

**The Correlation between the Orthodox and Steup's Systems
of Culling with Annual Egg Production**

by

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Introduction :

In judging the productiveness of poultry, the Orthodox and Steup's Systems are quite commonly used. The Orthodox System deals with certain external characteristics in connection with the egg production of the fowl, such as the distance between the pelvic bones, the distance between the pelvic and the keel bones, the pelvic condition, the color changes of the vent, shanks and skin, the condition of the body, the condition of the head parts, the condition of the molt, and the condition of the shanks. The Steup's System deals mainly with head point features, such as the flatness of the top of the skull, the width of the skull as carried forward, the head balance, and the levelness of the top of the head

However, there seems to be a question as to the reliability of these Systems; so it was deemed advisable to determine their accuracy. It is, therefore, the aim of this thesis to ascertain whether there is any correlation between the Orthodox and Steup's Systems with annual egg production.

Object :

The object of this thesis is to biometrically determine whether there is any correlation between the Orthodox and Steup's Systems with the first year's trap-nest record of the birds used in this investigation.

Plan of Work :

Measurements and descriptions of the birds involved in this investigation were taken under each of the two Systems. Individual egg records were obtained from one year's trap-nest record kept by the University of Arizona Poultry Department. Each character studied will be correlated with annual egg production. The original observations were made during the last week of the month of August.

Stock :

Ten characters in the Orthodox System and four characters in the Steup's System were observed on 142 Single Comb White Leghorns, 78 Single Comb Rhode Island Reds, and 8 White Minorca pullets, representing three different breeds; all of which were kept at the University of Arizona Poultry Plant.

General Discussion of Data

The band numbers in sequence, breed designation, and annual egg production of the 228 birds involved in this work are set forth in the list on pages 7 to 8.

Each of the 228 birds was studied in connection with the fourteen different characters mentioned in the introduction.

Each character was grouped appropriately, and then submitted to Pearson's method of correlation.

Pearson's Statistical Method

A few definitions are necessary at this point to help the reader in interpreting this statistical method.

Type is the ideal, or standard for selection.

Mode is the prevailing type, and is represented by the highest proportion of what the breeder actually produces.

Variability (σ) is deviation from type. It is best indicated by the standard deviation, a mathematical expression involving the deviation of every individual.

Mean (M) is merely a technical word for average.

A positive coefficient of correlation (r) is the tendency of the high value of one variable to go with the high value of the other variable.

A negative coefficient of correlation is the tendency of the high value of one variable to go with the low value of the other variable.

The probable error (P.E.) has no reference to errors in computations. If the whole poultry population was studied for certain characters, then there would be no probable error. It is merely an error that is likely to occur in a small sample like the one used in this work, namely 228 birds. It merely shows that the true value lies within the range set by \pm (P.E.). If the coefficient

of correlation be 1.00, and the probable error (P.E.) be ± 0.02 , then the chances are that the correct figure is not less than 0.98 (1.00-0.02) nor greater than 1.02 (1.00+0.02).

Pearson's method requires a frequency distribution for each of the characters studied, which in this case, happens to be 14 characters. The distribution of the different characters together with the annual production for 228 birds is set forth in Tables 1a to 14a.

The 228 birds were distributed in 13 production classes. The classes were grouped according to their range of production as follows :

<u>Range of annual egg production</u>	<u>Grouping</u>
40-59	60
60-79	80
80-99	100
100-119	120
120-139	140
140-159	160
160-179	180
180-199	200
200-219	220
220-239	240
240-259	260
260-279	280
280-299	300

Each character studied was divided into several grades, the lowest one denoting an excellent condition of the character, and the highest number in the grading indicating the poorest condition of the character. These grades were grouped according to their range as follows:

<u>Range of grade</u>	<u>Grouping</u>	<u>Range of grade</u>	<u>Grouping</u>
0 - 0.9	1	1.0-1.9	2

Range of grade (continued)

<u>Range of grade</u>	<u>Grouping</u>	<u>Range of grade</u>	<u>Grouping</u>
2.0- 2.9	3	3.0-3.9	4
4.0- 4.9	5	5.0-5.9	6
6.0- 6.9	7	7.0-7.9	8

The ranges for the annual egg production and the grade are necessary in computing for the true mean of both the annual egg production and the grade.

Explanation of the correlation tables

In the correlation tables set forth in Tables 1 b to 14 b the following symbols are used and are explained below :

- f = The frequency or distribution.
d = The deviation from the assumed mean.
 $\sum de.dg$ = The summation of the products of the deviation of egg production and the deviation of the grade.
189.5 = The assumed mean for egg production.
n = The number of individuals studied.
20 = Class interval in eggs.
e = Egg production.
g = Grade.

In order to obtain the values it was necessary to use the following formulas :

$$Me. = \text{True mean of egg production} \\ = 189.5 + \frac{\text{correction in assumed egg mean}}{n} \times 20$$

$$Mg. = \text{True mean of the grade} \\ = \text{Assumed mean for grade} + \frac{\text{correction in assumed g mean}}{n}$$

$$\sigma^2_e. = (\text{Standard deviation of eggs})^2 \\ = \frac{\sum ed^2}{n} - (\text{correction in assumed egg mean})^2 = x$$

$$\sigma_e. = \text{Standard deviation of eggs} = \sqrt{x} \\ \sigma^2_g. = (\text{Standard deviation of grade})^2 = \frac{\sum gd^2}{n} - (\text{correction in assumed grade mean})^2 = y$$

$$\sigma_g = \text{Standard deviation of grade} = \sqrt{y} \\ p = \frac{\sum de.dg}{n} \cdot \left\{ \frac{\text{correction in assumed egg mean}}{\text{assumed egg mean}} \right\} \cdot \left\{ \frac{\text{correction in assumed grade mean}}{\text{assumed grade mean}} \right\}$$

Formulas continued :

r = The coefficient of correlation = $\frac{D}{\frac{00\ 00}{\sqrt{n}}}$
 $P.E.$ = The probable error = $0.6745^1 \times \frac{1 - (r)^2}{\sqrt{n}}$
 = $\pm P.E.$

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- 1 - Mathematical constant.
 " - "For a complete statement of this method of study of breeding problems the reader is referred to Chapters X and XI of Pearson's "Grammar Science", published by A. and C. Black, London, and to Part III of Davenport's "Principles of Breeding, published by Ginn and Co., Boston." This is quoted from The Ill. Exp. Sta. Bul. No. 119 - Type and Variability in Corn by Davenport and Rietz.

A list of the 228 birds used in this work, together with their leg bands, breed designations, and twelve months production.

No.	Breed	Leg. Band	No.	Breed	Leg. Band	No.	Breed	Leg. Band
1	W.L.	226	47	W.L.	223	95	R.I.R.	132
2	" "	277	48	" "	198	96	" " "	172
3	" "	171	49	" "	253	97	" " "	143
4	" "	261	50	" "	226	98	" " "	184
5	" "	236	51	" "	243	99	" " "	146
6	" "	179	52	" "	245	100	" " "	58
7	" "	151	53	R.I.R.	171	101	" " "	200
8	" "	270	54	" " "	178	102	" " "	236
9	" "	215	55	" " "	155	103	" " "	167
10	" "	225	56	" " "	170	104	" " "	221
11	" "	127	58	" " "	240	105	W.L.	254
12	" "	238	59	" " "	248	106	" "	161
13	" "	166	60	" " "	96	107	" "	204
14	" "	240	61	" " "	271	108	" "	250
15	" "	273	63	" " "	193	109	" "	241
16	" "	246	64	" " "	222	110	" "	232
17	" "	227	65	" " "	217	111	" "	236
18	" "	252	66	W.L.	249	112	" "	273
19	" "	225	67	" "	189	113	" "	215
20	" "	240	68	" "	128	114	" "	224
21	" "	263	69	" "	204	115	" "	231
22	" "	238	70	" "	233	116	" "	215
24	" "	232	71	" "	259	117	" "	115
25	" "	246	72	" "	235	118	R.I.R.	210
26	" "	221	73	" "	192	120	" " "	255
27	W.L.	280	74	" "	268	121	" " "	201
28	" "	209	75	" "	267	122	" " "	226
29	" "	222	76	" "	260	123	" " "	169
30	" "	205	77	" "	229	124	" " "	191
31	" "	230	78	" "	180	125	" " "	220
32	" "	215	79	W.L.	199	126	" " "	168
33	" "	196	81	" "	216	127	" " "	171
34	" "	180	82	" "	229	128	" " "	266
35	" "	220	83	" "	224	129	" " "	273
36	" "	213	84	" "	209	130	" " "	234
37	" "	216	85	" "	227	132	R.I.R.	249
38	" "	152	86	" "	234	134	" " "	201
39	" "	234	87	" "	224	135	" " "	211
40	W.L.	163	88	" "	268	136	" " "	197
41	" "	243	89	" "	215	137	" " "	195
42	" "	260	90	" "	203	138	" " "	255
43	" "	228	91	" "	145	139	" " "	173
44	" "	236	92	R.I.R.	214	140	" " "	199
45	" "	160	93	" "	174	142	" " "	205
46	" "	195	94	" "	133	143	" " "	254

A list of the 228 birds used in this work, together with their leg bands, breed designations, and twelve months production - (Continued):

No.	Breed	An. Prd.	No.	Breed	An. Prd.	No.	Breed	An. Prd.
144	R.I.R.	196	198	W.L.	187	257	W.L.	274
146	" " "	245	199	" "	231	258	" "	239
147	" " "	169	200	" "	237	259	" "	167
148	" " "	150	201	" "	204			
149	" " "	241	202	" "	192			
150	" " "	175	203	" "	134			
151	" " "	178	204	" "	88			
152	" " "	128	205	" "	161			
153	" " "	173	206	" "	140			
154	" " "	220	207	" "	202			
155	" " "	257	208	" "	230			
156	" " "	176	209	W.L.	210			
157	W.L.	240	210	" "	234			
158	" "	185	211	" "	240			
159	" "	207	213	" "	224			
160	" "	167	214	" "	261			
163	" "	178	215	" "	222			
164	" "	248	216	" "	220			
165	" "	116	217	" "	211			
166	" "	172	218	" "	150			
167	" "	199	219	" "	197			
168	" "	202	221	" "	197			
169	" "	125	223	W.L.	212			
170	R. I.R.	180	224	" "	168			
171	" " "	208	225	" "	178			
173	" " "	189	226	" "	177			
175	" " "	146	227	" "	214			
176	" " "	179	228	" "	190			
177	" " "	217	229	" "	132			
178	" " "	171	232	" "	243			
179	" " "	185	233	" "	197			
180	" " "	152	236	Minorca	229			
181	" " "	182	238	" "	46			
182	" " "	201	239	" "	176			
183	R.I.R.	200	240	" "	200			
185	" " "	184	241	" "	183			
187	" " "	161	242	" "	44			
189	" " "	224	245	" "	151			
190	" " "	210	247	" "	175			
191	" " "	217	249	W.L.	180			
193	" " "	206	250	" "	218			
194	" " "	147	251	" "	219			
195	" " "	177	252	" "	194			
196	W.L.	157	253	" "	225			
197	" "	192	256	" "	229			

Table 1. - Setting forth original data regarding the distance between the pelvic bones and the annual egg production for 228 birds..

SEC. A		SEC. B		SECTION C							
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
13	166	1	226	4	261	88	268	225	178	134	201
22	238	2	277	5	236	87	224	226	177	138	255
39	234	3	171	6	179	90	203	232	243	132	249
34	180	17	227	8	270	91	145	233	197		
46	195	24	232	10	225	83	224	215	222		
47	223	25	246	12	238	79	199	217	211		
48	198	26	221	9	215	97	199	219	197		
45	99	15	273	19	225	102	236	211	240		
53	171	16	246	20	240	100	58	214	261		
55	155	21	263	18	252	101	200	216	220		
60	96	37	216	14	240	99	146	207	202		
74	268	42	260	30	209	98	184	199	231		
69	204	44	236	31	230	103	167	198	187		
86	234	51	243	38	152	115	231	201	204		
96	172	50	226	33	196	110	232	196	157		
95	132	49	252	27	280	105	234	206	140		
104	221	58	240	28	209	109	241	208	230		
94	133	77	229	32	215	113	215	193	206		
93	174	85	227	35	220	108	250	185	184		
114	224	84	209	36	213	106	161	183	200		
126	168	92	214	29	222	107	204	194	147		
238	46	111	236	41	243	117	115	191	217		
241	183	116	215	40	163	123	169	177	217		
239	176	125	220	52	245	121	201	180	152		
229	132	259	167	43	228	122	226	176	179		
213	224	249	180	54	178	118	210	179	185		
218	130	252	194	56	170	129	273	173	189		
221	197	242	44	61	271	120	255	171	208		
210	234	205	161	65	217	127	171	181	182		
204	88	167	199	63	198	124	191	170	180		
203	134	166	172	64	222	128	266	169	125		
175	146	144	196	72	235	130	234	168	202		
178	171	153	173	68	128	257	274	164	248		
159	207	135	211	76	260	258	239	158	185		
148	150	137	195	71	259	250	218	160	167		
152	128	139	173	75	267	253	225	157	240		
151	178	140	199	70	233	251	219	146	245		
154	220			73	192	256	229	147	169		
156	176			78	180	240	200	149	241		
				66	249	247	175	150	175		
				67	189	236	229	155	257		
				81	216	245	131	142	205		
				82	229	223	212	136	197		
				89	215	224	168	143	254		

Table 1 - Continued.

SEC. D		SEC. E.	
#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
11	127	7	151
59	248		
112	273		
227	214		
228	190		
209	210		
197	192		
200	237		
202	192		
190	210		
195	177		
189	224		
187	161		
182	201		
163	178		
165	116		

Legend:

Sec.	A	-	1	Finger Capacity
B	-	1.5	"	"
C	-	2	"	"
D	-	2.5	"	"
E	-	3	"	"

Table 1 a. -Showing the distribution of the distance between the pelvic bones with annual egg production for 228 birds.

							Total (228)
Annual Egg Production	300			1			1
	280	1	4	10	1		16
	260		5	16	1		22
	240	9	10	30	1		50
	220	2	5	31	5		43
	200	5	6	17	3		31
	180	9	6	17	3		35
	160	3		8		1	12
	140	6		3	1		10
	120			1	1		2
	100	3					3
	80						
	60	1	1	1			3
	Total (228)	39	37	135	16	1	
	(1)	(2)	(3)	(4)	(5)	(6)	

D i s t a n c e - 1/2 finger units.

Table 1 b. - Correlating the distance between the pelvic bones with the annual egg production for 228 birds.

ANNUAL PROD.	CAPACITY 1/2 FINGER UNITS					f	d	fd	fd ²	% de dg	
	2	3	4	5	6					++	--
40-59	1		1	1		3	-7	-21	147	7	
60-79							-6				
80-99	3					3	-5	-15	75	30	
100-119			1	1		2	-4	-8	32		4
120-139	6		3	1		10	-3	-30	90	33	
140-159	3		8		1	12	-2	-24	48	8	
160-179	9	6	17	3		35	-1	-35	35	21	
180-199	5	6	17	3		31		-133		99	
200-219	2	5	31	5		43	1	43	43	94	4
220-239	9	10	30	1		50	2	100	200	5	54
240-259		5	16	1		22	3	66	198		12
260-279	1	4	10	1		16	4	64	256		20
280-299			1			1	5	5	25		94
f	39	36	135	17	1	228		278	1149		
d	-2	-1		1	2			-133			
fd	-78	-36		17 + 2		-114	228	145			

$$228 \frac{19}{-95} = -0.41667$$

$$fd^2 = 156 + 36 \quad 17 + 4 = 213 \div 228 = 0.93421$$

$$Me. = 189.5 + \frac{145}{228} \times 20 = 202.22$$

$$Mg. = 3.45 - \frac{95}{228} = 3.0333$$

$$s_e^2 = \frac{1149}{228} - (0.63596)^2 = 4.6350$$

$$s_e = \sqrt{4.6350} = 2.1536$$

$$s_g^2 = \frac{213}{228} - (-0.41667)^2 = 0.76060$$

$$s_g = \sqrt{0.76060} = 0.87212$$

$$p = \frac{5}{228} - (0.63596)(-0.41667) = -0.24306$$

$$r = \frac{p}{s_e s_g} = \frac{-0.24306}{(2.1536)(0.87212)} = -0.12941$$

$$P.E. = 0.6745 \times \frac{1 - (-0.12941)^2}{\sqrt{228}} = 0.043925$$

$$r = -0.129 \pm 0.044$$

Discussion of the Individual Character

Character 1. The distance between the pelvic bones.

The pelvic bones, located at either side of the vent have a tendency to be wide apart, and flexible in a hen that is laying heavily, so that two or three fingerwidths can be easily inserted vertically between them. On the other hand, a hen in a dormant condition will usually have the pelvic bones close together, stiffened and measuring about one fingerwidth apart.

The 228 birds are distributed according to the distance between the pelvic bones as follows: 39 birds measured one finger capacity; 37 birds measured 1 1/2 fingers; 135 birds measured 2 fingers; 16 birds measured 2 1/2 fingers and only 1 bird measured 3 fingers.

The mode of 135 was attained by those birds measuring a 2 finger capacity between the pelvic bones.

The distribution of the annual production is as follows: 3 birds in the 60 egg group; 3 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 35 in the 180 egg group; 31 in the 200 egg group; 43 in the 220 egg group; 50 in the 240 egg group; 22 in the 260 egg group; 16 in the 280 egg group and 1 in the 300 egg group.

The highest frequency of 50 was attained by the group which produced 240 eggs.

$$r = -0.129 \pm 0.044$$

Character 1. The distance between the pelvic bones contin-
ued.

There is no correlation between annual production and the distance between the pelvic bones.

This was not in agreement with work done by Sherwood (1922), Hervey (1923), and Knox (1924).

Table 2. - Setting forth original data regarding the distance between the pelvic and the keel bones and the annual egg production for 228 birds.

SEC. A		SEC. B		SEC C.		SEC D.		SECTION E			
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
238	46	46	195	1	226	5	236	9	215	83	224
229	132	45	160	6	179	3	171	2	277	79	199
203	134	60	96	13	166	20	240	12	238	97	143
213	224			16	246	17	227	8	270	102	236
				22	238	25	246	11	127	101	200
				30	209	21	263	26	221	99	143
				39	234	14	240	24	232	110	232
				35	220	27	280	15	273	111	236
				48	198	34	180	18	252	106	161
				55	155	37	216	31	230	108	250
				76	260	42	260	38	152	113	215
				69	204	52	245	38	209	107	204
				88	268	49	253	36	213	123	169
				95	132	77	229	29	222	118	210
				104	221	74	268	41	243	126	168
				94	133	78	180	44	236	127	171
				93	174	96	172	47	223	124	191
				112	273	120	255	40	163	128	266
				241	183	249	180	50	226	130	234
				242	44	250	218	43	228	125	220
				245	131	252	194	53	171	257	274
				239	176	224	168	61	271	258	237
				218	130	225	178	65	217	259	167
				210	234	216	220	64	222	253	225
				199	231	219	197	59	248	251	219
				159	207	204	88	58	240	256	229
				168	202	166	172	72	235	247	175
				152	128	116	215	68	128	236	229
				155	257			71	259	227	214
				140	199			75	267	223	197
								73	192	209	210
								66	249	221	197
								67	189	217	211
								81	216	214	261
								82	229	175	146
								85	227	178	171
								90	203	167	199
								87	224	158	185
								84	209	157	240
								91	145	160	167

Table 2 - Continued

SEC. E Cont.		SEC. F		SEC. G		SEC. H		SEC. I	
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
165	116	33	196	4	261	122	226	211	240
149	241	32	215	7	151			190	210
156	176	51	243	10	225			193	206
150	175	63	198	19	225			185	184
143	254	92	214	54	178			187	161
135	211	100	58	56	170			189	224
137	195	103	167	70	233			182	201
139	173	114	224	86	234			173	189
		115	231	89	215			163	178
		105	234	98	184			142	205
		109	241	121	201			138	255
		117	115	215	222				
		129	273	198	187				
		240	200	200	237				
		226	177	202	192				
		223	212	197	192				
		232	243	206	140				
		207	202	208	230				
		201	204	183	200				
		196	157	194	147				
		205	161	191	217				
		195	177	177	217				
		170	180	180	152				
				176	179				
				179	185				
				171	208				
				181	182				
				169	125				
				164	248				
				148	150				
				144	196				
				146	245				
				153	173				
				151	178				
				147	169				
				154	220				
				136	197				
				134	201				
				132	249				
				228	190				

Table 2 - Continued.

Legend:

Sec. A	- 1	finger capacity	Sec. F	- 3.5	finger capacity
B	- 1.5	" "	G	- 4	" "
C	- 2	" "	H	- 4.5	" "
D	- 2.5	" "	I	- 5.	" "
E	- 3	" "			

Table 2 a. - Showing the distribution of the distance between the pelvic and the keel bones with annual egg production for 228 birds.

										Total (228)
300				1						1
280			3	3	8	1	1			16
260			2	6	10	3	3		2	26
240	1		7	4	24	3	8	1	1	49
220			4	3	17	6	7		4	41
200		1	3	5	9	3	9		3	33
180		1	4	5	12	4	6		1	35
160			1		5	1	5			12
140	2		5		2		1			10
120					1	1				2
100		1		1						2
80										
60	1		1			1				3
Total (228)	4	3	30	28	98	23	40	1	11	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Distance - 1/2 finger units.

Table 2 b. - Correlating the distance between the pelvic and the keel bones with the annual egg production for 228 birds.

CAPACITY 1/2 FINGER

ANNUAL PROD.	UNITS										f	d	fd	fd ²	Σ de dg	
	1	2	3	4	5	6	7	8	9	10					++	--
40-59		1		1	:		:	1			3	-7	-21	147	35	
60-79					:		:					-6				
80-99			1		1:		:				2	-5	-10	50	20	
100-119					:		1:	1			2	-4	-8	32		4
120-139		2		5	:	2:		1			10	-3	-30	90	48	
140-159				1	:	5:	1	5			12	-2	-24	48		18
160-179			1	4	5:	12:	4	6		1	33	-1	-33	33		4
180-199			1	2	5:	9:	3	9		3	33		-126			
200-219				4	3:	17:	6	7		4	41	1	41	41	25	
220-239		1		7	4:	24:	3	8	1	1	49	2	98	196	8	
240-259				2	6:	10:	3	3		2	26	3	78	234	21	
260-279				3	3:	8:	1	1			16	4	64	256	157	24
280-299					1:	:					1	5	5	25	-55	5

f 0:4:3:30:28 88:23:40:1:11 228
 d -5-4-3-2-1 1 2 3 4
 fd 0-16-9-60-28 23 80 3 44 150 228/160
 -113
 228/37
 0.16228

fd² = 0 64+27+120+28+23+160+9+1476 = 607 ÷ 228 = 2.6623

Mo. = 189.5 + $\frac{160}{228}$ x 20 = -203.54

Mg. = 3.0 + $\frac{37}{228}$ = 3.1623

σ²e = $\frac{1152}{228} - (0.70175)^2$ = 4.5602

σe = √4.5602 = 2.1360

σ²g = $\frac{607}{228} - (0.16228)^2$ = 2.3990

σg = √2.3990 = 1.5488

P = $\frac{102}{228} - (0.16228)(0.70175)$ = 0.33349

r = $\frac{P}{\sigma_e \sigma_g} = \frac{0.33349}{(2.1360)(1.5488)}$ = 0.10081

P.E. = $0.6745 \times \frac{1 - (0.10081)^2}{\sqrt{228}}$ = 0.044224

r = 0.101 ± 0.044

Discussion of the Individual Character - Continued:Character 2. The distance between the pelvic and the keel bones.

The distance between the pelvic and the keel bones is commonly referred to as "Abdominal Capacity". In hens laying heavily, the spread between these bones ranges from 4 to 6 horizontal fingerwidths. Poor layers will usually have a narrower spread, ranging from 2 to 3 horizontal fingerwidths.

The 228 are distributed according to the distance between the pelvic and the keel bones as follows : 4 birds measured 1 finger capacity; 3 birds measured 1 1/2 fingers; 30 birds measured 2 fingers; 28 birds measured 2 1/2 fingers; 88 birds measured 3 fingers; 23 birds measured 3 1/2 fingers; 40 birds measured 4 fingers; 1 bird measured 4 1/2 fingers, and 11 birds measured 5 fingers.

The mode of 88 was attained by those birds measuring a 3-finger capacity between the pelvic and the keel bones.

The distribution of the annual production is as follows: 3 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 33 in the 180 egg group; 33 in the 200 egg group; 41 in the 220 egg group; 49 in the 240 egg group; 26 in the 260 egg group; 16 in the 280 egg group and 1 in the 300 egg group.

The highest frequency of 49 was attained by the group which produced 240 eggs.

$$r = 0.101 \pm 0.044$$

Character 2. The distance between the pelvic and the keel bones . Continued :

There is no correlation between the annual production and the distance between the pelvic and the keel bones.

Similar results were obtained by Sherwood (1922), Knox (1924), and Waters (1927). On the other hand Asmundsen (1921) came to a different conclusion.

Table 3. - Setting forth original data regarding the pelvic condition and the annual egg production for 228 birds.

SECTION A				SECTION B							
#	AN.	#	AN.	#	AN.	#	AN.				
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>				
3	171	83	224	191	217	5	236	122	226	167	199
13	166	79	199	176	179	9	215	128	266	168	202
6	179	95	132	173	189	10	225	257	274	159	207
8	270	92	214	171	208	12	238	259	167	157	240
24	232	100	58	181	182	7	151	253	225	146	245
25	246	114	224	169	125	11	127	251	219	153	173
26	221	105	234	164	248	16	246	249	180	154	220
15	273	108	250	158	185	17	227	247	175	150	175
21	263	109	241	160	167	19	225	238	46	155	257
22	238	113	215	163	178	27	280	241	183	139	173
31	230	106	161	166	172	28	209	242	44		
33	196	112	273	144	196	38	152	223	212		
39	234	107	204	151	178	36	213	224	168		
29	222	116	215	152	128	51	243	225	178		
32	215	123	169	156	176	40	163	226	177		
35	220	118	210	149	241	42	260	227	214		
37	216	120	255	142	205	46	195	228	190		
41	243	129	273	136	197	50	226	229	132		
44	236	126	168	143	254	43	228	233	197		
47	223	127	171	134	201	53	171	215	222		
48	198	130	234	132	249	65	217	216	220		
52	245	125	220			55	155	219	197		
49	253	258	239			68	128	221	197		
45	160	250	218			76	260	211	240		
56	170	252	194			74	268	198	187		
61	271	256	229			66	249	200	237		
63	198	240	200			67	189	197	192		
64	222	236	229			81	216	196	157		
58	240	245	131			89	215	204	88		
59	248	232	243			86	234	205	161		
60	96	213	224			90	203	206	140		
72	235	209	210			96	172	190	210		
71	259	218	130			102	236	193	206		
77	229	217	211			104	221	183	200		
70	233	210	234			101	200	195	177		
75	267	214	261			93	174	194	147		
73	192	207	202			103	167	189	224		
69	204	199	231			99	146	177	217		
88	268	201	204			98	184	175	146		
85	227	202	192			110	232	180	154		
87	224	203	134			111	236	178	171		
84	209	208	230			115	231	179	185		
91	145	185	184			117	115	182	201		
								170	180		

Table 3 - Continued

<u>SEC. C</u>		<u>SEC. D</u>	
<u>#</u>	<u>AN.</u>	<u>#</u>	<u>AN.</u>
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
2	277	14	240
4	261	30	209
1	226		
20	240		
18	252		
34	180		
54	178		
78	180		
82	229		
97	143		
94	133		
121	201		
124	191		
239	176		
187	161		
165	116		
148	150		
147	169		
137	195		
135	211		
140	199		
138	255		

Legend:

Sec. A - Thin
 B - Medium
 C - Thick
 D - Very Thin

Table 3 a. - Showing the distribution of the pelvic condition with annual egg production for 228 birds.

					Total (228)
300			1		1
280		9	5	2	16
260	1	15	7	3	26
240		27	20	2	49
220	1	19	18	2	40
200		13	14	5	32
180		15	16	4	35
160		1	9	2	12
140		6	3	1	10
120			1	1	2
100		1	1		2
80					
60		1	2		3
Total (228)	2 (1)	107 (2)	97 (3)	22 (4)	
	Pelvic condition				

Legend:

1. Excellent - (very thin)
2. Good - (thin)
3. Medium - (medium)
4. Poor - (thick)

Table 3 b. - Correlating the pelvic condition with the annual egg production for 228 birds.

ANNUAL PROD.	PELVIC CONDITION				r	d	rd	rd ²	Σ de dg	
	4	3	2	1					++	--
40-59		: 2 :	1		3	-7	-21	147		7
60-79		: :				-6				
80-99		: 1 :	1		2	-5	-10	50		5
100-119	1	: 1 :			2	-4	-8	32	4	
120-139	1	: 3 :	6		10	-3	-30	90		15
140-159	2	: 9 :	1		12	-2	-24	48	2	
160-179	4	: 16 :	15		35	-1	-35	35		11
180-199	5	: 14 :	13		22					
200-219	2	: 18 :	19	1	40	1	40	40	19	-38
220-239	2	: 20 :	27		49	2	98	196	50	
240-259	3	: 7 :	15	1	26	3	78	234	42	
260-279	2	: 5 :	9		16	4	64	256	28	
280-299		: 1 :			1	5	5	25	145	
r	22	97	107	2	228		285	1153	-38	
d	-1		1	2			-128		107	
rd	-22		107	4 = 111		228	157			

$$rd^2 = 22 + 107 + 8 = 137 \div 228 = 0.60088$$

$$Me. = 189.5 + \frac{157}{228} \times 20 = 203.27$$

$$Kg. = 2.45 + \frac{89}{228} = 2.8404$$

$$\sigma^2_e = \frac{1153}{228} - (0.68860)^2 = 4.5828$$

$$\sigma_e = \sqrt{4.5828} = 2.1407$$

$$\sigma^2_g = \frac{137}{228} - (0.39035)^2 = 0.44851$$

$$\sigma_g = \sqrt{0.44851} = 0.66971$$

$$P = \frac{107}{228} - (0.68860)(0.39035) = 0.2005$$

$$r = \frac{P}{\sigma_e \sigma_g} = \frac{0.2005}{(2.1407)(0.66971)} = 0.13986$$

$$P.E. = \frac{0.6745 \times 1 - (0.13986)^2}{\sqrt{228}} = 0.043804$$

$$r = 0.140 \pm 0.044$$

Discussion of the Individual Character - Continued :

Character 3. The pelvic condition.

The pelvic condition refers to the condition of the pelvic bones. In a hen that has been laying heavily, the bones are comparatively free from fat and feel thin and pliable. On hens that are not laying the bones feel thick and stiff.

The 228 birds are distributed according to the pelvic condition as follows : 2 birds in excellent condition; 107 birds in good condition; 97 birds in medium condition, and 22 birds in poor condition.

The mode of 107 was attained by those birds which were in good condition.

The distribution of the annual production is as follows: 3 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 35 in the 180 egg group; 32 in the 200 egg group; 40 in the 220 egg group; 49 in the 240 egg group; 26 in the 260 egg group; 16 in the 280 egg group, and 1 in the 300 egg group.

The highest frequency of 49 was attained by the group which produced 240 egg.

$$r = 0.140 \pm 0.044$$

Character 3. The pelvic condition. Continued:

There is a slight correlation between the pelvic condition and annual production.

Similar results were obtained by Blittenbender, H. A. (1927). However, different results were secured by Knox (1924).

Table 4. - Setting forth original data regarding the color changes of the vent and the annual egg production for 220* birds.

SEC. A		SECTION B				SECTION C					
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
4	261	2	277	224	168	5	236	86	234	233	197
20	240	13	166	225	178	9	215	82	229	215	222
95	132	3	171	217	211	17	227	85	227	209	210
97	143	1	226	204	88	25	246	90	203	221	197
94	133	10	225	205	161	24	232	87	224	219	197
93	174	12	238	206	140	19	225	83	224	216	220
117	115	7	151	185	184	16	246	79	199	210	234
229	132	6	179	195	177	21	263	96	172	214	261
213	224	8	270	194	147	15	273	104	221	211	240
218	130	11	127	180	152	22	238	92	214	207	202
203	134	26	221	178	171	18	252	100	58	199	231
175	146	31	230	173	189	14	240	99	190	198	187
167	199	38	152	168	202	30	209	124	224	201	204
159	207	28	209	164	248	39	234	115	231	200	237
152	128	33	196	158	185	27	280	111	236	202	192
137	195	34	180	165	116	36	213	110	232	197	192
139	173	41	243	148	150	32	215	105	234	196	157
		51	243	151	178	35	220	109	241	208	230
		46	195	135	211	37	216	113	215	190	210
		44	236	140	199	29	222	108	250	193	206
		48	198			47	223	106	161	183	200
		40	163			42	260	107	204	189	224
		50	226			52	245	112	273	191	217
		49	252			43	228	116	215	187	161
		54	178			45	160	123	169	177	217
		56	170			61	271	122	226	176	179
		53	171			65	217	120	255	179	185
		60	96			55	155	126	168	182	201
		59	248			63	198	124	191	171	208
		58	240			64	222	128	266	181	182
		77	229			72	235	130	234	170	180
		69	204			68	128	125	220	169	125
		84	209			76	260	257	274	163	178
		91	145			71	259	258	239	160	167
		102	236			75	267	259	167	166	172
		101	200			70	233	250	218	157	240
		103	167			74	268	251	219	144	196
		98	184			73	192	249	180	146	245
		121	201			78	180	256	229	153	173
		118	210			66	249	226	177	156	176
		129	273			67	189	223	212	147	169
		127	171			88	268	227	214	149	241
		253	225			81	216	232	243	154	220
		252	194			89	215	228	190	150	175

Table 4. - Continued

SEC. C

Cont.

<u>#</u>	<u>AN.</u>
<u>HEN</u>	<u>PRO.</u>

155	257
142	205
136	197
143	254
134	201
138	255
132	249

Legend:

Sec. A - Yellow pigmentation
 B - Medium
 C - Pale

* This test can not be applied to Minoreas on account of their lack of pigmentation of skin and shanks.

Table 4 a. - Showing the distribution of the color changes of the vent with annual egg production for *220 birds.

Annual Egg Production				Total (220)
	(1)	(2)	(3)	
300	1			1
280	12	3	1	16
260	19	6	1	26
240	37	10	1	48
220	29	8	1	38
200	19	10	2	31
180	16	16	2	34
160	3	7	2	12
140	2	1	6	9
120		1	1	2
100		2		2
80				
60	1			1
Total (220)	139 (1)	64 (2)	17 (3)	220

*This test cannot be applied to Minorcas on account of their lack of pigmentation in skin and shanks.

Legend:

1. Good - (Pale in color)
2. Medium - (Medium)
3. Poor - (Yellow pigmentation)

Table 4 b. - Correlating the color changes of the vent with the annual egg production for 220 birdsⁿ.

ANNUAL PROD.	COLOR OF VENT			f	d	fd	fd ²	Σ de dg	
	3	2	1					++	--
40-59	:	:	1	1	-7	-7	49		7
60-79	:	:			-6				
80-99	:	2	:	2	-5	-10	50		
100-119	1	:	1	2	-4	-8	32	4	
120-139	6	:	1	9	-3	-27	81	12	
140-159	2	:	7	12	-2	-24	48		2
160-179	2	:	16	14	-1	-34	34		14
180-199	2	:	10	11		-110			
200-219	1	:	8	38	1	38	38	28	
220-239	1	:	10	48	2	96	192	72	
240-259	1	:	6	26	3	78	234	54	-23
260-279	1	:	3	16	4	64	256	44	
280-299	:	:	1	1	5	5	25	5	
f	17	64	139	220		281	1039	219	
d	-1		1			-110		-23	
fd	-17		139		220	171		196	
			-17			0.77727			
			220	122					

$$fd^2 = 17 + \frac{139}{220} = 156 \div 220 = 0.70909$$

$$Me. = 189.5 + \frac{171}{220} \times 20 = 205.05$$

$$Mg. = 1.45 + \frac{122}{220} = 2.0046$$

$$\sigma^2_e = \frac{1039}{220} - (0.77727)^2 = 4.1186$$

$$\sigma_e = \sqrt{4.1186} = 2.0295$$

$$\sigma^2_g = \frac{156}{220} - (0.55455)^2 = 0.40156$$

$$\sigma_g = \sqrt{0.40156} = 0.63369$$

$$P = \frac{196}{220} - (0.77727)(0.55455) = 0.45987$$

$$r = \frac{P}{\sigma_e \sigma_g} = \frac{0.45987}{(2.0295)(0.63369)} = 0.35760$$

$$P.E. = 0.6745 \times \frac{1 - (0.35760)^2}{\sqrt{220}} = 0.039666$$

$$r = 0.358 \pm 0.040$$

ⁿ. This test can not be applied to Minorcas on account of their lack of pigmentation of skin and shanks.

Discussion of the Individual Character. -Continued:

Character 4. The color changes of the vent.

Pigmentation refers to the yellow color deposited in the fat of the yellow-skinned fowl varieties. When the pullet starts to lay, she gradually becomes bleached or rather pale in the visible parts of the body. This is due to the diverting of the yellow pigment underneath the skin to the newly formed yolks within the body of the bird. The prevalence of yellow pigment is usually an indication of a dormant condition.

This same explanation of this character holds true for the following two characters; i.e., the color changes of the shank and skin.

The 220 birds are distributed according to the color changes of the vent as follows : 139 birds had good color; 64 birds had medium color and 17 birds had poor color.

The mode of 139 was attained by those birds which showed good color.

The distribution of the annual production is as follows: 1 bird in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 9 in the 140 egg group; 12 in the 160 egg group; 34 in the 180 egg group; 31 in the 200 egg group; 38 in the 220 egg group; 48 in the 240 egg group; 26 in the 260 egg group; 16 in the 280 egg group and 1 bird in the 300 egg group.

The highest frequency of 48 was attained by the group which produced 240 eggs.

Character 4. The color changes of the vent. - Continued :

$$r = 0.358 \pm 0.040$$

There is a significant correlation between the color changes of the vent and annual production.

Similar results were obtained by Blakeslee, Harris, Warner, Kirkpatrick (1917), Hervey (1923), Lewis, H. R. (1924).

Table 5. - Continued

SEC. C
Cont.

AN.
HEW PRO.

142 205
 136 197
 143 254
 134 201
 138 255
 132 249

Legend:

Sec. A - Yellow Pigmentation.
 B - Medium.
 C - Pale

* This test can not be applied to Minoreas on account of their lack of pigmentation of skin and shanks.

Table 5 e. - Showing the distribution of the color changes of the shank with annual egg production for *220 birds.

Annual Egg Production				Total (220)
	(1)	(2)	(3)	
300	1			1
280	13	3		16
260	20	6		26
240	38	10	1	49
220	28	9	1	38
200	19	10	2	31
180	15	16	2	33
160	3	7	2	12
140	2	1	6	9
120		1	1	2
100		2		2
80				
60	1			1
Total (220)	140 (1)	65 (2)	15 (3)	

*This test cannot be applied to Minorcas on account of their lack of pigmentation in skin and shanks.

Legend:

1. Good - (Pale in color)
2. Medium - (Medium)
3. Poor - (Yellow in pigmentation.)

Table 5 b. - Correlating the color changes of the shank with the annual egg production for 220 birds^u.

ANNUAL PROD.	COLOR OF SHANK			f	d	fd	fd ²	Σ de dg	
	3	2	1					++	--
40-59	:	:	1	1	-7	-7	49		7
60-79	:	:			-6				
80-99	:	2	:	2	-5	-10	50		
100-119	1	:	1	2	-4	-8	32	4	
120-139	6	:	1	9	-3	-27	81	12	
140-159	2	:	7	12	-2	-24	48		2
160-179	2	:	16	33	-1	-33	33		13
180-199	2	:	10	51		-109			
200-219	1	:	9	38	1	38	38	27	-22
220-239	1	:	10	49	2	98	196	74	
240-259	:	:	6	26	3	78	234	60	
260-279	:	:	3	16	4	64	256	52	
280-299	:	:		1	5	5	25	5	
f	15		65	220		283	1042	234	
d	-1					-109		-22	
fd	-15		140		220	174		212	
			-15			0.79091			
			220/125						

$$fd^2 = 15 + \frac{140}{220} = 155 \div 220 = 0.70455$$

$$Me. = 189.5 + \frac{174}{220} \times 20 = 205.318$$

$$Mg. = 1.45 + \frac{125}{220} = 2.0182$$

$$6^2e = \frac{1042}{220} - (0.79091)^2 = 4.1109$$

$$6e = \sqrt{4.1109} = 2.0275$$

$$6^2g = \frac{155}{220} - (0.56818)^2 = 0.38172$$

$$6g = \sqrt{0.38172} = 0.61784$$

$$P = \frac{212}{220} - (0.79091)(0.56818) = 0.51426$$

$$r = \frac{P}{6e \cdot 6g} = \frac{0.51426}{(2.0275)(0.61784)} = 0.41052$$

$$P.E. = 0.6745 \times \frac{1 - (0.41052)^2}{\sqrt{220}} = 0.037817$$

$$r = 0.411 \pm 0.038$$

^u. This test can not be applied to Minorcas on account of their lack of pigmentation of skin and shanks.

Discussion of the Individual Character - Continued :

Character 5. The color changes of the shank.

The reader is referred to Character No. 4 on page 32 for the explanation of pigmentation.

The 220 birds are distributed according to the color changes of the shank as follows : 140 birds had good color; 65 birds had medium color, and 15 birds had poor color.

The mode of 140 was attained by those birds which showed good color.

The distribution of the annual production is as follows: 1 bird in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 9 in the 140 egg group; 12 in the 160 egg group; 33 in the 180 egg group; 31 in the 200 egg group; 38 in the 220 egg group; 49 in the 240 egg group; 26 in the 260 egg group; 16 in the 280 egg group, and 1 in the 300 egg group.

The highest frequency of 49 was attained by the group which produced 240 eggs.

$$r = 0.411 \pm 0.038$$

There is a significant correlation between the color changes of the shank and annual production.

Similar results were obtained by Blakeslee, Harris, Warner, Kirkpatrick (1917), Sherwood (1922), Hervey (1923), and Lewis, H. R. (1924).

Table 6. - Continued.

SEC. C	
Cont.	
#	AN.
<u>HEN</u>	<u>PRO.</u>
157	240
144	196
146	245
153	173
156	176
147	169
149	241
150	175
154	220
155	257
136	197
142	205
143	254
132	249
134	201
138	255

Legend:

Sec. A - Yellow pigmentation,
 B - Medium,
 C - Pale.

* This test can not be applied to Minorcas on account of their lack of pigmentation of skin and shanks.

Table 6 a. - Showing the distribution of the color changes of the skin with annual egg production for *220 birds.

Annual Egg Production				Total (220)
	(1)	(2)	(3)	
300	1			1
280	12	3	1	16
260	20	6	1	27
240	34	12	1	47
220	28	10	1	39
200	19	10	2	31
180	16	15	2	33
160	3	7	2	12
140	2	1	6	9
120		1	1	2
100		2		2
80				
60	1			1
Total (220)	136 (1)	67 (2)	17 (3)	

*This test cannot be applied to Minorcas on account of their lack of pigmentation in skin and shanks.

Legend:

1. Good - (Pale in color)
2. Medium - (Medium)
3. Poor - (Yellow pigmentation)

Table 6 b. - Correlating the color changes of the skin with the annual egg production for 220 birds".

ANNUAL PROD.	COLOR OF SKIN			f	d	fd	fd ²	Σ de dg	
	3	2	1					++	--
40-59	:	:	1	1	-7	-7	49		7
60-79	:	:			-6				
80-99	:	2	:	2	-5	-10	50		
100-119	1	1	:	2	-4	-8	32	4	
120-139	6	1	2	9	-3	-27	81	12	
140-159	2	7	3	12	-2	-24	48		2
160-179	2	15	16	33	-1	-33	33		14
180-199	2	10	19	31		-109			
200-219	1	10	28	39	1	39	39	27	-23
220-239	1	12	34	47	2	94	188	66	
240-259	1	6	20	27	3	81	243	57	
260-279	1	3	12	16	4	64	256	44	
280-299	:	:	1	1	5	5	25	5	
f	17	67	136	220		283	1044	215	
d	-1		1			-109		-23	
fd	-17		136		220	174		192	
			-17			0.79091			
		220	119						
		0.54091							
fd ² =	17	+	136	=	153	÷	220	=	0.69545
Me. =	189.5	+	$\frac{174}{220}$	x	20	=	205.318		
Mg. =	1.45	+	$\frac{119}{220}$			=	1.9909		
σ ² e =	$\frac{1044}{220}$	-	(0.79091) ²			=	4.1200		
σe =	$\sqrt{4.1200}$					=	2.0298		
σ ² g =	$\frac{153}{220}$	-	(0.54091) ²			=	0.40287		
σg =	$\sqrt{0.40287}$					=	0.63472		
P =	$\frac{192}{220}$	-	(0.79091)(0.54091)	=	0.44492				
r =	$\frac{P}{\sigma e \sigma g}$			=	$\frac{0.44492}{(2.0298)(0.63472)}$	=	0.34533		
P.E. =				=	$0.6745 \times \frac{1 - (0.34533)^2}{\sqrt{220}}$	=	0.040060		
r =				=	0.345 ± 0.040				

" . This test can not be applied to Minorcas on account of their lack of pigmentation of skin and shanks.

Discussion of the Individual Character - Continued :

Character 6. The color changes of the skin.

The reader is referred to Character No. 4 on page 32 for the explanation of pigmentation.

The 220 birds are distributed according to the color changes of the skin as follows : 136 birds had good color; 67 birds had medium color and 17 birds had poor color.

The mode of 136 was attained by those birds which showed good color.

The distribution of the annual production is as follows: 1 bird in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 9 in the 140 egg group; 12 in the 160 egg group; 33 in the 180 egg group; 31 in the 200 egg group; 39 in the 220 egg group; 47 in the 240 egg group; 27 in the 260 egg group; 16 in the 280 egg group and 1 in the 300 egg group.

The highest frequency of 47 was attained by the group which produced 240 eggs.

$$r = 0.345 \pm 0.040$$

There is a significant correlation between the color changes of the skin and annual egg production.

No work has been done by other investigators on this character.

Table 7. - Setting forth original data regarding the body condition and the annual egg production for 228 birds.

SECTION A				SECTION B			
#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
5	236	70	233	249	180	143	254
9	215	74	268	256	229	138	255
4	261	73	192	240	200	132	249
10	225	78	180	247	175	181	182
12	238	66	249	236	229	26	221
7	151	67	189	226	177	20	240
6	179	67	189	226	177	16	246
8	270	88	268	227	214	21	263
11	127	81	216	228	190	22	238
17	227	89	215	232	243	40	163
19	225	86	234	233	197	42	260
24	232	82	229	215	222	46	195
25	246	85	227	209	210	48	198
15	273	90	203	214	261	53	171
18	252	87	224	216	220	61	271
31	230	83	224	211	240	58	240
27	280	79	199	207	202	69	204
28	209	97	143	199	231	84	209
33	196	102	236	198	187	91	145
38	152	93	174	200	237	96	172
36	213	100	58	201	204	92	214
32	215	103	167	202	192	101	200
35	220	98	184	196	157	104	221
37	216	114	224	197	192	99	146
29	222	115	231	205	161	111	236
41	243	110	232	206	140	112	273
51	243	105	234	208	230	123	169
47	223	109	241	221	197	118	210
44	236	113	215	193	206	120	255
50	226	108	250	195	177	129	273
52	245	106	161	191	217	126	168
49	253	107	204	176	179	130	234
43	228	117	115	179	185	125	220
54	178	116	215	182	201	252	194
56	170	121	201	173	189	241	183
65	217	122	226	174	143	223	212
63	198	124	191	109	125	224	168
59	248	127	171	163	178	225	178
72	235	128	266	164	248	217	211
68	128	257	274	157	240	219	197
76	260	258	239	165	116	204	88
77	229	259	167	151	178	190	210
71	259	253	225	147	169	185	184
75	267	250	218	142	205	183	200
		251	219	136	197	194	147

Table 7. - Continued

<u>SEC. C</u>		<u>SEC. D</u>	
<u>#</u>	<u>An.</u>	<u>#</u>	<u>An.</u>
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
14	240	13	166
34	180	30	209
55	155	39	234
95	132	45	160
94	133	64	222
238	46	60	96
242	44		
245	131		
239	176		
229	132		
213	224		
218	130		
203	134		
175	146		
168	202		
159	207		
148	150		
152	128		
135	211		
139	173		
140	199		

Legend:

- Sec. A - Soft and oily
 B - Medium and oily
 C - Dry and hard
 D - Medium and dry.

Table 7 a. - Showing the distribution of the body condition with annual egg production for 228 birds.

					Total (228)
300	1				1
280	8	6			14
260	18	7		1	26
240	39	9	2	1	51
220	24	12	1	3	40
200	19	11		2	32
180	16	15	2	2	35
160	5	4		3	12
140	3			7	10
120	2				2
100		1	1		2
80	1			2	3
60					
Total (228)	136 (1)	65 (2)	6 (3)	21 (4)	

Condition of the body

Legend:

1. Excellent - (soft and oily)
2. Good - (medium and oily)
3. Medium - (dry and medium)
4. Poor - (dry and hard)

Table 7 b. - Correlating the condition of the body with the annual egg production for 228 birds.

ANNUAL PROD.	BODY CONDITION				f	d	fd	fd ²	Σ de dg	
	4	3	2	1					++	--
40-59	2		:	1	5	-7	-21	147	21	
60-79			:							
80-99		1	:	1	2	-5	-10	50	5	
100-119			:	2	2	-4	-8	32		8
120-139	7		:	3	10	-3	-30	90	33	
140-159	3		:	4	12	-2	-24	48	2	
160-179	2	2	:	15	35	-1	-35	35		10
180-199	2		:	11	32		-128			
200-219	3	1	:	12	40	1	40	40	17	
220-239	1	2	:	9	51	2	102	204	70	-18
240-259	1		:	7	26	3	78	234	48	
260-279			:	6	14	4	64	256	32	
280-299			:	1	1	5	5	25	5	
f	21	6		65	228		289	1160	233	
d	-2	-1		1			-128		-18	
fd	-42	-6		136		228	161		215	
				-48			0.70614			
				228			88			
				0.38596						

$$fd^2 = 84 + 6 + 136 = 226 \div 228 = 0.99123$$

$$Me. = 189.5 + \frac{161}{228} \times 20 = 203.62$$

$$Mg. = 1.45 + \frac{88}{228} = 1.8360$$

$$6^2e = \frac{1160}{228} - (0.70614)^2 = 4.5892$$

$$6e = \sqrt{4.5892} = 2.1422$$

$$6^2g = \frac{226}{228} - (0.38596)^2 = 0.84226$$

$$6g = \sqrt{0.84226} = 0.91775$$

$$P = \frac{215}{228} - (0.70614)(0.38596) = 0.67044$$

$$r = \frac{P}{6e \cdot 6g} = \frac{0.67044}{(2.1422)(0.91775)} = 0.34102$$

$$P.E. = 0.6745 \times \frac{1 - (0.34102)^2}{\sqrt{228}} = 0.039482$$

$$r = 0.341 \pm 0.039$$

Discussion of the Individual Character - Continued:

Character 7. The body condition.

The abdominal region on a laying bird is enlarged and expanded by the widening out of the keel bones; also, there is a softening of the tissues so that the skin and the body fat feel soft and oily in the excellent layer, as contrasted with the hard and dry condition in the poor layer.

The 228 birds are distributed according to the body condition as follows: 136 birds in excellent condition; 65 birds in good condition; 6 birds in medium condition, and 21 birds in poor condition.

The mode of 136 was attained by those birds which showed excellent condition.

The distribution of the annual production is as follows: 3 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 35 in the 180 egg group; 32 in the 200 egg group; 40 in the 220 egg group; 51 in the 240 egg group; 26 in the 260 egg group; 14 in the 280 egg group, and 1 bird in the 300 egg group.

The highest frequency of 51 was attained by the group which produced 240 eggs.

$$r = 0.341 \pm 0.039$$

There is a significant correlation between the body condition and annual egg production.

No work has been done by other investigators on this character.

Table 8. - Setting forth original data regarding the condition of the head parts and the annual egg production for 228 birds.

SECTION A		SEC. B		SEC. C		SECTION D							
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.				
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>				
5	236	224	168	3	171	54	178	58	240	196	157		
9	215	225	178	1	226	13	216	72	235	193	206		
2	277	226	177	29	222			73	192	183	200		
4	261	209	210	32	215			74	268	195	177		
12	238	221	197	39	234			75	267	187	161		
6	179	217	211	77	229			78	180	177	217		
8	270	216	220	70	233			89	215	176	179		
11	127	210	234	219	197			90	203	179	185		
20	240	214	261					87	224	182	201		
21	263	207	202					84	209	173	189		
38	152	199	231					79	199	171	208		
28	209	201	204					97	143	181	182		
27	280	200	237					25	246	104	221	170	180
33	196	197	192					24	232	94	133	166	172
35	220	206	140					19	225	100	58	148	150
36	213	208	230					16	246	103	167	144	196
37	216	180	152					15	272	99	146	153	173
48	198	178	171					22	238	98	184	147	169
49	253	169	125					18	252	115	231	149	241
56	170	164	248					14	240	111	236	150	175
68	128	163	178					31	230	113	215	155	257
76	260	158	185					30	209	108	250	136	197
71	259	160	167					41	243	106	161	137	195
66	249	157	240					51	243	106	161	137	195
67	189	165	116					47	223	112	273	140	199
88	268	154	220					42	260	116	215	138	255
81	216	142	205					52	245	122	226	135	211
86	234	143	254					40	163	129	273		
82	229							50	226	120	255		
85	227							43	228	124	191		
91	145							45	160	128	266		
83	224							53	171	130	234		
114	224							61	271	250	218		
105	234							65	217	253	225		
109	241							63	198	236	229		
110	232							64	222	247	175		
117	115							59	248	241	183		
257	274									239	176		
258	239									223	212		
259	167									227	214		
251	219									232	243		
252	194									228	190		
249	180									233	197		
256	229									215	222		
240	200									211	240		
240	200									198	187		
240	200									202	192		

Table 8. - Continued

<u>SEC. E</u>		<u>SEC. F</u>		<u>SEC. G</u>	
<u>#</u>	<u>AN.</u>	<u>#</u>	<u>AN.</u>	<u>#</u>	<u>AN.</u>
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
151	178	55	155	34	180
		60	96	44	234
		96	172	46	195
		95	132	69	204
		101	200	93	174
		102	236	121	201
		92	214	123	169
		101	204	118	210
		126	168	127	171
		204	88	125	220
				238	255
				242	44
				213	224
				218	130
				203	134
				205	161
				190	210
				185	184
				194	147
				189	224
				191	217
				175	146
				167	199
				168	202
				159	207
				146	245
				152	128
				156	176
				139	173
				132	249
				134	201
				245	131
				229	132

Legend:

- Sec. A - Large and plump comb and wattles
 B - Large and medium comb " "
 C - Medium and plump comb " "
 D - Medium and medium comb " "
 E - Medium and shrivelled comb & "
 F - Small and medium comb " " "
 G - Small and shrivelled comb " "

Table 8 a. - Showing the distribution of the condition of the head parts with annual egg production for 228 birds.

								Total (228)
300	1							1
280	8			8				16
260	8			16			3	27
240	18	5		21		1	4	49
220	12	1		16		3	8	40
200	8	1		19			4	32
180	9	1	1	15	1	2	6	35
160	4			5		1	2	12
140	3			1		1	5	10
120	2							2
100						2		2
80								
60				1			1	2
Total (228)	73	8	1	102	1	10	33	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
	Condition of the head parts							

Legend:

- | | |
|------------------------------|---|
| 1. Large and plump comb | } Comb & Wattles
In the order of
their importance,-
first indicating ideal
type and last indicating
poorest. |
| 2. Large and medium " | |
| 3. Medium and plump " | |
| 4. Medium and medium " | |
| 5. Medium and shriveled comb | |
| 6. Small and medium " | |
| 7. Small and shriveled " | |

Table 8 b. - Correlating the condition of the head parts with the annual egg production for 228 birds

ANNUAL PROD.	CONDITION OF HEAD PARTS										$\Sigma de dg$		
	7	6	5	4	3	2	1	f	d	fd	fd ²	++	--
40-59	1			1	:	:		2	-7	-14	98	35	
60-79				:	:				-6				
80-99		2		:	:			2	-5	-10	50	30	
100-119				:	:		2	2	-4	-8	32		16
120-139	5	1		1	:	:	3	10	-3	-30	90	54	
140-159	2	1		5	:	:	4	12	-2	-24	48	16	
160-179	6	2	1	15	:	1	9	35	-1	-35	35	28	
180-199	4			19	:	:	8	32		-121			
200-219	8	3		16	:	:	12	40	1	40	40	32	
220-239	4	1		21	:	:	5	18	2	98	196	2	
240-259	3			16	:	:	8	27	3	81	243		36
260-279				8	:	:	8	16	4	64	256	32	
280-299				:	:		1	1	5	5	25	10	-52
f	33	10	1	102		1	8	73	228		288	1113	239
d	-4	-3	-2	-1			1	2		-121			-52
fd	-132	-30	-2	-102			8	146		228	-167		187

$$228 \sqrt{\frac{154}{-112}} = 0.73246$$

$$-0.49123$$

$$fd^2 = 528 + 90 + 4 + 102 + 8 + 292 = 1024 \div 228 = 4.4912$$

$$Me. = 189.5 + \frac{167}{228} \times 20 = 204.15$$

$$Mg. = 2.45 - \frac{112}{228} = 1.9588$$

$$\sigma_e^2 = \frac{1113}{228} - (0.73246)^2 = 4.3451$$

$$\sigma_e = \sqrt{4.3451} = 2.0845$$

$$\sigma_g^2 = \frac{1024}{228} - (-0.49123)^2 = 4.2499$$

$$\sigma_g = \sqrt{4.2499} = 2.0615$$

$$P = \frac{187}{228} - (0.73246)(-0.49123) = 1.1799$$

$$r = \frac{P}{\sigma_e \sigma_g} = \frac{1.1799}{(2.0845)(2.0615)} = 0.27459$$

$$P.E. = 0.6745 \times \frac{1 - (0.27459)^2}{\sqrt{228}} = 0.041303$$

$$r = 0.275 \pm 0.041$$

Discussion of the Individual Character - Continued :Character 8. The condition of the head parts.

The comb and wattles of good producers are usually large and plump, although those of the poor producers are small and shrivelled.

The 228 birds are distributed according to the condition of the head parts as follows : 73 birds were classified in group 1; 8 birds in group 2; 1 bird in group 3; 102 birds in group 4; 1 bird in group 5; 10 birds in group 6, and 33 birds in group 7.

The mode of 102 was attained by those birds in group 4; i.e., the group with the medium condition of the head parts.

The distribution of the annual production in eggs is as follows: 2 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 35 in the 180 egg group; 32 in the 200 egg group; 40 in the 220 egg group; 49 in the 240 egg group; 27 in the 260 egg group; 16 in the 280 egg group, and 1 bird in the 300 egg group.

The highest frequency of 49 was attained by the group which produced 240 eggs.

$$r = 0.275 \pm 0.041$$

The condition of the head parts correlates with annual egg production to a fair extent.

No work has been done by other investigators on the condition of the head parts .

Table 9. - Continued

SEC. E Cont.		SEC. F	
#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
112	273	25	246
107	204	14	240
117	115	78	180
116	215	66	249
123	169	89	215
122	226	91	145
118	210	83	224
129	213	96	175
120	255	104	221
126	168	105	234
127	171	110	232
124	191	108	250
128	266	247	175
130	234	236	229
125	220	233	197
251	219	210	234
256	229	211	240
240	200	207	202
224	168	200	232
225	178	202	192
227	214	206	140
219	197	208	230
214	261	195	177
198	187	170	180
199	231	164	248
196	157	166	172
197	192	142	205
190	210	143	254
193	206		
183	200		
185	184		
194	147		
189	224		
191	217		
181	182		
158	185		
163	178		
160	167		
157	240		
165	116		
146	245		
136	197		
132	249		
138	285		
140	199		
228	190		

Legend:

- Sec. A - Complete Molt
 B - Neck, back and wing Molt
 C - Neck and wing Molt
 D - Neck and back Molt
 E - Neck Molt
 F - No Molt.

Table 9 a. - Showing the distribution of the molt condition with annual egg production for 228 birds.

Annual Egg Production		Molt condition						Total (228)
		(1)	(2)	(3)	(4)	(5)	(6)	
300		1					1	
280		13	1	2			16	
260	7	9	5	1	4		26	
240	8	22	6	2	9	1	48	
220	3	18	3	3	11	3	41	
200	4	13	3	1	8	4	33	
180	4	10	3	2	13	2	34	
160	2	3	2		4	1	12	
140		1	2	1	3	3	10	
120		2					2	
100					2		2	
80								
60		1			2		3	
Total (228)	28	93	25	12	56	14		

Legend:

- | | |
|-------------------|-----------------------------|
| 1 - No molt | 4 - Neck and wings |
| 2 - Neck molt | 5 - Neck and back and wings |
| 3 - Neck and back | 6 - Complete molt |

Table 9 b. - Correlating the molt condition with the annual egg production for 228 birds.

ANNUAL PROD.	MOLT CONDITION						f	d	fd	fd ²	Σ de dg	
	6	5	4	3	2	1					++	--
40-59		2				1	3	-1	-21	147	21	
60-79								-6				
80-99		2					2	-5	-10	50	20	
100-119						2	2	-4	-8	32		8
120-139	3	3	1	2	1		10	-3	-30	90	45	
140-159	1	4		2	3	2	12	-2	-24	48	8	
160-179	2	13	2	3	10	4	34	-1	-34	34	16	
180-199	4	8	1	3	13	4	33		-127			
200-219	3	11	3	3	18	3	41	1	41	41		10
220-239	1	9	2	6	22	8	48	2	96	192	30	
240-259		4	1	5	9	7	26	3	78	234	42	-18
260-279			2	1	13		16	4	64	256	44	
280-299					1		1	5	5	25	5	
f	14	56	12	25	93	28	228		284	1149	231	
d	-3	-2	-1		1	2			-127		-18	
fd	-42	-112	-12	-166	93 + 56			228	157		213	
				149					0.68860			
				228	-17							

$$\begin{aligned}
 fd^2 &= 126 + 224 + 12 + 93 + 112 = 567 \div 228 = 2.4868 \\
 M_e &= 189.5 + \frac{157}{228} \times 20 = 203.27 \\
 M_g &= 2.45 - \frac{17}{228} = 2.3754 \\
 \sigma_e^2 &= \frac{1149}{228} - (0.68860)^2 = 4.5653 \\
 \sigma_e &= \sqrt{4.5653} = 2.1367 \\
 \sigma_g^2 &= \frac{567}{228} - (-0.074562)^2 = 2.4832 \\
 \sigma_g &= \sqrt{2.4832} = 1.5758 \\
 p &= \frac{213}{228} - (0.68860)(-0.074562) = 0.98555 \\
 r &= \frac{p}{\sigma_e \sigma_g} = \frac{0.98555}{(2.1367)(1.5758)} = 0.29270 \\
 P.E. &= 0.6745 \times \frac{1 - (0.29270)^2}{\sqrt{228}} = 0.040850 \\
 x &= 0.293 \pm 0.041
 \end{aligned}$$

Discussion of the Individual Character. - Continued:

Character 9. The molt condition.

Molting is a physiological change of the dropping of the old plumage and the growth of a new coat to replace it. Conditions being normal, molting takes place any time of the year the hen stops laying, and also at different lengths of time to complete the molt. Good layers are usually late molters. The molt is first manifested on the neck; later on it appears on the back and wings, and finally ending in a complete molt. The most common period for the molt to take place is during the month of August, at which time this work was done.

The 228 birds are distributed according to the condition of the molt as follows : 28 birds were classified in group 1; 93 birds in group 2; 25 birds in group 3; 12 birds in group 4; 56 birds in group 5, and 14 in group 6.

The mode of 93 was attained by group 2 which showed a neck molt.

The distribution of the annual production is as follows; 3 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 34 in the 180 egg group; 33 in the 200 egg group; 41 in the 220 egg group; 48 in the 240 egg group; 26 in the 260 egg group; 16 in the 280 egg group, and 1 in the 300 egg group.

The highest frequency of 48 was attained by the group

Character 9. The molt condition. - Continued :
which produced 240 eggs.

$$r = 0.293 \pm 0.041$$

The molting factor correlates to a fair degree with the annual egg production.

Similar results were obtained by Sherwood (1922), and Hervey (1923).

Table 10. - Setting forth original data regarding the condition of the shank and the annual egg production for 228 birds.

SEC. A		SECTION B								SEC. C	
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
HEN	PRO.	HEN	PRO.	HEN	PRO.	HEN	PRO.	HEN	PRO.	HEN	PRO.
9	215	5	236	73	192	224	168	156	176	1	226
24	232	2	277	74	268	223	212	147	169	7	151
14	240	4	261	88	268	227	214	149	241	8	270
15	273	13	166	81	216	232	243	154	220	16	245
37	216	3	171	89	215	233	197	155	257	38	152
51	243	10	225	82	229	215	222	142	205	33	196
46	195	12	238	85	227	209	210	136	197	34	180
47	223	6	179	90	203	218	130	143	254	56	170
44	236	11	127	87	224	221	197	134	201	61	271
40	163	26	221	84	209	217	211			55	155
50	226	20	240	79	199	219	197			63	198
43	228	17	227	96	172	216	220			60	96
75	267	25	246	102	236	210	234			59	248
70	233	19	225	100	58	214	261			66	249
78	180	21	263	98	184	211	240			69	204
67	189	22	238	114	224	207	202			86	234
116	215	18	252	115	231	199	231			91	145
249	180	30	209	111	236	198	187			83	224
225	178	31	230	110	232	201	204			95	132
213	224	39	234	105	234	200	237			97	143
202	192	28	209	109	241	197	192			104	221
		27	280	113	215	196	157			94	133
		36	213	108	250	204	88			101	200
		32	215	106	161	203	134			92	214
		35	220	112	273	205	161			93	174
		29	222	107	204	206	140			103	167
		41	243	117	115	208	230			99	146
		42	260	123	169	190	210			121	201
		52	245	122	226	195	177			118	210
		48	198	257	274	189	224			129	273
		49	253	259	167	191	217			120	255
		45	160	253	225	177	217			126	168
		54	178	250	218	173	189			127	171
		53	171	251	219	169	125			124	191
		65	217	252	194	167	199			128	266
		64	222	249	180	163	178			130	234
		58	240	256	229	160	167			125	220
		72	235	240	200	166	172			236	229
		68	128	247	175	159	207			238	46
		76	260	245	131	157	240			241	183
		77	229	239	176	165	116			242	44
		71	259	226	177	148	150			229	132
						144	196				

Table 10. - Continued

SEC. C	
Cont.	
<u>#</u>	<u>AV.</u>
<u>HEX</u>	<u>PRO.</u>
228	190
193	206
185	184
183	200
194	147
187	161
175	146
180	152
176	179
179	185
182	201
178	171
171	208
181	182
170	180
168	202
164	248
158	185
146	245
152	128
153	173
151	178
150	175
137	195
139	173
135	211
140	199
138	255
132	249

Legend:

- Sec. A - Very shrunken Shank
 B - Shrunken Shank
 C - Smooth Shank

Table 10 a. - Showing the distribution of the condition of the shanks with annual egg production for 228 birds.

Annual Egg Production				Total (228)
	(1)	(2)	(3)	
300		1		1
280	2	9	4	15
260	2	17	8	27
240	7	35	6	48
220	3	25	11	39
200	5	15	13	33
180	2	21	13	36
160		3	9	12
140		6	4	10
120		2		2
100		1	1	2
80				
60		1	2	3
Total (228)	21	136	71	
	(1)	(2)	(3)	

Condition of the shanks.

Legend:

- 1. Good - (very shrunken shanks)
- 2. Medium - (shrunken shanks)
- 3. Poor - (smooth shanks)

Table 10 b. - Correlating the condition of the shank with the annual egg production for 228 birds.

ANNUAL PROD.	SHANK CONDITION			f	d	fd	fd ²	Σ de dg	
	3	2	1					++	--
40-59	2	1		3	-7	-21	147	14	
60-79					-6				
80-99	1	1		2	-5	-10	50	5	
100-119		2		2	-4	-8	32		
120-139	4	6		10	-3	-30	90	12	
140-159	9	3		12	-2	-24	48	18	
160-179	13	21	2	36	-1	-36	36	11	
180-199	13	15	5	33		-129			
200-219	11	25	3	39	1	39	39		8
220-239	6	35	7	48	2	96	192	2	
240-259	8	17	2	27	3	81	243		18
260-279	4	9	2	15	4	60	240		8
280-299		1		1	5	5	25	62	-34
f	71	136	21	228		281	1142	-34	
d	-1		1			-129		28	
fd	-71	(-71)	21		228	152			
		(21)				0.66667			
	228	-50							
		-0.21930							

$$fd^2 = 71 + 21 = 92 \div 228 = 0.40351$$

$$Me. = 189.5 + \frac{152}{228} \times 20 = 202.83$$

$$Mg. = 1.45 - \frac{50}{228} = 1.2307$$

$$s_e^2 = \frac{1142}{228} - (0.66667)^2 = 4.5644$$

$$s_e = \sqrt{4.5644} = 2.1365$$

$$s_g^2 = \frac{92}{228} - (-0.21930)^2 = 0.35542$$

$$s_g = \sqrt{0.35542} = 0.59617$$

$$P = \frac{28}{228} - (0.66667)(-0.21930) = 0.26901$$

$$r = \frac{P}{s_e s_g} = \frac{0.26901}{(2.1365)(0.59617)} = 0.21120$$

$$P.E. = 0.6745 \times \frac{1 - (0.21120)^2}{\sqrt{228}} = 0.042684$$

$$r = 0.211 \pm 0.043$$

Discussion of the Individual Character - Continued :

Character 10. The condition of the shank.

Good layers will usually have thin and shrivelled shanks, although poor layers will have thick and plump shanks.

The 228 birds are distributed according to the condition of the shank as follows : 21 birds showed good condition; 136 birds showed medium condition, and 71 birds showed poor condition.

The mode of 136 was attained by those birds which showed medium condition.

The distribution of the annual production is as follows: 3 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 36 in the 180 egg group; 33 in the 200 egg group; 39 in the 220 egg group; 48 in the 240 egg group; 27 in the 260 egg group; 15 in the 280 egg group; and 1 in the 300 egg group.

The highest frequency of 48 was attained by the group which produced 240 eggs.

$$r = 0.211 \pm 0.043$$

The condition of the shank correlates with annual egg production to a fair degree.

No work has been done by other investigators on the condition of the shank in relation to egg production.

Table 11. - Setting forth original data regarding the flatness of the top of the skull and the annual egg production for 228 birds.

SECTION A				SECTION B				SEC. C			
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.		
HEN	PRO.	HEN	PRO.	HEN	PRO.	HEN	PRO.	HEN	PRO.		
9	215	252	194	132	249	91	145	183	200	6	179
2	277	256	229	139	173	79	199	195	177	16	246
13	166	240	200	137	195	96	172	189	224	15	273
3	171	241	183	155	257	94	133	191	217	22	238
10	225	242	44	150	175	101	200	177	217	18	252
12	238	245	131	154	220	93	174	175	146	31	230
8	270	239	176	5	236	100	58	176	179	39	234
17	227	223	212	4	261	103	167	179	185	27	280
26	221	227	214	1	226	99	146	182	201	34	180
21	263	209	210	7	151	98	184	178	171	36	213
38	152	221	197	11	127	114	224	173	189	37	216
42	260	219	197	20	240	112	273	171	208	29	222
52	245	216	220	19	225	107	204	170	180	51	243
48	198	210	234	24	232	117	115	164	248	44	236
40	163	214	261	25	246	116	215	165	116	61	271
49	253	211	240	30	209	121	201	148	150	65	217
45	160	207	202	28	209	120	255	152	128	63	198
59	248	199	231	33	196	127	171	153	173	81	216
71	259	198	187	32	215	128	266	156	176	95	132
77	229	202	192	35	220	130	234	143	254	97	143
73	192	206	140	46	195	125	220	147	169	102	236
66	249	185	184	47	223	249	180			104	221
67	189	187	161	50	226	247	175			106	161
69	204	180	152	43	228	236	229			122	226
88	268	167	199	54	178	226	177			118	210
85	227	168	202	56	170	224	168			129	273
87	224	169	125	53	171	229	132			126	168
83	224	158	185	64	222	232	243			124	191
92	214	163	178	58	240	228	190			128	266
115	231	160	167	72	235	233	197			225	178
110	232	166	172	68	128	215	222			213	224
105	234	157	240	76	260	218	130			193	206
109	241	144	196	75	267	217	211			194	147
113	215	142	205	70	233	200	237			181	182
108	250	138	255	74	268	201	204			159	207
123	169			78	180	196	157			151	178
252	274			89	215	197	192			136	197
258	239			86	234	203	134			135	211
259	167			82	229	204	88			134	201
253	225			90	203	205	161			140	199
250	218			84	209	208	230				
						190	210				

Table 11. - Continued

<u>SEC. D</u>	
<u>F</u>	<u>AN.</u>
<u>HEN</u>	<u>PRO.</u>
14	240
41	243
55	155
60	96
111	236
238	46
149	241

Legend:

Sec. A - Excellent
B - Good
C - Medium
D - Poor

Table 11a. - Showing the distribution of the flatness of the top of the skull with annual egg production for 228 birds.

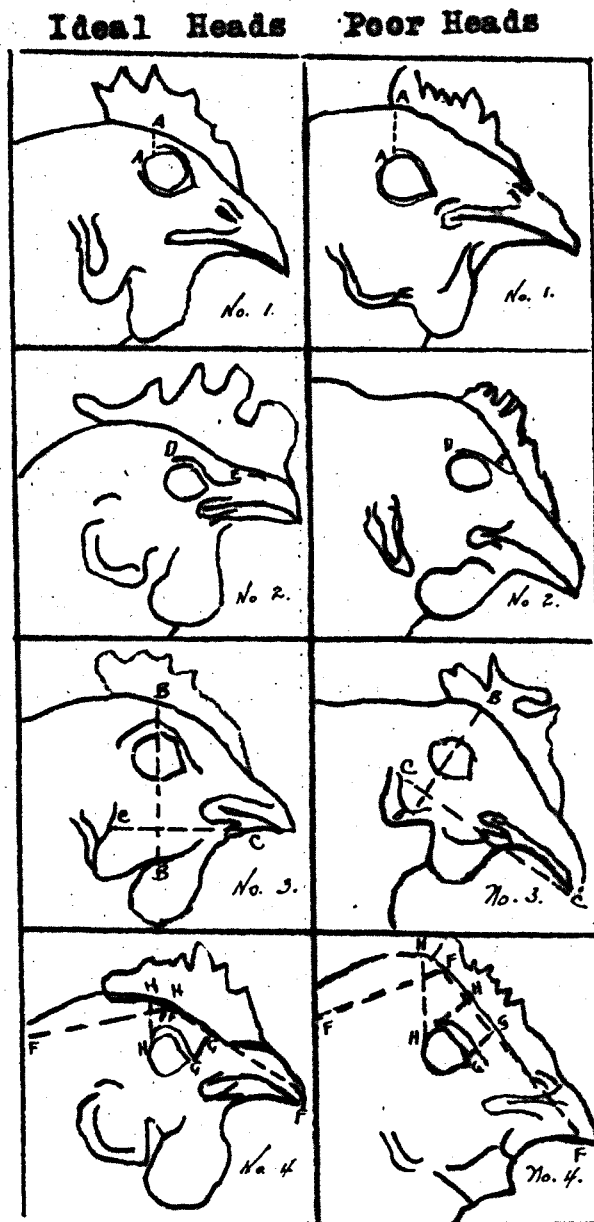
Annual Egg Production					Total (228)
	(1)	(2)	(3)	(4)	
300			1		1
280	6	6	4		16
260	10	9	3	3	25
240	19	22	9	1	51
220	13	18	9		40
200	13	13	6		32
180	11	19	5		35
160	3	6	2	1	12
140	2	7	1		10
120		2			2
100		1		1	2
80					
60		1		1	2
Total (228)	77 (1)	104 (2)	40 (3)	7 (4)	

Degree of flatness of skull

Legend:

1. Excellent
2. Good
3. Medium
4. Poor.

The Steup's System



Figure¹ - The Key to Head Points

1. H. H. Steup 1928 "Breeding and Culling by Head Points" Figure 6; page 24, published by the Poultry Tribune, Mount Morris, Illinois.

Discussion of the Individual Character - Continued :

Character 11. The flatness of the top of the skull.

Mr. H. H. Steup, formerly Assistant Professor of Poultry Husbandry, Kansas State, Agricultural College, claims that on good producers with flat heads the eye sets well up toward the base of the comb. At this point the reader is referred to the Figure on page 69, No.1. It will be observed that the line AA is very short on the ideal head. Although on poor producers, the top of the skull slopes or rounds downward sidewise to an eye set low in the head; giving the line AA on the poor head much more length.

The 228 birds are distributed according to the flatness of the top of the skull as follows : 77 birds showed an ideal type; 104 birds showed a good type; 40 birds showed a medium type and 7 birds showed a poor type.

The mode of 104 was attained by those birds which showed a good type of the character.

The distribution of the annual production is as follows: 2 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 35 in the 180 egg group; 32 in the 200 egg group; 40 in the 220 egg group; 51 in the 240 egg group; 25 in the 260 egg group; 16 in the 280 egg group and 1 in the 300 egg group.

The highest frequency of 51 was attained by the group which produced 240 eggs.

Character 11. The flatness of the top of the skull-Continued:

$$r = 0.092 \pm 0.044$$

There is no correlation between the flatness of the top of the skull and annual egg production.

The Steup's System is a very recent one. There is no published data regarding the correlation of any of its points with annual egg production.

Table 12. - Setting forth original data regarding the width of the skull and the annual egg production for 228 birds.

SEC. A		SECTION B				SECTION C			
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
12	238	5	236	115	231	198	187	9	215
17	227	4	261	111	236	201	204	2	277
38	152	8	270	110	232	200	237	13	166
42	260	26	221	105	234	196	157	3	171
48	198	20	240	113	215	204	88	1	226
61	271	15	273	108	250	203	134	10	225
65	217	18	252	112	273	190	210	7	151
55	155	14	240	117	115	185	184	6	179
64	222	31	230	116	215	183	200	11	127
59	248	50	209	123	169	195	177	25	246
58	240	33	196	121	201	194	147	24	232
72	235	34	180	122	226	189	224	19	225
68	128	36	213	129	273	191	217	16	246
76	260	32	215	120	255	175	146	21	263
66	249	37	216	126	168	180	152	22	238
91	145	47	223	124	191	176	179	39	234
83	224	44	236	128	266	179	185	28	209
79	199	40	163	130	234	182	201	27	280
96	172	50	226	125	220	178	171	35	220
94	133	49	253	259	167	173	189	29	222
101	200	43	228	253	225	171	208	41	243
103	167	45	160	251	219	181	182	51	243
109	241	54	178	249	180	170	180	46	195
258	239	56	170	256	229	167	199	52	245
239	176	63	198	240	200	164	248	53	171
225	178	77	229	247	175	158	185	60	96
216	220	71	259	236	229	163	178	70	233
210	234	75	267	241	183	160	167	89	215
211	240	74	268	242	44	159	207	82	229
207	202	73	192	245	131	165	116	97	143
199	231	78	180	226	177	148	150	102	236
197	192	67	189	224	168	144	196	93	174
206	140	69	204	223	212	146	245	106	161
208	230	88	268	227	214	152	128	107	204
187	161	81	216	229	132	149	241	118	210
169	125	86	234	232	243	154	220	127	171
168	202	85	227	228	190	150	175	257	274
166	172	90	203	233	197	155	257	250	218
157	240	87	224	215	222	142	205	252	194
153	173	84	209	213	224	136	197	238	46
156	176	95	132	218	130	143	254	209	210
151	178	104	221	217	211	134	201	221	197
147	169	92	214	219	197	132	249	202	192
137	195	100	58	214	261			205	161
139	173	99	146						
135	211	98	184						
138	255	114	224						

Legend:

Sec. A - Good
 B - Medium
 C - Poor

Table 12 a. - Showing the distribution of the skull width with annual egg production for 228 birds.

Annual Egg Production				Total (228)
	(1)	(2)	(3)	
300			1	1
280	3	10	3	16
260	7	14	5	26
240	10	28	11	49
220	5	26	9	40
200	4	23	5	32
180	11	16	8	35
160	4	6	2	12
140	3	6	1	10
120		2		2
100		1	1	2
80				
60		2	1	3
Total (228)	47	134	47	

Degrees of skull width

Legend:

- 1. Good
- 2. Medium
- 3. Poor

Table 12 b. - Correlating the skull width with the annual egg production for 228 birds.

ANNUAL PROD.	SKULL WIDTH			f	d	fd	fd ²	Σ de dc	
	3	2	1					++	--
40-59	1	2		3	-7	-21	147	7	
60-79					-6				
80-99	1	1		2	-5	-10	50	5	
100-119				2	-4	-8	32		
120-139	1	6	3	10	-3	-30	90		6
140-159	2	6	4	12	-2	-24	48		4
160-179	8	16	11	35	-1	-35	35		3
180-199	5	23	4	32		-128			
200-219	9	26	5	40	1	40	40		4
220-239	11	28	10	49	2	98	196		2
240-259	5	14	7	26	3	78	234	6	
260-279	3	10	3	16	4	64	256	18	
280-299	1			1	5	5	25		5
f	47	134	47	228		285	1153		-24
d	-1		1			-128			18
fd	-47	+	47	= 0.0	228	157			-6
fd ²	47	+	47	= 94	÷ 228	= 0.68860			
Me.	= 189.5	- 157	× 20			= 203.27			
Mg.	= 1.45					= 1.45			
σ ² _e	=	$\frac{1153}{228}$	- (0.68860) ²			= 4.5828			
σ _e	=	$\sqrt{4.5828}$				= 2.1407			
σ ² _g	=	$\frac{94}{228}$	- (0.0) ²			= 0.41228			
σ _g	=	$\sqrt{0.41228}$				= 0.20305			
P	=	$\frac{-6}{228}$	- (0.68860)(0.0)			= -0.026316			
r	=	$\frac{P}{\sigma_e \sigma_g}$	=	$\frac{-0.026316}{(2.1407)(0.20305)}$		= -0.06054			
P.E.	=	0.6745	× $1 - \frac{(-0.06054)^2}{228}$			= 0.044514			

$$r = -0.061 \pm 0.044$$

Discussion of the Individual Character - Continued :
 Character 12. The skull width as carried forward.

In the Steup's System it is claimed that good producers will usually have the eye set well forward in the head under the front half on the comb, although poor producers usually have the eye sitting farther back under the rear half of the comb or else behind the comb entirely. Most skull widths taper and narrow just in front of the eye. The reader is referred to the Figure on page 69 No. 2. It will be observed that the ideal type carry this width farther forward than do the poor type. The front point of skull width is illustrated as point E.

The 228 birds are distributed according to the skull width as carried forward as follows : 47 birds showed a good type; 134 showed a medium type, and 47 birds showed a poor type.

The mode of 134 was attained by those birds which showed a medium type of the carry forward of the skull width.

The distribution of the annual production is as follows: 3 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 35 in the 180 egg group; 32 in the 200 egg group; 40 in the 220 egg group; 49 in the 240 egg group; 26 in the 260 egg group; 16 in the 280 egg group, and 1 in the 300 egg group.

The highest frequency of 49 was attained by the group which produced 240 eggs.

Character 12. The skull width as carried forward - Continued :

$$r = \pm 0.061 - 0.044$$

There is no correlation between the skull width as carried forward and annual egg production.

Table 13. - Setting forth original data regarding the head balance and the annual egg production for 228 birds.

SECTION A				SECTION B						SEC. C	
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
17	227	197	192	4	261	115	231	195	177	5	236
19	225	196	157	6	179	111	236	194	147	9	215
35	220	206	140	8	270	110	232	175	146	2	277
48	198	190	210	11	127	106	161	177	217	13	166
40	163	185	184	12	238	112	273	176	179	3	171
54	178	187	161	14	240	117	115	179	185	1	226
65	217	189	224	15	273	116	215	173	189	7	151
55	155	191	217	16	246	123	169	170	180	26	221
63	198	180	152	18	252	118	210	169	125	20	240
64	222	182	201	21	263	129	273	167	199	25	246
60	96	178	171	30	209	126	168	163	178	24	232
59	248	181	182	38	152	127	171	160	167	22	238
58	240	168	202	39	234	128	266	159	207	31	230
66	249	166	172	27	280	130	234	157	240	28	209
88	268	146	245	33	196	125	220	165	116	37	216
89	215	153	173	34	180	257	274	148	150	29	222
82	229	156	176	36	213	258	239	144	196	51	243
87	224	151	178	32	215	259	167	152	128	47	223
91	145	147	169	41	243	253	225	142	205	44	236
95	132	149	241	46	195	250	218	143	254	49	253
96	172	154	220	56	170	249	180	139	173	42	260
97	143	155	257	63	198	256	229			43	228
104	221	137	195	61	271	236	224			52	245
103	167	135	211	72	235	242	222			45	160
98	184	134	201	68	128	245	131			50	226
109	241	138	255	76	260	239	176			75	267
121	201			77	229	226	177			70	233
122	226			71	259	224	168			73	192
120	255			74	268	223	212			69	204
124	191			78	180	227	214			93	174
251	219			67	189	232	243			114	224
247	175			81	216	215	222			105	234
225	178			86	234	217	211			113	215
228	190			85	227	219	197			108	250
233	197			90	203	199	231			107	204
209	210			84	209	198	187			252	194
213	224			83	224	201	204			240	200
218	130			79	199	200	237			238	46
221	197			102	236	204	88			241	183
219	197			94	133	203	134			229	132
216	220			101	200	205	161			210	234
211	240			92	214	208	230			214	261
207	202			100	58	193	206			202	192
				99	146	183	200			171	208

Table 13. - Continued

SEC. C
Cont.

<u>#</u>	<u>AN.</u>
<u>HEN</u>	<u>PRO.</u>

164	248
158	185
150	175
136	197
140	199
132	249

Legend:

Sec. A - Good
B - Medium
C - Poor

Table 13 a. - Showing the distribution of the head balance with annual egg production for 228 birds.

Annual Egg Production				Total (228)
	(1)	(2)	(3)	
300		1		1
280	1	10	4	15
260	10	9	8	27
240	12	22	15	49
220	13	20	10	43
200	11	15	6	32
180	13	16	4	33
160	6	5	1	12
140	2	7	1	10
120		2		2
100	1	1		2
80		1		1
60			1	1
Total (228)	69	109	50	

Legend:

1. Good
2. Medium
3. Poor.

Table 13 b. - Correlating the head balance with the annual egg production for 228 birds.

ANNUAL PROD.	HEAD BALANCE							$\Sigma de dg$	
	3	2	1	r	d	rd	rd ²	++	--
40-59	1	:	:	1	-7	-7	49	7	
60-79		:	1	1	-6	-6	36		
80-99		:	1	2	-5	-10	50		5
100-119		:	2	2	-4	-8	32		
120-139	1	:	7	10	-3	-30	90		3
140-159	1	:	5	12	-2	-24	48		10
160-179	4	:	16	33	-1	-33	33		9
180-199	6	:	15	32		-118			
200-219	10	:	20	43	1	43	43	3	
220-239	15	:	22	49	2	98	196		6
240-259	8	:	9	27	3	81	243	6	
260-279	4	:	10	15	4	60	240	16	12
280-299		:	1	1	5	5	25		45
Σ	50		109	69	228	287	1085		16
d	-1			1		-118			-29
rd	-50			69		228	169		
			-50						
			228	19					
			0.083333						

$$rd^2 = 50 + \frac{69}{228} = 119 \div 228 = 0.52193$$

$$Me. = 189.5 + \frac{169}{228} \times 20 = 204.32$$

$$Mg. = 1.45 + \frac{19}{228} = 1.53333$$

$$s^2_e = \frac{1085}{228} - (0.74123)^2 = 4.2094$$

$$s_e = \sqrt{4.2094} = 2.0517$$

$$s^2_g = \frac{119}{228} - (0.083333)^2 = 0.52887$$

$$s_g = \sqrt{0.52887} = 0.72723$$

$$P = \frac{-29}{228} - (0.74123)(0.083333) = -0.18896$$

$$r = \frac{P}{s_e s_g} = \frac{-0.18896}{(2.0517)(0.72723)} = -0.12664$$

$$P.E. = 0.6745 \times \frac{1 - (-0.12664)^2}{\sqrt{228}} = 0.043962$$

$$r = -0.127 \pm 0.044$$

Discussion of the Individual Character - Continued :
 Character 13 . The head balance

The reader is referred to the Figure on page 69 No.3. It is claimed that on good producers the distance BB from the bottom of the comb to the top of the wattle is nearly equal in length to the line CC from front of the earlobe to the end of the beak. On poor layers the line CC is usually much longer than the line BB; thus it gives a narrow snakey appearance to the head.

The 228 birds are distributed according to the degree of the head balance as follows : 69 birds showed a good degree; 109 showed a medium degree, and 50 showed a poor degree of head balance.

The mode of 109 was attained by those birds which showed a medium degree of head balance.

The distribution of the annual production is as follows: 1 bird in the 60 egg group; 1 in the 80 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 33 in the 180 egg group; 32 in the 200 egg group; 43 in the 220 egg group; 49 in the 240 egg group; 27 in the 260 egg group; 15 in the 280 egg group, and 1 in the 300 egg group.

The highest frequency of 49 was attained by the group which produced 240 eggs.

$$r = - 0.127 \pm 0.044$$

There is no correlation between the head balance and annual egg production.

Table 14. - Setting forth original data regarding the levelness of the top of the head and the annual egg production for 228 birds.

SECTION A				SECTION B				SEC. C	
#	AN.	#	AN.	#	AN.	#	AN.	#	AN.
<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>	<u>HEN</u>	<u>PRO.</u>
2	277	225	178	5	236	130	234	148	150
4	261	226	177	13	166	125	220	1	226
3	171	214	261	12	238	258	239	8	270
10	225	206	140	7	151	259	167	20	240
17	227	194	147	11	127	253	225	25	246
41	243	177	217	26	221	250	218	24	232
51	243	180	152	19	225	251	219	16	246
46	195	176	179	21	263	256	229	15	273
47	223	170	180	22	238	240	200	18	252
42	260	169	125	31	230	247	175	30	209
52	245	168	202	38	152	209	210	27	280
48	198	164	248	39	234	217	211	32	215
40	163	158	185	28	209	219	197	60	96
50	226	163	178	33	196	216	220	77	229
49	253	157	240	34	180	211	240	70	233
43	228			36	213	199	231	88	268
45	160			35	220	201	204	81	216
54	178			37	216	200	237	86	234
56	170			29	222	202	192	87	224
53	171			44	236	197	192	96	172
61	271			68	128	203	134	95	132
65	217			71	259	204	88	104	221
55	155			75	267	205	161	100	58
63	198			74	268	208	230	103	167
64	222			78	180	193	206	114	224
59	248			66	249	185	184	111	236
58	240			67	189	183	200	110	232
72	235			89	215	191	217	105	234
76	260			90	203	175	146	117	115
73	192			91	145	179	185	122	226
69	204			83	224	178	171	118	210
84	209			79	199	167	199	129	273
94	133			97	143	160	167	127	171
92	214			101	200	165	116	124	191
93	174			99	146	147	169	128	266
98	184			115	231	146	245	257	274
107	204			109	241	151	178	252	194
112	273			113	215	157	240	249	180
236	229			108	250	150	175	241	183
238	46			106	161	136	197	227	214
242	44			116	215	143	254	229	132
245	131			123	169	137	195	232	243
239	176			121	201	139	173	228	190
224	168			120	255	140	199	233	197
				126	168	132	249	215	222
								213	224

Table 14. - Continued.

SEC. C		SEC. D	
Cont.			
#	AN.	#	AN.
<u>HEM</u>	<u>PRO.</u>	<u>HEM</u>	<u>PRO.</u>
218	130	9	215
221	197	6	179
210	234	14	240
207	202	82	229
198	187	85	227
196	157	102	236
190	210	154	220
195	177		
189	224		
187	161		
182	201		
173	189		
171	208		
181	182		
166	172		
159	207		
144	196		
152	128		
153	173		
156	176		
149	241		
155	257		
142	205		
135	211		
134	201		
138	255		

Legend:

Sec. A - Excellent
 B - Good
 C - Medium
 D - Poor

Table 14 a. - Showing the distribution of the levelness of the top of the head with annual egg production for 228 birds.

Annual Egg Production					Total (228)
	(1)	(2)	(3)	(4)	
300			1		1
280	7	3	6		16
260	8	10	8	1	27
240	8	22	16	4	50
220	7	18	14	1	40
200	7	14	10		31
180	13	12	8	1	34
160	4	7	1		12
140	3	3	4		10
120		1	1		2
100		1	1		2
80					
60	2		1		3
Total (228)	59 (1)	91 (2)	71 (3)	7 (4)	

Degree of levelness of top of the head

Legend:

1. Excellent
2. Good
3. Medium
4. Poor

Table 14 b. - Correlating the levelness of the top of the head with the annual egg production for 228 birds.

ANNUAL PROD.	LEVELNESS OF TOP OF THE HEAD				f	d	fd	fd ²	% de	dg
	4	3	2	1						
40-59	:	1	:	2	3	-7	-21	147		28
60-79	:	:	:			-6				
80-99	:	1	:	1	2	-5	-10	50		5
100-119	:	1	:	1	2	-4	-8	32		4
120-139	:	4	:	3	10	-3	-30	90		27
140-159	:	1	:	7	12	-2	-24	48		30
160-179	1	:	8	:	12	-1	-34	34		37
180-199	:	10	:	14	31		-127			
200-219	1	:	14	:	18	7	40	40	31	-131
220-239	4	:	16	:	22	8	50	200	68	
240-259	1	:	8	:	10	8	27	243	75	
260-279	:	6	:	3	7	16	4	256	68	
280-299	:	1	:	:	1	5	5	25		
f	7	71	91	59	228		290	1165	242	
d	-1		1	2			-127		-131	
fd	-7		91 + 118 = 209		228		163		111	

$$\frac{228 \times -127}{228 \times 228} = \frac{-127}{228} = -0.71491$$

$$fd^2 = 7 + 91 + 236 = 334 \div 228 = 1.4649$$

$$Me. = 189.5 + \frac{163}{228} \times 20 = 203.80$$

$$Mg. = 2.45 + \frac{202}{228} = 3.3360$$

$$\sigma^2_e = \frac{1165}{228} - (0.71491)^2 = 4.5985$$

$$\sigma_e = \sqrt{4.5985} = 2.1444$$

$$\sigma^2_g = \frac{334}{228} - (0.88596)^2 = 0.67997$$

$$\sigma_g = \sqrt{0.67997} = 0.82460$$

$$P = \frac{111}{228} - (0.71491)(0.88596) = -0.14654$$

$$r = \frac{P}{\sigma_e \sigma_g} = \frac{-0.14654}{(2.1444)(0.82460)} = -0.082871$$

$$P.E. = 0.6745 \times \frac{1 - (-0.082871)^2}{\sqrt{228}} = 0.044371$$

$$r = -0.083 \pm 0.044$$

Discussion of the Individual Character - Continued :

Character 14. The levelness of the top of the skull.

The reader is referred to the Figure on page 69, No. 4. It will be observed that the levelness of the top of the skull is indicated by noticing the degree of slant to the lines FFF. Mr. Steup, H. H. claims that good hens have these lines approaching levelness, whereas the poor producers have enough slope so as to produce a gable roof effect. On good hens, the center of the front of the eye is nearly the same distance from the bottom of the comb (as indicated by line GG) as is the same point on the rear of the eye (line HH). On poor producers, the vertical line HH is much longer than the line GG.

The 228 birds are distributed according to the levelness of the top of the skull as follows : 59 birds showed an excellent condition; 91 birds showed good condition; 71 birds showed medium condition and 7 birds showed a poor condition.

The mode of 91 was attained by the birds which showed a good condition or rather degree of levelness.

The distribution of the annual production is as follows: 3 birds in the 60 egg group; 2 in the 100 egg group; 2 in the 120 egg group; 10 in the 140 egg group; 12 in the 160 egg group; 34 in the 180 egg group; 31 in the 200 egg group; 40 in the 220 egg group; 50 in the 240 egg group; 27 in the 260 egg group; 16 in the 280 egg group, and 1 in the 300 egg group.

The highest frequency of 50 was attained by the group

Character 14. The levelness of the top of the skull-Continued:
which produced 240 eggs.

$$r = -0.083 \pm 0.044$$

There is no correlation between the levelness of the
top of the skull (head) and annual egg production.

Summary

Before attempting to summarize the findings of this investigation, it should be clearly understood that the purpose of this thesis is to point out whether or not those physiological and morphological characters involved in the discussion are accurate enough to be taken as an index for past production. No attempt has been made in this work to foretell the future production of the fowl by the use of the Systems herein mentioned.

The following is a summary of the Coefficient of Correlation between annual egg production and the fourteen characters observed on the two hundred and twenty eight birds used in this work :

Characters Correlated with Annual Egg Production	Coefficient of Correlation
<u>" The Orthodox System "</u>	
1. The distance between the pelvic bones....	-0.129 ± 0.044
2. The distance between pelvic and keel....	0.101 ± 0.044
3. The pelvic condition	0.140 ± 0.044
4. The color changes of the vent.....	0.358 ± 0.040
5. The color changes of the shank.....	0.411 ± 0.038
6. The color changes of the skin	0.345 ± 0.040
7. The condition of the body	0.341 ± 0.039
8. The condition of the head parts	0.275 ± 0.041
9. The melting factor.....	0.293 ± 0.041
10. The condition of the shanks.....	0.211 ± 0.043
<u>" The Steep's System "</u>	
11. The flatness of the top of the skull ...	0.092 ± 0.044
12. The skull width as carried forward	-0.061 ± 0.044
13. The head balance	-0.127 ± 0.044
14. The levelness of the top of the head....	-0.083 ± 0.044

It will be observed from the summary of the Coefficient of Correlation that the only significant correlations with the annual egg production are the color changes of the vent,

Summary - Continued :

shanks and skin, and the condition of the body.

The molt condition, the condition of the head parts, and the condition of the shanks correlate with annual egg production to a fair degree.

There is a very slight correlation between the pelvic condition and the annual egg production.

The following characters show no correlation with annual egg production : the distance between the pelvic bones; the distance between the pelvic and the keel bones; the flatness of the top of the skull; the skull width as carried forward; the head balance, and the levelness of the top of the head. The last four represent the Steup's Head Points System.

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