SEGREGATION AND RECOMBINATION OF THE GENES FOR TINGED, BLOOD, BUFF, AND CORAL IN DROSOPHILA MELANOGASTER.

ROSCOE R. HYDE.

From the Department of Immunology, School of Hygiene and Public Health, Johns Hopkins University, Baltimore.

Contents.

In a previous paper I reported the origin of blood and tinged, two sex-linked eye mutants in Drosophila. Both mutants gave complete linkage with white, eosin and cherry and consequently formed with the red of the wild type a sextuple system of multiple allelomorphs. Safir and Lancefield later reported buff and coral, two other members of this system, as shown by their linkage to white. T. H. Morgan has kindly supplied me with stocks of buff and coral and this paper records the combinations made with these two stocks to my stocks of blood and tinged. The results of these crosses bear out the expectation that, since blood and tinged are allelomorphic to white and buff and coral are allelomorphic to white, the mutants buff, coral, tinged and blood should show allelomorphism to each other.

The evidence from such a system is significant as it bears on the nature of the change that takes place in the chromosomes of mutant stocks. If the different mutants are a result of losses of materials that lie at different levels on the sex-chromosome, then the wild type eye should result in the daughters on crossing any two of these mutants, since the daughter receives two sex-chromosomes and each would restore the missing allelomorph of the other. As a matter of fact the daughters from all combinations are com-

pounds, with eyes intermediate in color between the parent types. If the genes for these different eye colors are allocated at different levels on the sex chromosome there should appear among the grandsons eyes of the wild type as a result of the phenomenon of crossing over. The evidence presented from these combinations is consistant with that obtained from other tests in showing that this does not occur.

The nomenclature employed is that used in other publications for the members of this system.—white w, tinged wt, buff w^{bu}, eosin w^{e}, cherry w^{c}, coral w^{co}, blood w^{b}, red W.

The female is expressed by the formula XX, the male XO, consequently the formula for a tinged eyed female is wtwtXX, a tinged eye male wtXO.

The following tables give the results of the combinations made between the different members of this allelomorphic series. The genetic composition of the parents (P), the children (F_1), and grandchildren (F_2) are expressed in terms of the nomenclature stated above. The numbers indicate the number of flies realized from the different combinations.

1. *Linkage of Buff and Tinged*

(a) Buff ♀ by Tinged ♂.

P. $w^{bu}w^{bu}XX$. $w^{t}XO$

F_1. $w^{bu}w^{t}XX$ $w^{bu}XO$

(1). 52 58

(2). 200 185

(3). 406 301

F_2	$w^{bu}w^{bu}XX$	$w^{bu}w^{t}XX$	$w^{bu}XO$	$w^{t}XO$.
1	135		112	
1a	155		110	
2	84		56	
2a	58		28	
3	129		136	
3a	83		65	
4	136		118	
4a	45		53	
5	91		70	
5a	130		93	
6	75		115	
6a	85		96	
7	23		30	
7a	95		108	
Total	1324		1190	

The buff females and the tinged-buff compounds are practically inseparable. The two classes of males can be separated into buff and tinged males but are here classified together. The wild red eyed form did not appear in the F_1 or F_2 generation. The F_2 males and females show a slight variation in color although we were unable to separate the two on a color basis.

(b) Buff ♂ by Tinged ♀

P.	$w^{bu}XO$.	$w^{t}w^{t}XX$
F_1	$w^{t}w^{bu}XX$	$w^{t}XO$.
	(1) 30	31
	(2) 256	200
	(3) 94	85

The tinged males and the tinged-buff compound females of the F_1 are inseparable on a color basis as one might expect since the two colors are separated by such a small margin.

F_2	$w^{t}w^{t}XX$	$w^{t}w^{bu}XX$	$w^{t}XO$	$w^{bu}XO$.
1	72		48	
2	127		103	
3	113		65	
4	242		186	
5	68		47	
6	112		82	
Total	734		531	

The F_2 males can be separated with difficulty.

2. *Linkage of Buff and Blood.*

(a) Buff ♀ by Blood ♂.

P.	$w^{bu}w^{bu}XX$.	$w^{b}XO$
F_1	$w^{bu}w^{b}XX$	$w^{bu}XO$
	202	198

F_1 Females compounds uniform deep red—males like buff.

F_2	$w^{bu}w^{bu}XX$	$w^{bu}w^{b}XX$	$w^{bu}XO$	$w^{b}XO$
1	51	72	50	69
2	45	46	49	37
3	130	148	117	119
4	158	152	168	139
Total	384	418	384	364

Males and females in the F_2 are easily separated into the different classes.

(b) Buff ♂ by Blood ♀.

P. $w^{bu}XO$. $w^{b}w^{b}XX$

F^1 $w^{bu}w^{b}XX$ $w^{b}XO$

117 104

F_1 Males typical of blood eyes—light when young—turn very dark with age. Females lighter than blood and do not turn so dark with age.

F_2	$w^{b}w^{bu}XX$	$w^{b}w^{b}XX$	$w^{bu}XO$	$w^{b}XO$
1	79	83	60	58
2	66	79	45	54
3	139	182	147	112
4	79	67	74	77
Total	363	411	326	301

3. *Linkage of Coral and Tinged.*

(a) Coral ♀ by Tinged ♂.

P. $w^{co}w^{co}XX$. $w^{t}XO$

F_1	$w^{co}w^{t}XX$ 27		$w^{co}XO$ 22	
F_1 Flies	Lighter than coral stock		Same color as coral stock	
F_2	$w^{co}w^{co}XX$	$w^{co}w^{t}XX$	$w^{co}XO$	$w^{t}XO$
1	79	94	79	84
1a	78	70	75	56
1b	46	40	33	29
2	74	78	65	47
2a	57	62	62	58
3	40	43	51	54
Total	374	387	365	328

(b) Coral ♂ by Tinged ♀.

P. $w^{co}XO$. $w^{t}w^{t}XX$

F_1	$w^{t}w^{co}XX$ 44		$w^{t}XO$ 36	
F_2	$wtw^{t}XX$	$w^{t}w^{co}XX$	$w^{t}XO$	$w^{co}XO$
1	31	48	33	35
1a	63	60	61	60
1b	5	7	4	8
2	68	54	74	52
2a	68	68	53	61
2b	24	18	9	14
Total	259	255	234	230

4. *Linkage of Coral and Blood.*

(a) Coral ♀ by Blood ♂.

P. $w^{co}w^{co}XX$. $w^{b}XO$

F_1	$w^{co}w^{b}XX$ 18		$w^{co}XO$ 18	
F_1 Flies	Female just a hint lighter than male.		As these flies become older the sexes are indistinguishable.	
F_2	$w^{co}w^{co}XX$	$w^{co}w^{b}XX$	$w^{co}XO$	$w^{b}XO$
1	116		103	
1a	159		135	
2	49		81	
2a	180		178	
Total	945		497	

The two classes of males can be separated when young. Females cannot be separated with certainty. They show a variable range as is true of blood which overlaps the coral.

(b) Coral ♂ by Blood ♀.

P. $w^{co}XO$. $w^{b}w^{b}XX$

F_1	$w^{b}w^{co}XX$ 18		$w^{b}XO$ 17	
F_1 Flies	Females and males same color; dark as males. A mere hint that females are lighter.			
F_2	$w^{b}w^{b}XX$	$w^{b}w^{co}XX$	$w^{b}XO$	$w^{co}XO$
1	103		116	
1a	143		107	
1b	21		27	
2	162		146	
2a	126		122	
2b	82		70	
Total	637		588	

5. *Linkage of Coral and Buff.*

(a) Coral ♀ by Buff ♂.

P. $w^{co}w^{co}XX$. $w^{bu}XO$

F_1	$w^{co}w^{bu}XX$ 31		$w^{co}XO$ 29	
F_1 Flies	Much lighter than coral		Same color as stock coral.	
F_2	$w^{co}w^{co}XX$	$w^{co}w^{bu}XX$	$w^{co}X0$	$w^{bu}XO$
1	57	40	49	44
1a	50	56	45	40
Total	107	96	94	84

(b) Coral ♂ by Buff ♀.

P. $w^{co}XO$. $w^{bu}w^{bu}XX$

F_1	$w^{bu}w^{co}XX$ 44		$w^{bu}XO$ 37	
F_1 Flies	Lighter than buff Lighter than coral Lighter than blood?		Same color as buff stock.	
F_2	$w^{bu}w^{bu}XX$	$w^{bu}w^{co}XX$	$w^{bu}XO$	$w^{co}XO$
1	57	41	46	45
1a	253	233	239	277
1b	45	25	33	29
2	198	203	166	175
2a	20	19	29	20
Total	573	521	513	446

Compound ♀ much lighter than ♂.

6. *Linkage of Tinged and Blood.*

(a) Tinged ♀ by Blood ♂.

P. $w^{t}w^{t}XX$. $w^{b}XO$

F_1	$w^{t}w^{b}XX$ 33		$w^{t}XO$ 2)	
F_1 Flies	All lighter than blood, but darker than tinged.		Males like tinged stock.	
F_2	$w^{t}w^{t}XX$	$w^{t}w^{b}XX$	$w^{b}XO$	$w^{t}XO$
1	74	98	71	78
1a	109	105	104	97
2	37	36	21	32
2a	57	52	46	63
2b	29	22	26	28
Total	306	313	268	298

(b) Tinged ♂ by Blood ♀.

P. w^tXO . w^bw^bXX

F_1	w^tw^bXX 18		w^bXO 17	
F_1 Flies	Females much lighter than males.		Typical of blood stock Sexes easily separated on color basis.	
F_2	w^bw^bXX	w^bw^tXX	w^bXO	w^tXO
1	52	55	41	45
1a	68	68	47	61
1b	9	9	5	4
2	35	31	42	47
2a	164	160	112	136
2b	45	45	26	33
Total	373	368	273	326

7. *Linkage of Coral to Eosin.*

(a) Eosin ♀ and Coral ♂.

P. $w^e w^e XX$. $w^{cu}XO$

F_1	$w^e w^{cu} XX$ 108 200		$w^e XO$ 94 200	
F_1 Flies	Indistinguishable from coral compound does not seem to modify.		Typical of eosin; slight color change with age.	
F_2	$w^e w^e XX$	$w^e w^{cu} XX$	$w^e XO$	$w^{cu} XO$
9a	60	55	60	57
	40	54	71	47
11a	30	30	24	35
	60	68	65	70
11b	15	10	14	16
	62	60	59	48
F_2 Flies	Like Eosin ♀ ♀	Slightly darker than ♀ but not as dark as males.	Like eosin ♂ .	Much like blood when old but not as dark

(b) Eosin ♂ by Coral ♀.

P. $w^{e}XO$. $w^{co}w^{co}XO$

F_1	$w^{e}w^{co}XX$ 125		$w^{co}XO$ 115	
F_1 Flies	The eye colors are hard to distinguish. The females seem to be a little lighter than the males; darker when old.			
F_2	$w^{co}w^{co}XX$	$w^{co}w^{e}XX$	$w^{e}X$	$w^{co}X$
1		166	70	90
1a		59	36	40
1b		107	17	34
2		196	98	97
3		87	40	50
3a		80	31	41
Total		695	292	352

8. *Summary.*

The genes for buff and coral known to be allelomorphic to white have here been tested with tinged and blood, two other genes allelmorphic to white. The expectation is that since both are allelomorphic to white, they will be allelomorphic to each other. The results of the different combinations made verify the expectations. Sufficient evidence has accumulated to show that these are members of the same allelomorphic series. The fact that the red eyed fly does not appear in the F_1 or F_2 bears out the assumption that the different members of this multiple allelomorph series are but different expressions of the same material particle and that they occupy identical loci on the sex-chromosome.

9. *Literature.*

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