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FURTHER DATA ON THE CROSSING OF ALBINO RING DOVES WITH WHITE ONES*

MASAHARU TANGE

INTRODUCTION

In the previous paper on the studies ot the sex-linked inheritance of plumage color in the ring dove, the writer (Tange, 1934) reported the results of crossing albino ring doves (which had mutated to blond ones in his aviary and were named by him "Albino I") with white ones. This cross breeding produced colored or blond individuals in F_1; that is, blond females and blond males in equal number from the crossing of a white female with an albino male, and white females and blond males in equal number from the crossing of an albino female with a white male. The results from these studies in addition to those obtained by crossing blond ring doves with white ones, so far as the plumage color was concerned, may be designated by the following genetic formulae:

Blond ring doves: $♀ = CCZ^IW$, $♂ = CCZ^IZ^I$;
White ring doves: $♀ = CCZ^iW$, $♂ = CCZ^iZ^i$;
Albino ring doves: $♀ = ccZ^IW$, $♂ = ccZ^IZ^I$.

He also considered another kind of albino ring doves, which he named "Albino II", of the genetic formulae, $♀ = ccZ^iW$ and $♂ = ccZ^iZ^i$, that was expected to be bred. The data presented

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here are those of F_2's obtained by crossing the albino ring doves ("Albino I") with white ones, as well as those obtained by crossing individuals which were mainly raised out of the offspring of albino ring doves crossed with white ones.

Material and Methods

The birds used here are the white and albino ring doves above-named and the cross-bred ones obtained by crossing albino ring doves with white ones. All of them were reared in the writer's aviary and the pedigrees are known in full.

The methods of keeping birds, rearing squabs, and discriminating individuals are the same as described in the previous paper published in 1934.

Experimental Results

Some of the data concerning F_1 were presented in the previous paper: when an albino male was crossed with a white female the sons and daughters were all blond, while in the reciprocal cross, *i.e.*, a white male crossed with an albino female produced blond sons and white daughters. Further data concerning F_1, which have been obtained by continued crossing experiments show the same results, and are presented here in addition to the data concerning F_2, and others.

(A) White ♀ × Albino ♂

(a) F_1

Table 1.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ CC 95 (W)* / ♂ DD 62 (A)	7	8	0	0	0	0	15
♀ CC 95 (W)** / ♂ EE114 (A)	23	28	0	0	0	0	51

* The same pair and number of offspring as described in the previous paper (Tange, 1934).

**The same pair as described in the previous paper, but the number of offspring increased.

W=white, A=albino, H.W=hybrid white, H.B=hybrid blond.

♀ BB 5 (W) / ♂ EE 118 (A)	20	19	0	0	0	0	39
♀ CC 185 (H.W)* / ♂ EE 32 (A)	1	3	0	0	0	0	4
♀ BB 65 (H.W) / ♂ EE 32 (A)	9	14	0	0	0	0	23
♀ CC 56 (H.W) / ♂ EE 32 (A)	7	5	0	0	0	0	12
♀ CC 56 (H.W)' / ♂ GG 7 (A)	48	44	0	0	0	0	92
Totals	115	121	0	0	0	0	236
Expected	118.0	118.0	0	0	0	0	236
Standard error	±7.68	±7.68					

(b) F_2

Table 2.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ FF 263 (H.B) / ♂ FF 227 (H.B)	1	5	0	0	1	0	7
♀ FF 263 (H.B) / ♂ GG 64 (H.B)	0	1	0	0	0	1	2
♀ FF 263 (H.B) / ♂ HH 163 (H.B)	11	35	23	0	16	17	102
♀ GG 134 (H.B) / ♂ GG 133 (H.B)	15	27	14	0	5	10	71
♀ GG 134 (H.B) / ♂ HH 116 (H.B)	12	9	6	0	4	8	39
♀ EE 88 (H.B) / ♂ FF 192 (H.B)	5	2	2	0	0	1	10
♀ GG 61 (H.B) / ♂ GG 62 (H.B)	20	40	25	0	14	18	117
♀ EE 187 (H.B) / ♂ EE 186 (H.B)	4	6	0	0	4	2	16
♀ EE 183 (H.B) / ♂ EE 182 (H.B)	14	21	9	0	11	15	70
♀ NN 93 (H.B) / ♂ EE 182 (H.B)	3	3	0	0	0	0	6
♀ EE 248 (H.B) / ♂ FF 14 (H.B)	3	5	4	0	6	4	22
♀ EE 248 (H.B) / ♂ GG 141 (H.B)	16	26	11	0	10	8	71
♀ MM 83 (H.B) / ♂ EE 182 (H.B)	7	12	9	0	1	1	30
♀ EE 249 (H.B) / ♂ GG 8 (H.B)	18	39	15	0	9	17	98
Totals	129	231	118	0	81	102	661
Expected	$123\frac{15}{16}$	$247\frac{14}{16}$	$123\frac{15}{16}$	0	$82\frac{10}{16}$	$82\frac{10}{16}$	661
Standard error	±10.03	±12.45	±10.03		±8.50	±8.50	

(B) Albino ♀ × White ♂

(a) F_1

Table 3.

Pair	Blond ♀	Blond ♂	White ♀	White ♂	Albino ♀	Albino ♂	Totals
♀ CC 215 (A)* / ♂ CC 96 (W)	0	3	3	0	0	0	6
♀ CC 215 (A)** / ♂ BB 11 (W)	0	29	26	0	0	0	55
♀ CC 214 (A)** / ♂ BB 54 (W)	0	25	22	0	0	0	47
♀ II 31 (A) / ♂ BB 54 (W)	0	2	2	0	0	0	4
Totals	0	59	53	0	0	0	112
Expected	0	56.0	56.0	0	0	0	112
Standard error		±5.29	±5.29				

(b) F_2

Table 4.

Pair	Blond ♀	Blond ♂	White ♀	White ♂	Albino ♀	Albino ♂	Totals
♀ FF 269 (H.W) / ♂ FF 67 (H.B)	14	21	23	21	9	12	100
♀ FF 148 (H.W) / ♂ FF 147 (H.B)	33	21	30	21	13	27	145
♂ FF 68 (H.W) / ♀ EE 139 (H.B)	13	14	15	20	8	6	76
♀ HH 22 (H.W) / ♂ EE 139 (H.B)	13	12	10	11	8	12	66
♀ FF 1 (H.W) / ♂ EE 57 (H.B)	22	11	11	17	19	16	96
♀ FF 66 (H.W) / ♂ EE 194 (H.B)	8	5	6	8	11	8	46
♀ FF 66 (H.W) / ♂ HH 100 (H.B)	19	8	17	12	11	7	74
♀ HH 161 (H.W) / ♂ FF 195 (H.B)	14	18	17	17	16	8	90
♀ HH 142 (H.W) / ♂ FF 195 (H.B)	6	6	5	3	3	2	25
Totals	142	116	134	130	98	98	718
Expected	$134\frac{10}{16}$	$134\frac{10}{16}$	$134\frac{10}{16}$	$134\frac{10}{16}$	$89\frac{12}{16}$	$89\frac{12}{16}$	718
Standard error	±10.46	±10.46	±10.46	±10.46	±8.86	±8.86	

* The same pair and number of offspring as described in the previous paper.

**The same pair as described in the previous paper, but the number of offspring increased.

(C) Miscellaneous Crossing

(a) F_1 white ♀ of Section B.a. × "Albino I" ♂

Table 5.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ FF 272 (H.W) / ♂ FF 197 (A)	4	5	0	0	10	5	24
♀ FF 191 (H.W) / ♂ EE 230 (A)	30	31	0	0	30	24	115
Totals	34	36	0	0	40	29	139
Expected	$34\frac{3}{4}$	$34\frac{3}{4}$	0	0	$34\frac{3}{4}$	$34\frac{3}{4}$	139
Standard error	±5.11	±5.11				±5.11	±5.11

(b) "Albino I" ♀ × F_1 blond ♂ of Section B.a.

Table 6.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ EE 47 (A) / ♂ EE 56 (H.B)	5	17	6	0	12	10	50
Expected	$6\frac{2}{8}$	$12\frac{4}{8}$	$6\frac{2}{8}$	0	$12\frac{4}{8}$	$12\frac{4}{8}$	50
Standard error	±2.34	±3.06	±2.34		±3.06	±3.06	

(c) F_2 albino ♀ × White ♂.

(i) F_2 albino ♀ of Section A.b. × White ♂.

Table 7

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ HH 36 (A) / ♂ CC 184 (W)	0	2	2	0	0	0	4
♀ HH 36 (A) / ♂ BB 54 (W)	0	2	2	0	0	0	4
♀ GG 4 (A) / ♂ DD 198 (W)	0	51	57	0	0	0	108
Totals	0	55	61	0	0	0	116
Expected	0	58.0	58.0	0	0	0	116
Standard error		±5.39	±5.39				

(ii) F_2 albino ♀ of Section B.b. × White ♂.

Table 8.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♂ GG 37 (A) / ♂ DD 198 (W)	0	0	4	2	0	0	6
♀ HH 37 (A) / ♂ CC 184 (W)	0	0	5	7	0	0	12
♀ HH 72 (A) / ♂ CC 184 (W)	0	0	1	1	0	0	2
Totals	0	0	10	10	0	0	20
Expected	0	0	10.0	10.0	0	0	20

(d) White ♀ × F_2 albino ♂ of Section B.b.

Table 9.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ BB 52 (W) / ♂ GG 22 (A)	0	0	6	6	0	0	12
Expected	0	0	6.0	6.0	0	0	12

(e) "Albino II" ♀ × White ♂

Table 10.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ KK 22 (A) / ♂ BB 54 (W)	0	0	8	8	0	0	16
Expected	0	0	8.0	8.0	0	0	16

(f) "Albino II" ♀. × Parent of albino mutants.

Table 11.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ JJ 5 (A) / ♂ BB 61 (B)	8	11	0	0	13	8	40

♀ JJ 92 (A) / ♂ BB 10 (B)	11	18	0	0	9	15	53
Totals	19	29	0	0	22	23	93
Expected	$23\frac{1}{4}$	$23\frac{1}{4}$	0	0	$23\frac{1}{4}$	$23\frac{1}{4}$	93
Standard error	±4.18	±4.18			±4.18	±4.18	

(g) F_1 white ♀ of Section B.a. × Albino ♂ of Section C.b.

Table 12.

Pair	Blond		White		Albino		Totals
	♀	♂	♀	♂	♀	♂	
♀ FF 271 (W) / ♂ FF 193 (A)	8	5	9	6	13	20	61
Expected	$7\frac{5}{8}$	$7\frac{5}{8}$	$7\frac{5}{8}$	$7\frac{5}{8}$	$15\frac{2}{8}$	$15\frac{2}{8}$	61
Standard error	±2.58	±2.58	±2.58	±2.58	±3.38	±3.38	

(D) Pure Breeding of "Albino II"

Table 13.

Pair	Albino		Totals
	♀	♂	
♀ HH 72 (A) / ♂ GG 22 (A)	41	49	90
♀ II 19 (A) / ♂ KK 4 (A)	13	17	30
♀ LL 32 (A) / ♂ MM 43 (A)	6	5	12
♀ LL 17 (A) / ♂ LL 45 (A)	21	26	47
♀ LL 2 (A) / ♂ LL 1 (A)	30	28	58
♀ KK 1 (A) / ♂ KK 28 (A)	26	25	51
Totals	137	150	287
Expected	143.5	143.5	287
Standard error	±8.47	±8.47	

(E) To Distinguish "Albino II" from "Albino I"

(i) To distinguish "Albino II" ♀ from "Albino I" ♀.

Table 14.

Pair	Blond		White		Totals
	♀	♂	♀	♂	
♀ HH 72 (A) / ♂ CC 133 (W)	0	0	1	1	2
♀ II 19 (A) / ♂ CC 133 (W)	0	0	1	1	2

Each of the birds ♀ HH 72 (A) and ♀ II 19(A) produced a white male offspring from the crossing with white male, and this enables us to regard the birds as "Albino II".

(ii) To distinguish "Albino II" ♂ from the Albino ♂ which is heterozygous with respect to the gene *I*.

Table 15.

Pair	Blond		White		Totals
	♀	♂	♀	♂	
♀ BB 52 (W) / ♂ KK 4 (A)	0	0	5	5	10
Expected	0	0	5.0	5.0	10
Standard error			±1.58	±1.58	

The results obtained from the crossing metioned above are enough to discriminate the bird ♂ KK 4 (A) to be the "Albino II" ♂, for the reason described in Section 3. a. ii. under Consideration (p. 140).

CONSIDERATION

(1) F_1 and F_2. The experimental results of crossing albino ring doves ("Albino I") with white ones were described in the previous paper, and assumptions were made: the blond color of plumage in the ring dove was due to two factors which were named by the writer "C" and "I", *C* being an autosomal color factor and responsible for developing the plumage color and eye

color characteristic to the white ring dove, I being a sex-linked intensity factor unable to exhibit any coloration by itself and causing the bird to remain an albino. The genetic formulae for the white and albino ring doves were designated as follows:

White ring doves: ♀ = CCZ^iW, ♂ = CCZ^iZ^i;
Albino ring doves: ♀ = ccZ^IW, ♂ = ccZ^IZ^I.

The results shown in Tables 1, 2, 3 and 4 may be interpreted by the following scheme of inheritance:

(A)

White ♀ × Albino ♂

P_1	CCZ^iW white ♀	×	ccZ^IZ^I albino ♂
P_1 gamets	(CW), (CZ^i)		(cZ^I)
F_1	CcZ^IW blond ♀ 1	:	CcZ^IZ^i blond ♂ 1
F_1 gametes	(CW), (cW), (CZ^I), (cZ^I)		(CZ^I), (CZ^i), $cZ^I)$, (cZ^i)

F_2	CCZ^IW blond ♀	CCZ^iW white ♀	CcZ^IW blond ♀	CcZ^iW white ♀
	CcZ^IW blond ♀	CcZ^iW white ♀	ccZ^IW albino ♀	ccZ^iW albino ♀
	CCZ^IZ^I blond ♂	CCZ^IZ^i blond ♂	CcZ^IZ^I blond ♂	CcZ^IZ^i blond ♂
	CcZ^IZ^I blond ♂	CcZ^IZ^i blond ♂	ccZ^IZ^I albino ♂	ccZ^IZ^i albino ♂

blond ♀ : blond ♂ : white ♀ : white ♂ : albino ♀ : albino ♂
3 : 6 : 3 : 0 : 2 : 2

(B)

Albino ♀ × White ♂

P_1	ccZ^IW albino ♀	×	CCZ^iZ^i white ♂
P_1 gametes	(cW), (cZ^I)		(CZ^i)
F_1	CcZ^iW white ♀ 1		CcZ^IZ^i blond ♂ 1

F_1 gametes	(CW), (cW), (CZ^i), (cZ^i)		(CZ^I), (CZ^i), (cZ^I), (cZ^i)	
F_2	CCZ^IW blond ♀	CCZ^iW white ♀	CcZ^IW blond ♀	CcZ^iW white ♀
	CcZ^IW blond ♀	CcZ^iW white ♀	ccZ^IW albino ♀	ccZ^iW albino ♀
	CCZ^IZ^i blond ♂	CCZ^iZ^i white ♂	CcZ^IZ^i blond ♂	CCZ^iZ^i white ♂
	CcZ^IZ^i blond ♂	CcZ^iZ^i white ♂	ccZ^IZ^i albino ♂	ccZ^iZ^i albino ♂

blond ♀ : blond ♂ : white ♀ : white ♂ : albino ♀ : albino ♂
3 : 3 : 3 : 3 : 2 : 2

As is shown in Tables 1, 2, 3 and 4, the actual numbers of offspring, *i.e.*, F_1 and F_2 *ex* White ♀ × Albino ♂ as well as those *ex* Albino ♀ × White ♂, are not far from the theoretical ones calculated upon the above scheme; deviations do not exceed three times the standard errors.

(2) Various Cases of Crossing. The results described in Tables 5, 6, 7, 8, 9, 10, 11 and 12 are obtained from the miscellaneous crossing, and may be interpreted by the same scheme as described above. Thus:

(a) F_1 white ♀ of Section B. a. × "Albino I" ♂. (Table 5).

The F_1 white ♀ is heterozygous with respect to the gene *C*, and produces four kinds of gametes instead of two (Cf. P_1 of Section A). Consequently there occurs both blond and albino offspring in F_1 when it is mated with "Albino I" ♂; it differs from F_1 *ex* pure White ♀ × "Albino I" ♂:

P_1	CcZ^iW		× ccZ^IZ^I	
P_1 gametes	(CW), (CZ^i), (cW), (cZ^i)		cZ^I	
F_1	CcZ^IW blond ♀	CcZ^IZ^i blond ♂	ccZ^IW albino ♀	ccZ^IZ^i albino ♂

The experimental results shown in Table 5 are in agreement with the theoretical expectation.

(b) "Albino I" ♀ × F_1 blond ♂ of Section B. a. (Table 6).

The F_1 blond ♂ is heterozygous with respect to genes *C* and

I, and generates four kinds of gametes. When it is crossed with all "Albino I" ♀ all appear blond, white and albino offspring, except white ♂.

P_1	ccZ^IW		×	CcZ^IZ^i	
P_1 gametes	$(cW), (cZ^I)$			$(CZ^I), (CZ^i), (cZ^I), (cZ^i)$	
F_1	CcZ^IW blond ♀	CcZ^iW white ♀		ccZ^IW albino ♀	ccZ^iW albino ♀
	CcZ^IZ^I blond ♂	CcZ^IZ^i blond ♂		ccZ^IZ^I albino ♂	ccZ^IZ^i albino ♂

blond ♀		blond ♂		white ♀		white ♂		albino ♀		albino ♂
1	:	2	:	1	:	0	:	2	:	2

The results shown in Table 6 agree with the theoretical expectation, although the actual numbers of progeny are not large.

(c) F_2 albino ♀ × White ♂. (Tables 7 and 8).

There are two kinds of F_2 albino ♀ *ex* both White ♀ × Albino ♂ and Albino ♀ × White ♂, and they are to be designated genetically as ccZ^IW and ccZ^iW as shown in the scheme described above. When they are crossed with White ♂, the former produces F_1's of blond ♂ and white ♀ in equal number, while the latter produces F_1's of white ♀ and white ♂ in equal number, no blond offspring at all in this case; for example, HH 36 shown in Table 7 is an F_2 albino ♀ of Section A. b. and GG 37 is an F_2 albino ♀ of Section B. b., the former is to be designated as ccZ^IW and the latter as ccZ^iW: there are F_2 albino ♀'s which are to be designated as ccZ^iW in Section A. b., and there are also F_2 albino ♀'s which are to be designated as ccZ^IW in section B.b. The scheme of inheritance is as follows:

(i) P_1	ccZ^IW	×	CCZ^iZ^i
P_1 gametes	$(cZ^I), (cW)$		(CZ^i)
F_1	CcZ^IZ^i blond ♂ 1		CcZ^iW white ♀ 1
(ii) P_1 gametes	ccZ^iW	×	CCZ^iZ
P_1 gametes	$(cW), (cZ^i)$		(CZ^i)
F_1	CcZ^iW white ♀ 1		CcZ^iZ^i white ♂ 1

All the results of crossing are in agreement with the theoretical expectation although the number of individuals is small.

The albino females lacking in *I* are the "Albino II" females named so by the writer.

(d) White ♀ × F_2 albino ♂ of Section B.b. (Table 9).

There are two kinds of F_2 albino ♂ of Section B.b., *i.e.*, ccZ^IZ^i and ccZ^iZ^i. When they are crossed with white ♀, the former produces both blond and white offspring, while the latter produces white offspring only; F_2 albino ♂ such as GG22 in Table 9 must be an individual of the genetic constitution of ccZ^iZ^i. The results of crossing white ♀ with F_2 albino ♂ of the genetic constitution of ccZ^IZ^i have not been obtained in the present crossing experiments.

(i) P_1	CCZ^iW		×		ccZ^IZ^i	
P_1 gametes	$(CW), (CZ^i)$				$(cZ^I)\,(cZ^i)$	
F_1	CcZ^IW blond ♀	CcZ^IZ^i blond ♂		CcZ^iW white ♀		CcZ^iZ^i white ♂
	1	: 1	:	1	:	1
(ii) P_1	CCZ^iW		×		ccZ^iZ^i	
P_1 gametes	$(CW), (CZ^i)$				(cZ^i)	
F_1	CcZ^iW white ♀				CcZ^iZ^i white ♂	
	1				1	

The results of crossing shown in Table 9 correspond to the scheme described in (ii) above; and the bird GG22 is to be regarded as an "Albino II" ♂.

(e) "Albino II" ♀ × White ♂. (Table 10).

As the albino ♀ KK22 shown in Table 10 is the female offspring *ex* ♀ HH72 (A) in Table 8 × ♂ GG22 (A) in Table 9, the former being of the genetic constitution of ccZ^iW and the latter of ccZ^iZ^i (Cf. the preceding Section), it belongs only to "Albino II", and the crossing of the present Section is identical with that of Section c. ii.

P_1	ccZ^iW	×	CCZ^iZ^i
P_1 gametes	$(cW), (cZ^i)$		(CZ^i)

F_1	CcZ^iW white ♀ 1	:	CcZ^iZ^i white ♂ 1

(f) "Albino II" ♀ × Parent of albino mutants. (Table 11).

As the male parent of albino mutants may be designated as CcZ^IZ^I (Tange, 1934), the results of crossing "Albino II" ♀ with the male parent are able to be explained by the following scheme of inheritance:

P_1	ccZ^iW	×	CcZ^IZ^I	
P_1 gametes	$(cW), (cZ^i)$		$(CZ^I), (cZ^I)$	
F_1	CcZ^IW blond ♀	CcZ^IZ^i blond ♂	ccZ^IW albino ♀	ccZ^IZ^i albino ♂
	1 :	1 :	1 :	1

The results of crossing are in approximate agreement with the theoretical expectation as shown in Table 11.

(g) F_1 white ♀ of Section B. a. × Albino ♂ of Section C. b. (Table 12).

The genetic constitution of the F_1 white ♀ of Section B. a. is CcZ^iW as shown above. There are two kinds of genetic constitution of albino ♂ of Section C. b., *viz.*, ccZ^IZ^I and ccZ^IZ^i, the former belonging to "Albino I". The male bird FF193 (A) in Table 12 is considered to be designated as ccZ^IZ^i instead of ccZ^IZ^I, because there occurred white offspring when it was crossed with female white bird, (Cf. Section C. a.). Thus:

P_1	CcZ^iW	×	ccZ^IZ^i	
P_1 gametes	$(CW), (cW), (CZ^i), (cZ^i)$		$(cZ^I), (cZ^i)$	
F_1	CcZ^IW blond ♀	CcZ^iW white ♀	ccZ^IW albino ♀	ccZ^iW albino ♀
	CcZ^IZ^i blond ♂	CcZ^iZ^i white ♂	ccZ^IZ^i albino ♂	ccZ^iZ^i albino ♂

blond ♀	blond ♂	white ♀	white ♂	albino ♀	albino ♂
1 :	1 :	1 :	1 :	2 :	2

The results of crossing shown in Table 12 are well explained by the scheme mentioned above, the actual numbers secured being not far from the theoretical ones; the deviations do not exceed three times the standard errors.

(3) The "Albino II" Individuals Breed True.

(a) To distinguish genotypically the "Albino II" from the "Albino I" by the progeny test. (i) To distinguish genotypically the "Albino II" ♀ from the "Albino I" ♀. This is simple since the "Albino I" ♀ produces male offspring of blond plumage color when it is crossed with White ♂, while the "Albino II" ♀ does not produce such colored offspring when crossed with White ♂ (Cf. Sections c.i., c.ii. and e.). The female birds HH72 (A) and II 19 (A) shown in Table 14 can be considered as individuals belonging to "Albino II", because both of them produced *male* offspring of white plumage color. (ii) To distinguish genotypically the "Albino II" ♂ (ccZ^iZ^i) from the "Albino I" ♂ (ccZ^IZ^I) as well as from the Albino ♂ which is heterozygous with respect to the gene *I*, *i.e.*, Albino ♂ designated as ccZ^IZ^i. The "Albino I" ♂ produces *blond* offspring only in F_1 when it is crossed with the white female as was shown in Table 1, while the "Albino II" ♂ produces *white* offspring only in F_1 when it is crossed with the white female as was explained in Section d. ii. Thus the "Albino II" ♂ may be distinguished from the "Albino I" ♂ without difficulty by the progeny test. We will consider next the method of distinguishing the "Albino II" ♂ from the Albino ♂ heterozygous with respect to the gene *I*. The Albino ♂ designated as ccZ^IZ^i produces both blond and white offspring in equal number as was shown in the scheme of inheritance described in Section d.i., while the "Albino II" ♂ produces white offspring only when crossed with the white female. So if the total number of offspring produced by an albino ♂ crossed with a white ♀ is at least 10 and all are white without exception, this enables us to determine the albino ♂ to be an "Albino II" ♂ and never to be an Albino ♂ of ccZ^IZ^i; thus the deviation and standard error of experiments calculated on the assumption that the ratio of the blond birds to the white ones which will be produced by crossing Albino ♂ of ccZ^IZ^i with white ♀ of CCZ^iW is 1:1, are ± 5.0 and ± 1.58, respectively; the deviation exceeds three times the standard error, so the experimental results, which secure 10 birds of white plumage without exception, are not explainable by the scheme of $CCZ^iW \times ccZ^iZ^i$ (Cf. Sections d. i. and d. ii.).

(b) The "Albino II" individuals breed true. An F_2 albino female HH72 was mated with an F_2 albino male GG22 as shown in Table 13, both of them being the progeny *ex* Albino ♀ × White ♂ of Section B, and having been shown, as mentioned above, that they are of the genetic constitution ccZ^iW and ccZ^iZ^i, respectively. They have bred 90 individuals up to the present, all albino, 41 being females and 49 males. The other five pairs shown in Table 13 are all the offspring *ex* HH72 × GG22. Two individuals ♀ II 19 as well as ♂ KK4 out of 10 have shown that they have no *I* gene in their genetic constitution as a result of crossing them with white birds as shown in Tables 14 and 15; the remaining eight individuals are sure to be of the same genetic constitution as the two. Thus a new kind of albino ring doves of the genetic constitution ♀ $= ccZ^iW$ and ♂ $= ccZ^iZ^i$ have been bred, and they breed true.

Summary and Conclusion

(1) Further data on the crossing of albino ring doves with white ones are presented in this paper.

(2) It is shown that the results of crossing experiments presented in this paper are all satisfactorily explained by the two-factor hypothesis brought forward by the writer (Tange, 1934). The blond color of plumage in the ring dove is developed by the combination of two factors: one being that which is responsible for the white plumage color and the dark eye color characteristic of the white ring dove, and the other being the intensity factor. The intensity factor can not develop coloration by itself, therefore it leaves the bird an albino with the snow-white plumage and the red eye. The two factors are the color factor *C* and the intensity factor *I*, the former being autosomal and the latter sex-linked as described in a paper published in 1934.

(3) Albino ring doves lacking both *C* and *I* factors and designated as ♀ $= ccZ^iW$ and ♂ $= ccZ^iZ^i$ have been bred by the present crossing experiments. They breed true and have established

another kind of albino ring doves which the writer named "Albino II"

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