some white shoats from the back cross of the Poland China and Yorkshire [(Y × P) × Y], as in Table II.

From a consideration of the above-mentioned facts, it may be stated that the appearance of the simplex eye and heterochromia stands in intimate relation to the *uniformly white* coat, whether swine are pure breeds or hybrids. As to the heredity factors of the iris colour of swine and especially of the heterochromia, however, I am not in a position to make any assertion.

Since Darwin, it is well known that the white cat with the blue eye is deaf, especially on the side with the said eye. In swine, however, no correlation seems to exist between the non-duplex iris and the acoustic disturbance.

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