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Improving Mongrel Farm Flocks Through Selected Standardbred Cockerels

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IMPROVING MONGREL FARM FLOCKS THROUGH SELECTED STANDARDBRED COCKERELS[1]

WILLIAM A. LIPPINCOTT

Grading is recognized among livestock men as the quickest and cheapest breeding method of improving an ordinary farm herd. For the commercial production of food of animal origin, good grades may be as economical as purebreds. The practice of grading is growing rapidly. It is resulting in an increased efficiency in food production and reacting to the lasting benefit of the pure breeds of horses, cattle, sheep, and swine.

There are several very good reasons why grading has not been so generally adopted as a breeding practice with regard to farm flocks of chickens. It is, in the first place, much simpler to develop a standardbred flock of chickens than a purebred herd of larger animals. The initial cost is relatively small and the rate of reproduction more rapid. There are no registry rules to be abided by and pedigree records, desirable as they may be, are not required. In very many, perhaps most communities of the Middle West, the demand for vigorous standardbred cockerels is so insistent that a considerable source of profit is overlooked on those farms which harbor other than standardbred flocks.

A further reason for the nonadoption of grading as a poultry breeding method is found in the multiplicity of breeds and varieties. Even in sections where standardbred poultry is abundant, so many types and colors are found, that buyers and packers have been unable to secure large enough numbers of any one type and color to justify paying a premium for uniformity. There has therefore been little financial incentive in grading up poultry for market. This difficulty may possibly not be overcome until general conditions are such as to make cooperative effort along agricultural lines more neces-

ACKNOWLEDGMENT.—It is a pleasure for the writer to acknowledge his indebtedness to Norton L. Harris and James Machir. The pens were under the immediate supervision of Mr. Harris throughout the experiment. The results with regard to egg production could hardly have been obtained without skillful management. Mr. Machir kept the records throughout the experiment and took all the photographs shown.

[1] Contribution No. 13 from the Department of Poultry Husbandry.

sary than at present. If that time arrives, with it may come the possibility of a given community uniting upon a certain breed and variety of chickens and producing it and its grades in large enough numbers to warrant buyers in paying a premium for uniformity.

With the discovery by Pearl[1] that high winter egg production in the Barred Plymouth Rock breed is inherited by pullets only from their sires, and not from their dams, new light was thrown on the possibilities of grading as a poultry breeding method on the general farm. For the farmer whose attention has been so taken by other matters that he has not found it possible to give a standardbred flock his thought, it appears that grading, by means of standardbred cockerels from high-producing families, ought to offer a ready and rapid means of improving egg production, as well as of securing a uniform flock, assuming that high production is inherited in other breeds in the same way as in the Plymouth Rock.

From the standpoint of breeders of standardbred poultry, the adoption of grading as a more general farm practice would undoubtedly prove desirable in three ways: (1) It would open a wider outlet for standardbred cockerels, (2) awaken a still larger interest in standardbred poultry in the open country than now prevails, and (3) tend to raise the average egg production of the standard breeds.

The interest of the farmer of the Middle West is in egg production. When he buys standardbred males he consistently demands cockerels from high-producing families. This is due largely to the wide interest in good egg production fostered and developed by state agricultural experiment stations which have been conducting egg-laying contests. Recently, however, it has been heightened by food conditions growing out of the war. Should this demand continue, as there is every reason to believe it will, there will be an increased effort on the part of breeders to meet it. This can only mean a higher average production of the breeds commonly found on general farms.

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[1] Pearl, Raymond. The mode of inheritance of fecundity in the domestic fowl. Jour. Expt. Zool. **13**:153-268. Figs. 2. 1912.

HISTORY OF THE EXPERIMENT

It was with some of the foregoing considerations in mind that in the fall of 1912 the Kansas Agricultural Experiment Station undertook an investigation which has since been known as "The Grading Experiment." Its object was to ascertain what influence selected standardbred cockerels might have in improving mongrel flocks of chickens with regard to egg production and uniformity.

Unfortunately a storm wrecked the building in which the experiment was housed, in the midst of the first breeding season. The pens were unavoidably mixed and the work for that year came to naught. The following fall, 1913, a new start was made which marks the beginning of the work herein reported.

Forty mongrel pullets were purchased from Perry Brothers, poultry packers, Manhattan. These were divided into four lots of ten each on November 1, the lots being so selected that they were as similar as possible in type, weight, and development. No consideration was given to color. The appearance of these pullets sometime after their purchase is shown in figures 1, 8, 15, and 22. These figures show the four lots into which the pullets were divided, being entered on the records as Pens I, II, III, and IV, respectively.

The original four pens were housed from November 1, 1913, to November 1, 1914, in colony houses that were identical and surrounded by yards of equal size. On November 1, 1914, each original pen was displaced by a pen of daughters (see following) and the original females turned in with the general college flock until their respective laying years were completed. This process was repeated for each of the three years.

All pens were fed the same ration throughout the experiment, so far as proportions were concerned, the amount fed each pen being varied according to its needs. All were given all the feed they would consume and remain active. In so far as it was possible to make them, the environmental conditions were the same for all of the 16 pens.

A White Orpington cockerel (legband 1E) was mated with Pen I (legbands 51 to 60, inclusive); a Barred Rock cockerel (legband 3E), with Pen II (legbands 61 to 70, inclusive); a Single Comb White Leghorn cockerel (legband 105E), with Pen III (legbands 71 to 80, inclusive); and a mongrel cockerel

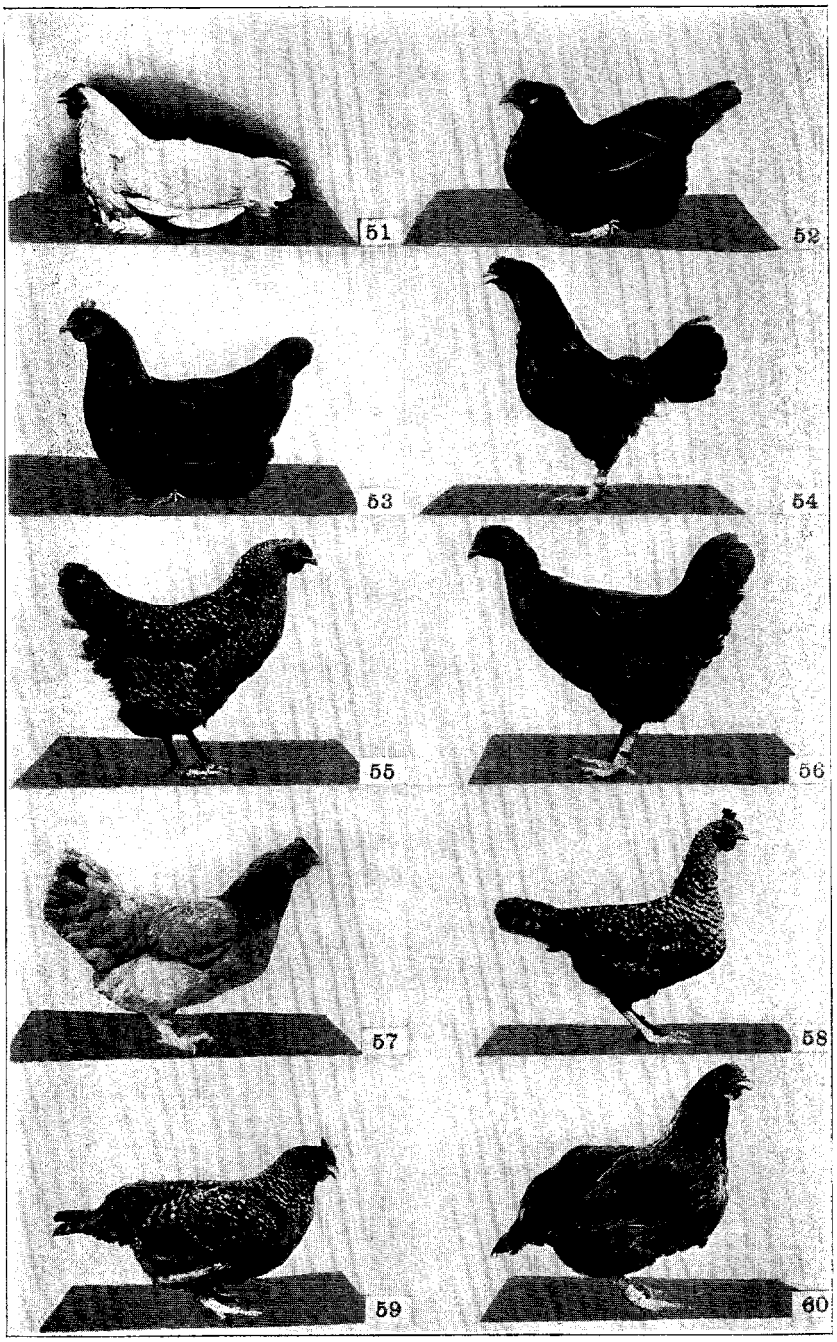


Fig. 1.—See opposite page for description

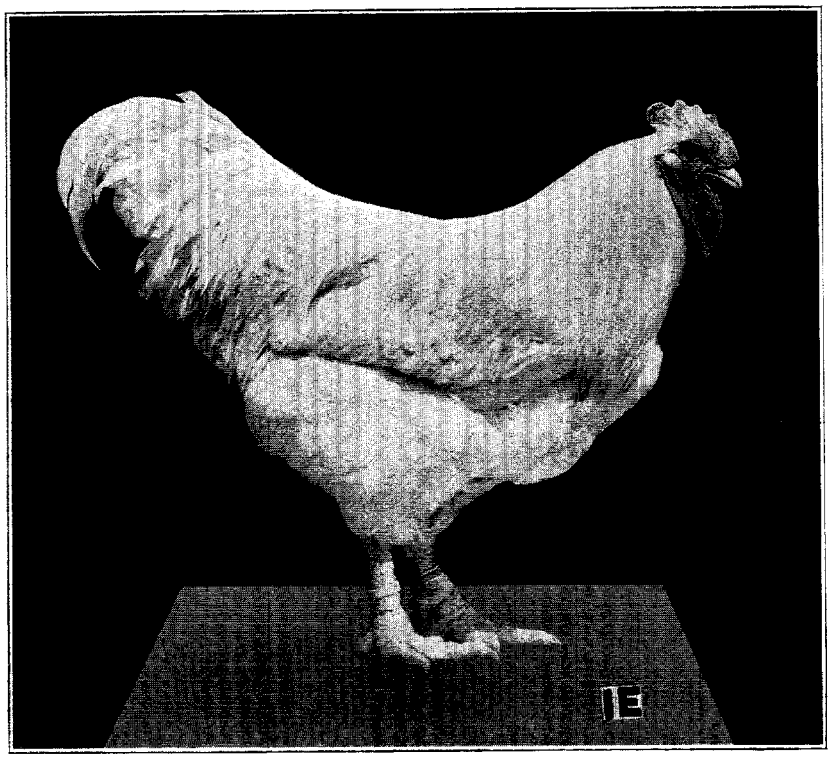


Fig. 2.—White Orpington male 1E mated with Pen I. Sire of females in Pen V. His pedigree in so far as furnished by his breeder, Cyphers Company Poultry Farm, Elma Center, N. Y., is as follows:

Sire
Not recorded
Dam
Hen 55 (imported)
Record, 187 eggs in 10 months

Fig. 1.—Original mongrel females, legband Nos. 51 to 60, inclusive, comprising Pen I. Mothers of females in Pen V (fig. 3)

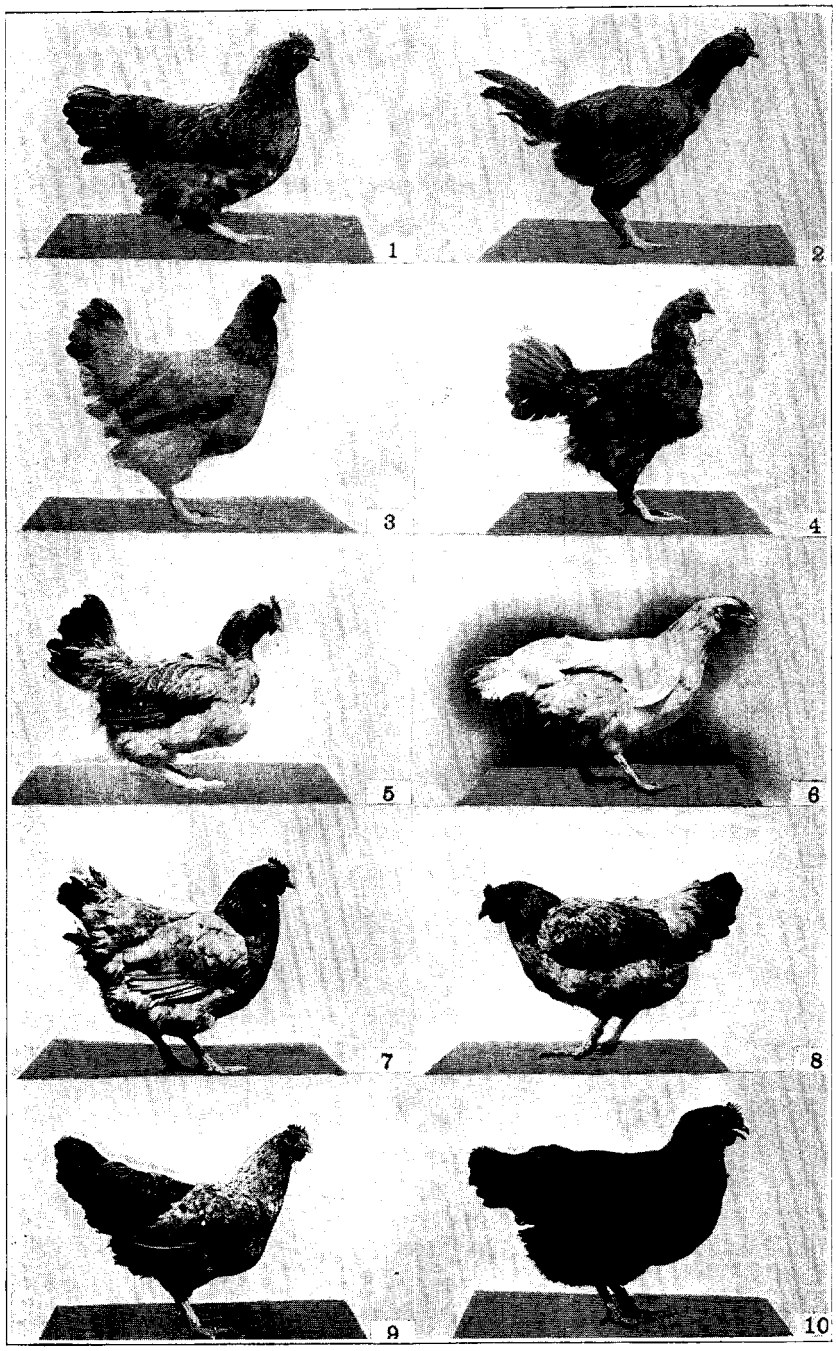


Fig. 8.—See opposite page for description

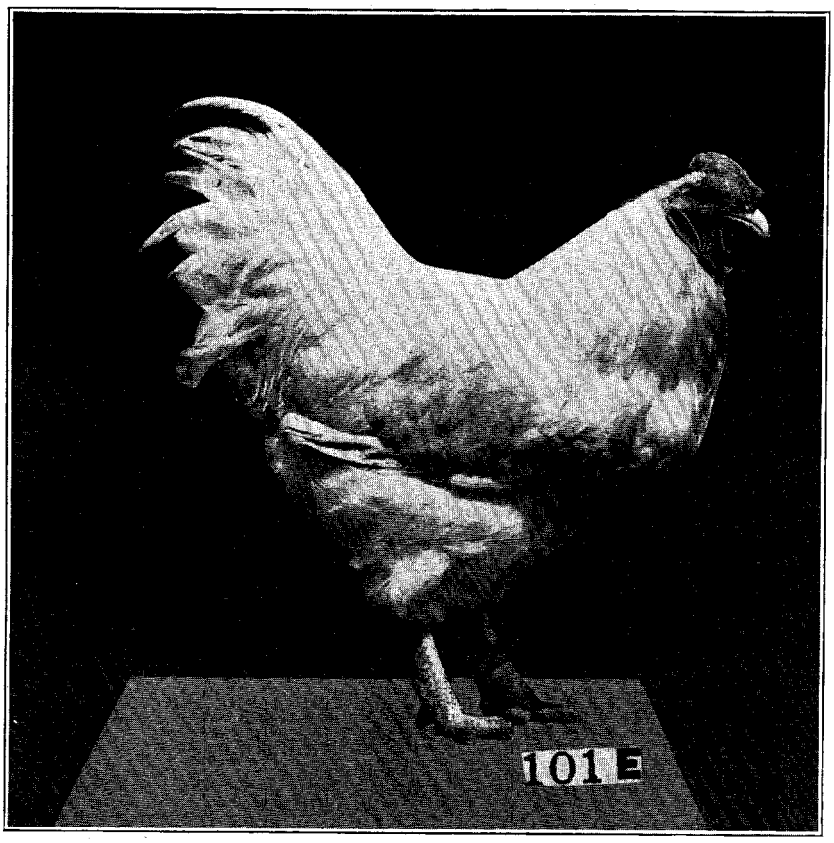
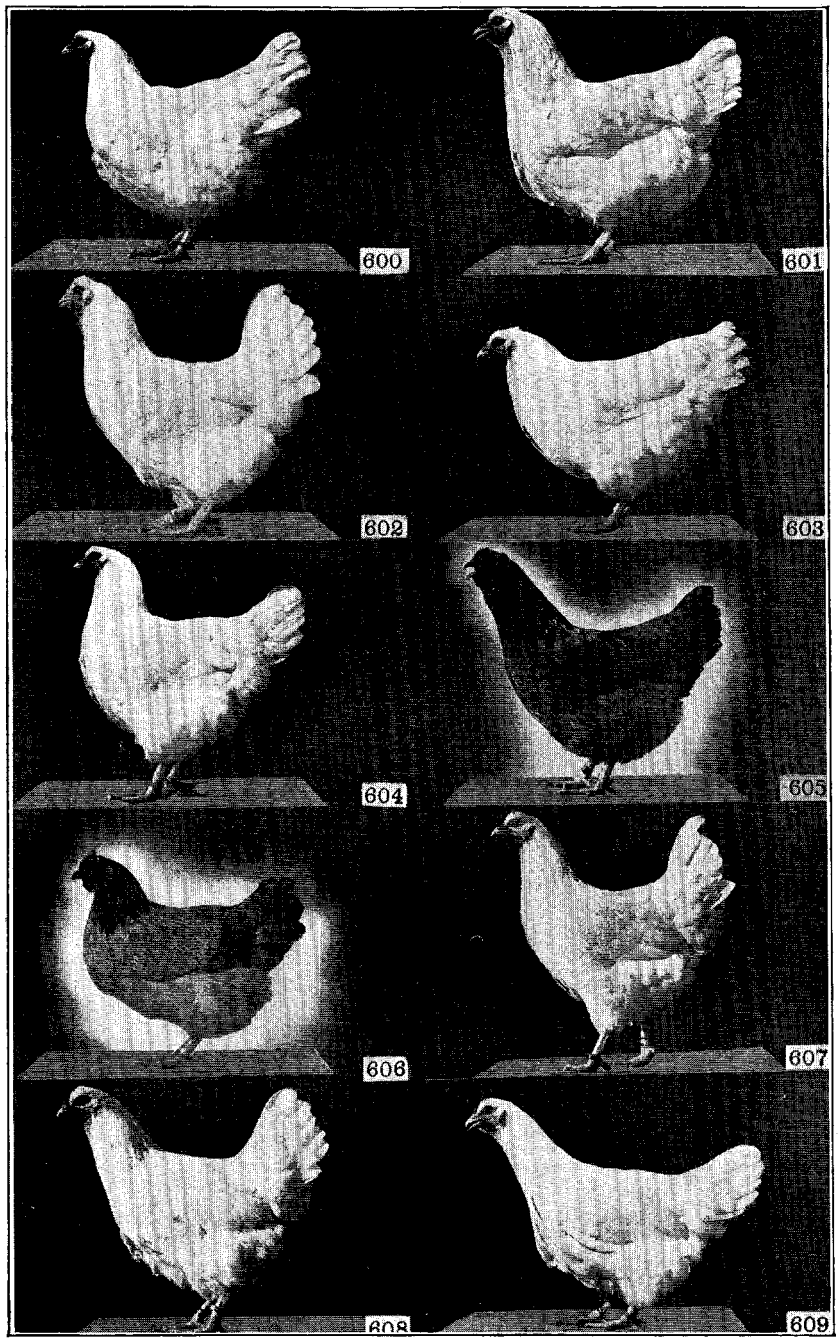


Fig. 4.—White Orpington male 101E mated with Pen V. Sire of females in Pen IX. His pedigree in so far as furnished by his breeder, Cyphers Company Poultry Farm, Elma Center, N. Y., is as follows:

Sire—Cockerel 3885	Cockerel 92	Not recorded
		Not recorded
	Hen 102	Not recorded
	Record of 206 eggs	Not recorded
Dam—Hen 433	Not recorded	
Record of 210 eggs	Not recorded	

Fig. 3.—First-generation White Orpington grades, legband Nos. 1 to 10, inclusive, comprising Pen V. Mothers of females in Pen IX (fig. 5)



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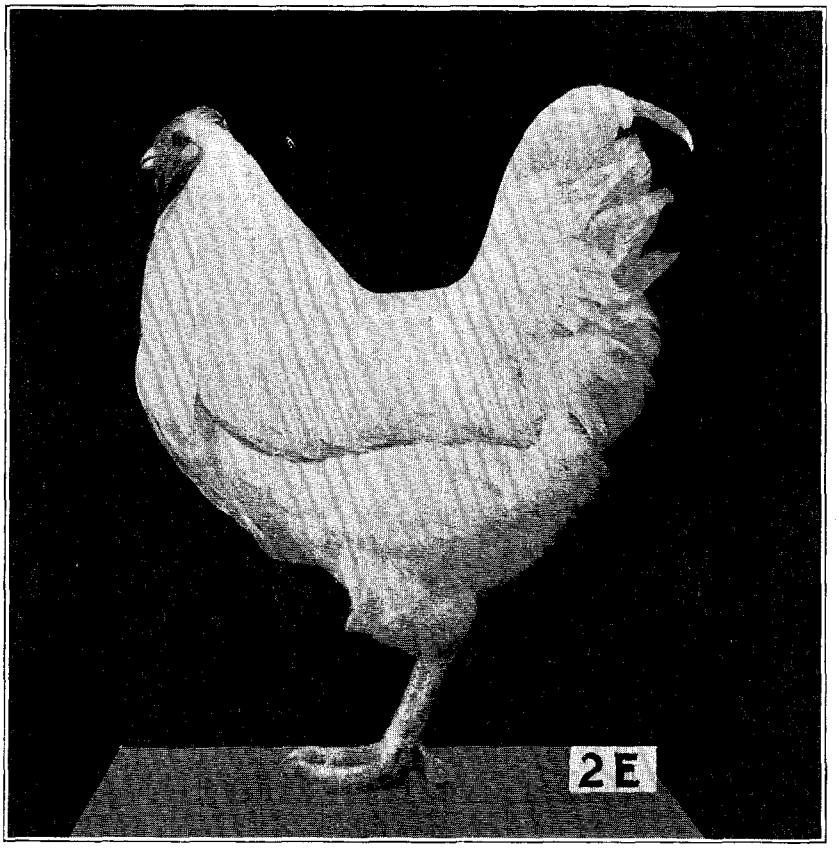


Fig. 6.—White Orpington male 2E mated with Pen IX. Sire of females in Pen XIII. His pedigree in so far as furnished by his breeder, Cyphers Company Poultry Farm, Elma Center, N. Y., is as follows:

Sire
Not recorded
Dam
Hen 438
Record, 212 eggs

Fig. 5.—Second-generation White Orpington grades, legband Nos. 600 to 609, inclusive, comprising Pen IX. Mothers of females in Pen XIII (fig. 7)

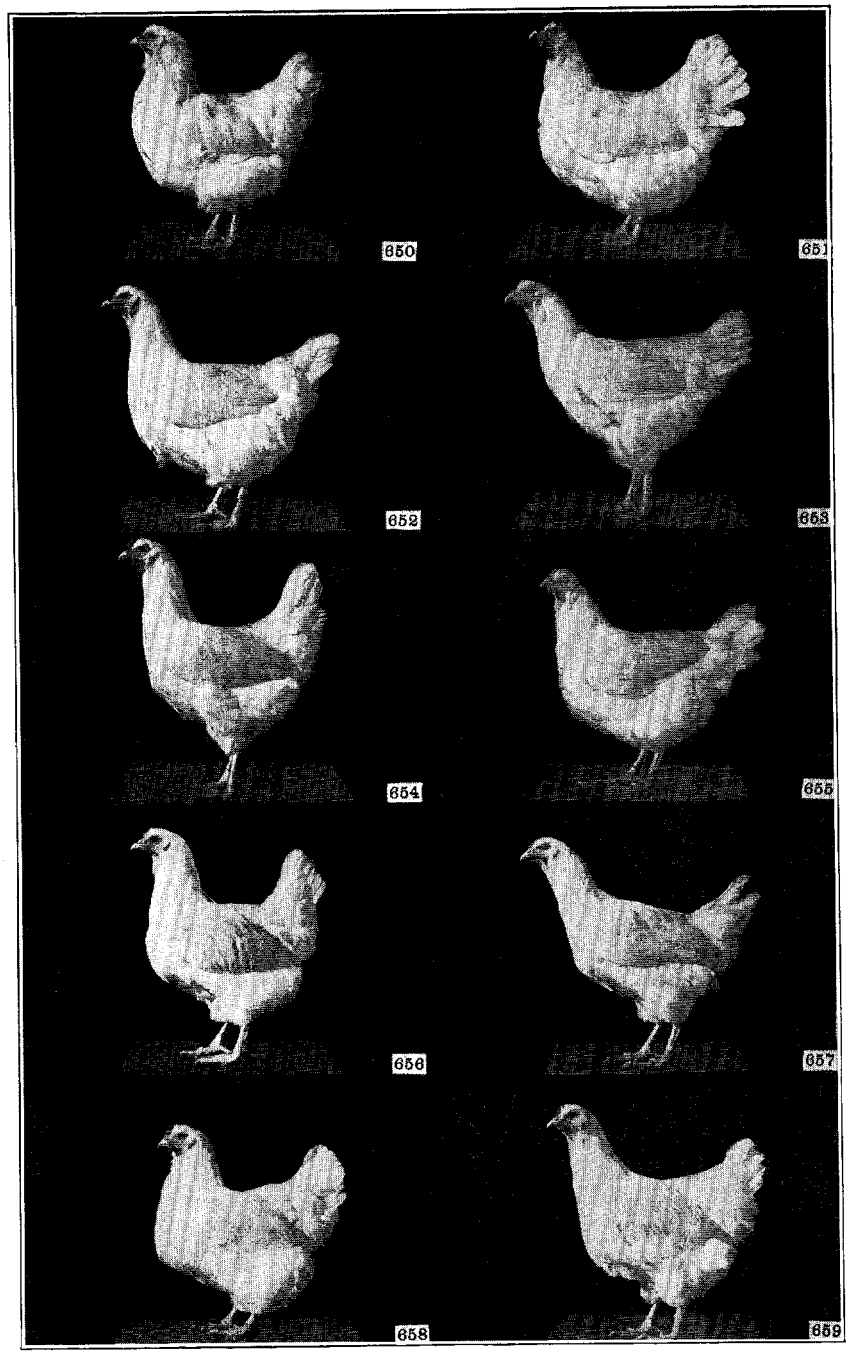


Fig. 7.—See opposite page for description

(legband 8E), with Pen IV (legbands 81 to 90, inclusive). The cockerels mated to the first three pens were, according to the information furnished by their breeders, from high-producing families of their respective breeds. The mongrel cockerel was purchased from the packing house with the mongrel pullets. As with the pullets, nothing was known about his breeding beyond what might be surmised from his appearance. The appearance of these cockerels may be seen in figures 2, 9, 16, and 23, and the pedigrees of 1E, 3E, and 105E, in so far as they were furnished by the breeders from whom they were purchased, are to be found in the accompanying legends.

The following fall, 1914, ten of the pullet offspring from each of the foregoing pens were mated with cockerels of the same breeds as their respective sires.

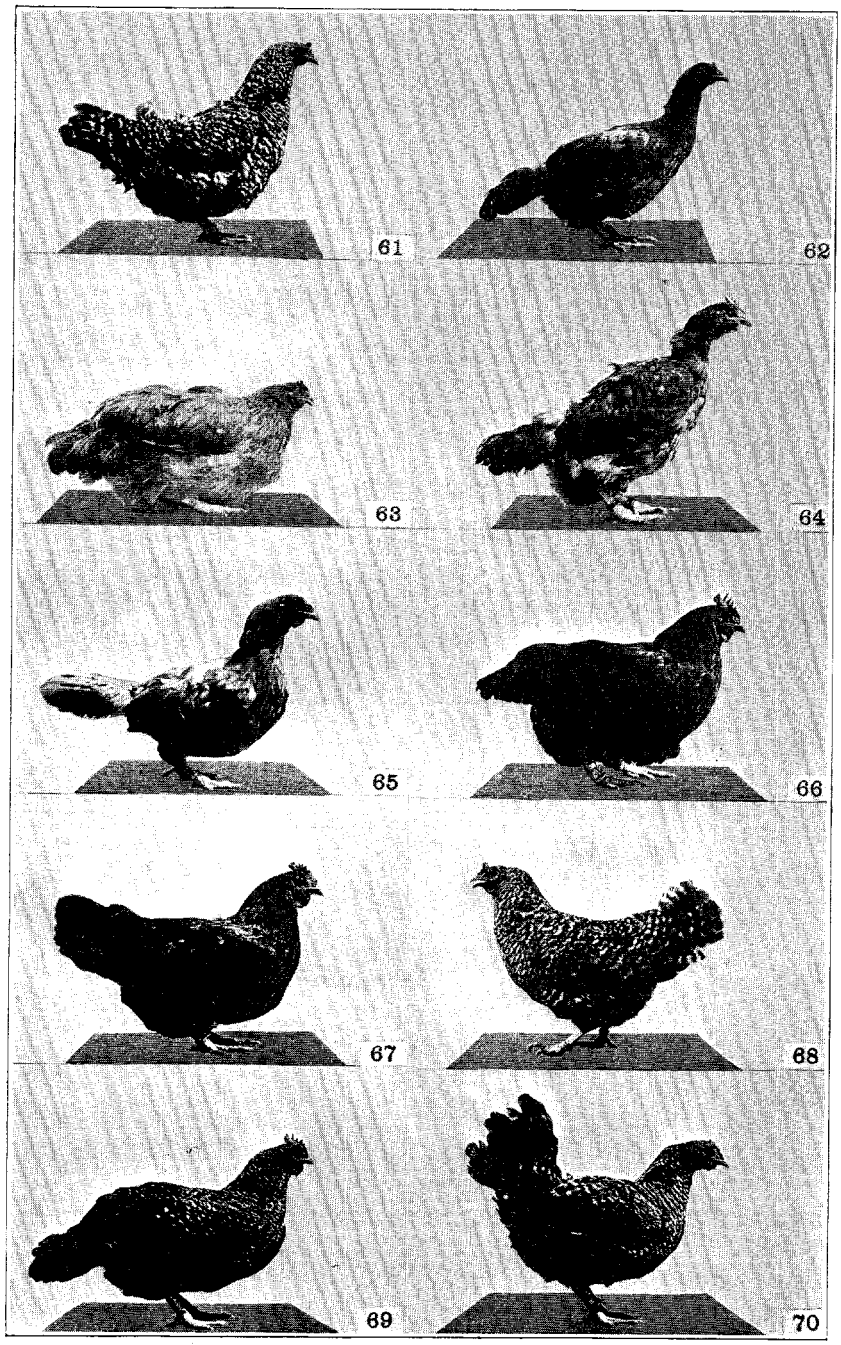
The pullets out of Pen I (legbands 1 to 10, inclusive) comprised Pen V; those from Pen II (legbands 11 to 20, inclusive), Pen VI; those from Pen III (legbands 21 to 30, inclusive), Pen VII; and those from Pen IV (legbands 31 to 40, inclusive), Pen VIII.

One pullet was selected from each female in Pens I to IV that had surviving daughters. In the cases where there were no daughters, pullets from other females in the same pen were used. The basis of choice in such cases was vigor and similarity to the breed of their sires. The egg records of their dams were not consulted. The appearance of the individuals in the respective pens may be seen in figures 3, 10, 17 and 24.

The cockerels used during the second year's breeding were as follows: Pen V, White Orpington 101E; Pen VI, Barred Plymouth Rock 102E; Pen VII, Single Comb White Leghorn 103E; and Pen VIII, mongrel 10E. The appearance of these males may be seen in figures 4, 11, 18, and 25, and their breeding in so far as furnished by their breeders is given in the accompanying legends.

The next fall, 1915, the process was repeated. Ten pullets (legbands 600 to 609, inclusive) out of Pen V constituted Pen IX and were mated with White Orpington cockerel 2E. Ten pullets (legbands 610 to 619, inclusive) from Pen VI were mated as Pen X with Barred Plymouth Rock cockerel 5E.

Fig. 7.—Third-generation White Orpington grades, legband Nos. 650 to 659, inclusive, comprising Pen XIII



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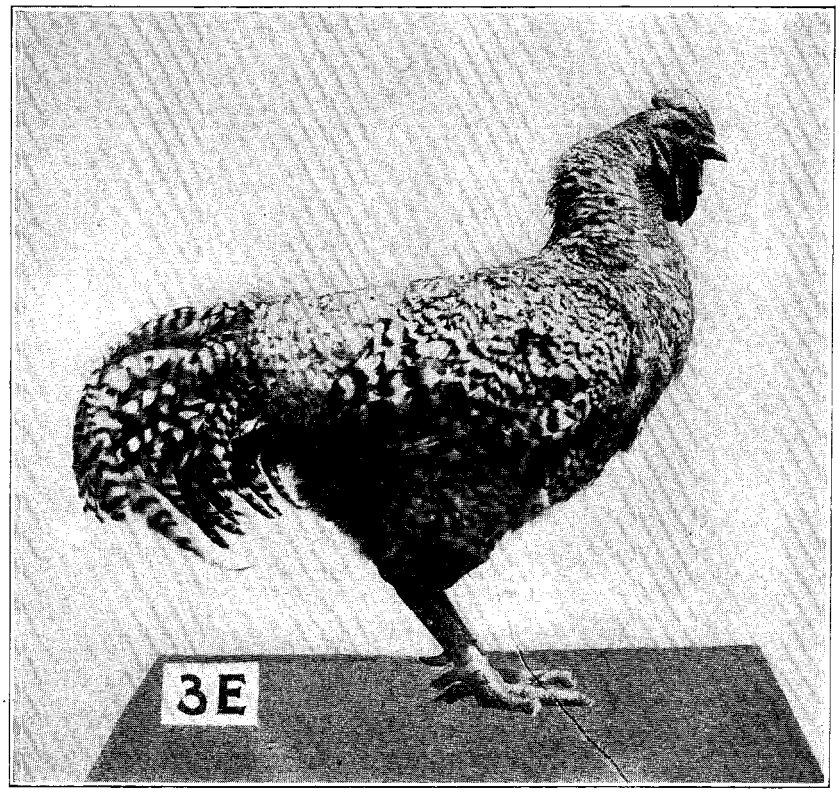
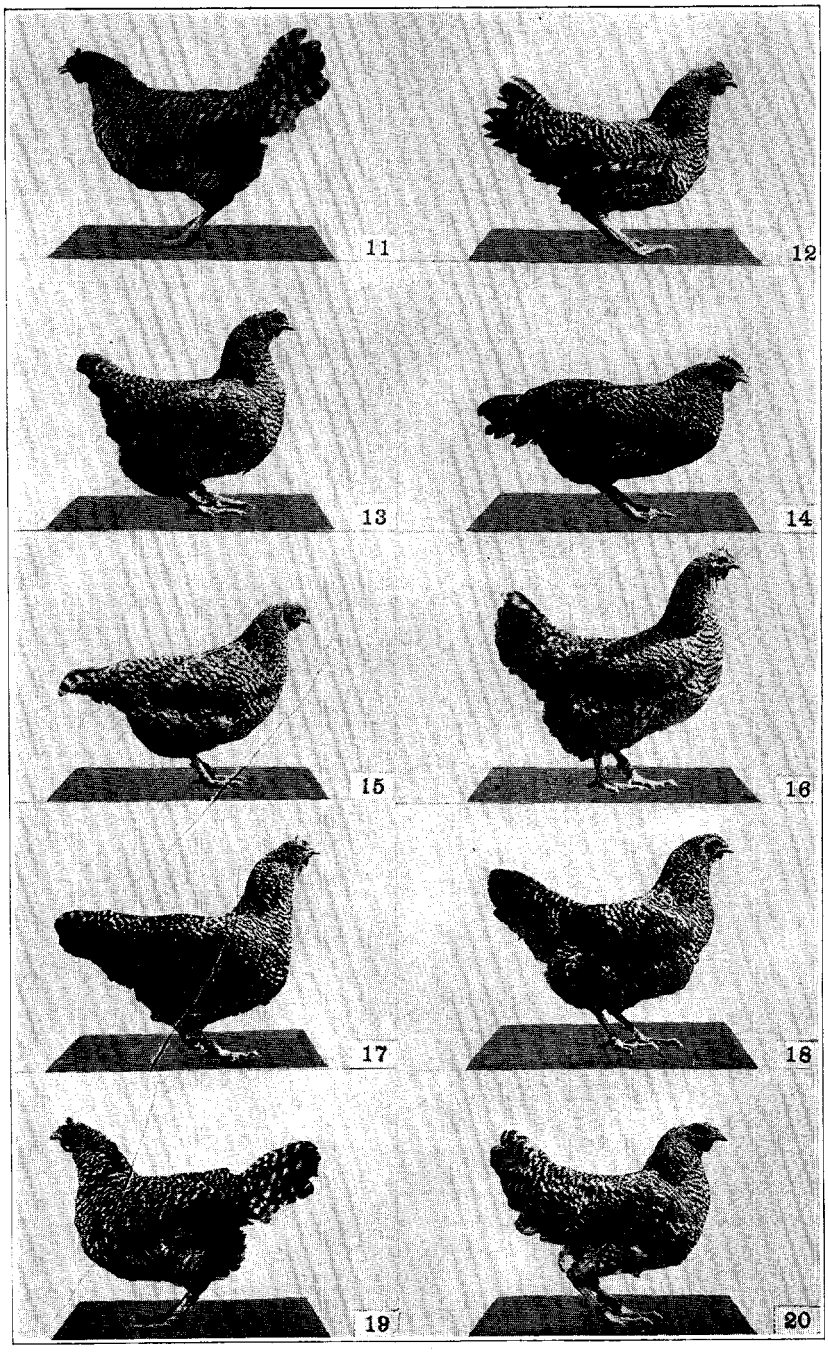


Fig. 9.—Barred Plymouth Rock male 3E mated with Pen II. Sire of females in Pen VI. His pedigree in so far as furnished by his breeder, Mr. J. W. Parks, Altoona, Pa., is as follows:

Sire—Cockerel 268		Not recorded
	Hen 1108	Not recorded
	Record of 209 eggs	Not recorded
Dam—Hen 952		Not recorded
Record of 232 eggs		Not recorded

Fig. 8.—Original mongrel females, legband Nos. 61 to 70, inclusive, comprising Pen II. Mothers of females in Pen VI (fig. 10)



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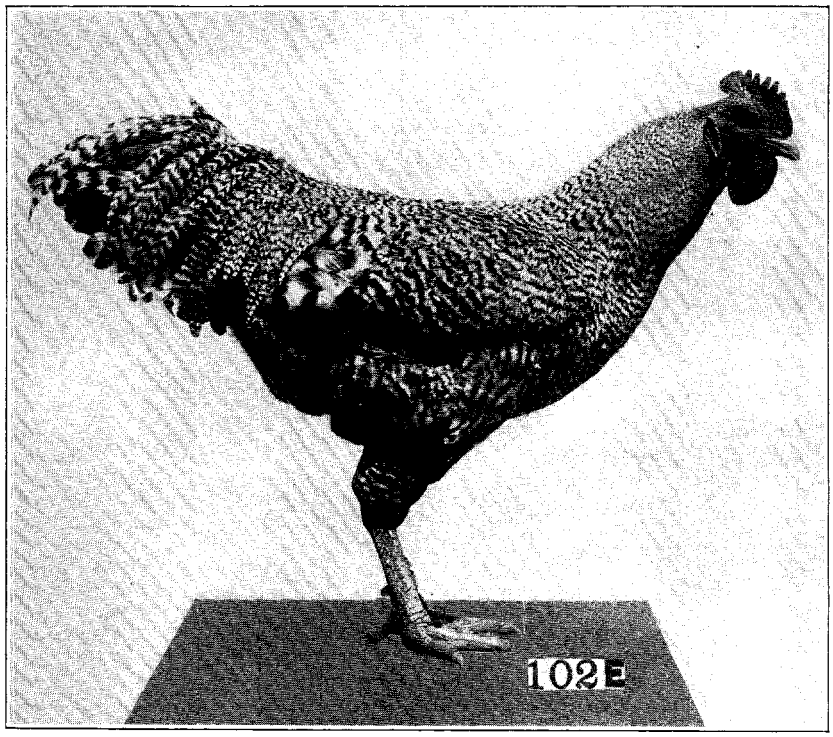
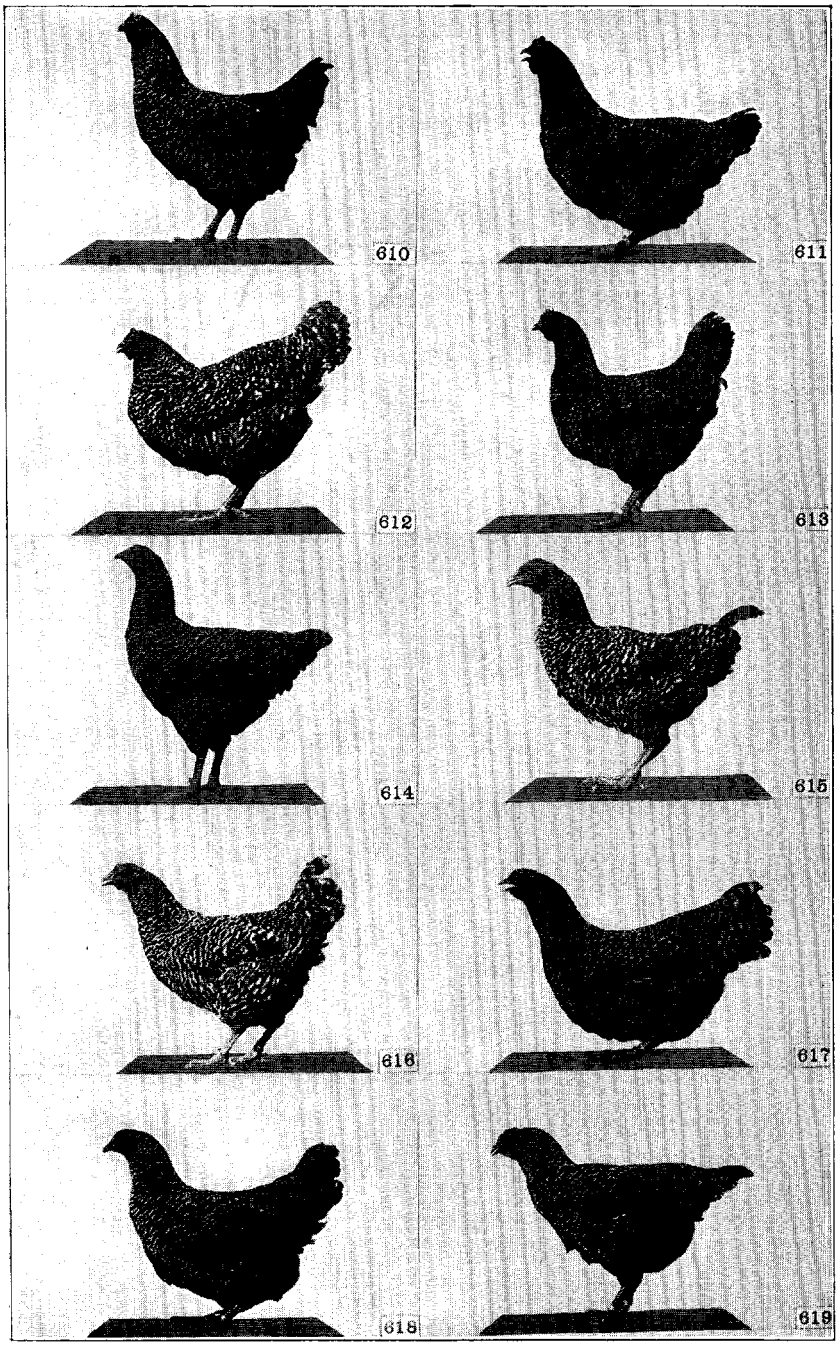


Fig. 11.—Barred Plymouth Rock male 102E mated with Pen VI. Sire of females in Pen X. His pedigree in so far as furnished by his breeder, Mr. J. W. Parks, Altoona, Pa., is as follows:

Sire—Cockerel 41643	Not recorded	
	Hen 952	Not recorded
	Record of 232 eggs	Not recorded
Dam—Hen 952	Not recorded	
Record of 232 eggs	Not recorded	

Fig. 10.—First-generation Barred Plymouth Rock grades, legband Nos. 11 to 20, inclusive, comprising Pen VI. Mothers of females in Pen X (fig. 12)



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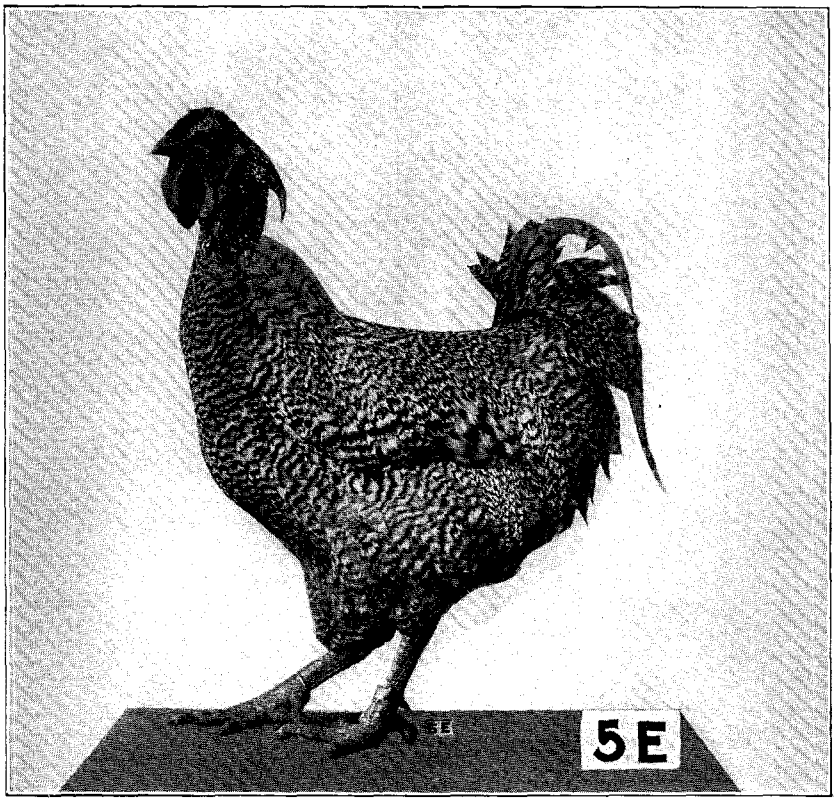


Fig. 13.—Barred Plymouth Rock male 5E mated with Pen X. Sire of females in Pen XIV. Bred by Maine Agricultural Experiment Station. No pedigree furnished

Fig. 12.—Second-generation Barred Plymouth Rock grades, legband Nos. 610 to 619, inclusive, comprising Pen X. Mothers of females in Pen XIV (fig. 14). (This group was much more uniform than the photographs indicate)

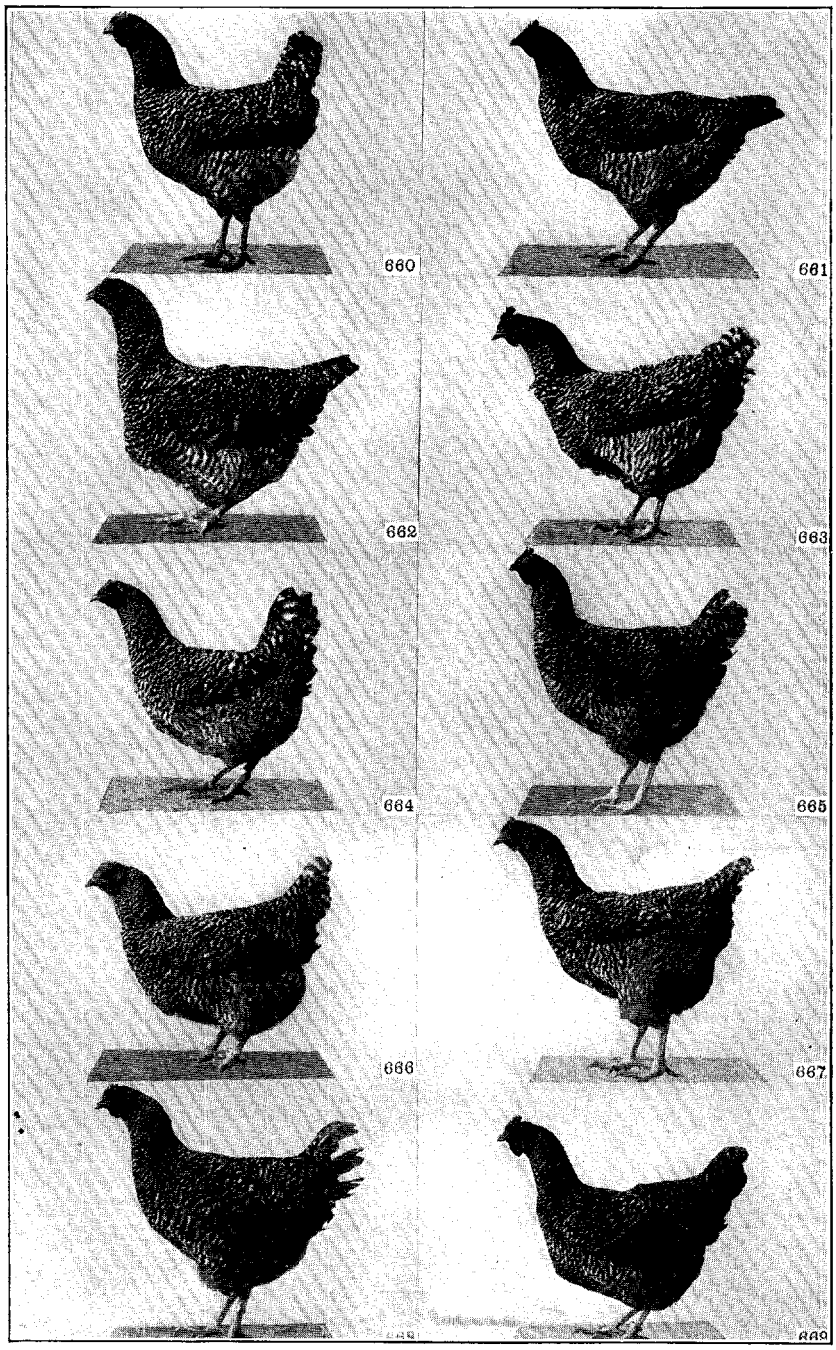


Fig. 14.—See opposite page for description

The same number of pullets (legbands 620 to 629, inclusive) from Pen VII was mated with Single Comb White Leghorn cockerel 6E, and recorded as Pen XI. Ten mongrel daughters (legbands 630 to 639, inclusive) from Pen VIII were mated with mongrel cockerel 4E and constituted Pen XII.

The appearance of the pullets in Pens IX to XII is shown in figures 5, 12, 19, and 26, and that of the cockerels in figures 6, 13, 20, and 27. The breeding of 2E and 6E, as reported by the breeders from whom the birds were purchased, is shown in the accompanying legends. Barred Plymouth Rock cockerel 5E was purchased from the Maine Agricultural Experiment Station. No account of his breeding was obtainable beyond the statement from Doctor Pearl that he was from their high-producing line.

The next year, 1916-17, ten pullets each from Pens IX, X, XI, and XII were kept until they completed their first laying year. The respective groups of pullets were designated as Pen XIII (legbands 650 to 659, inclusive), Pen XIV (legbands 660 to 669, inclusive), Pen XV (legbands 670 to 679, inclusive), and Pen XVI (legbands 680 to 689, inclusive). The appearance of these pullets is shown in figures 7, 14, 21 and 28.

SELECTION OF THE COCKERELS

The standardbred cockerels used throughout the experiment were purchased solely upon the representations of their breeders. In so far as could be ascertained by correspondence the birds chosen were as desirable from an egg-production standpoint as any to be secured at the time. They were purchased without previous inspection and no means beyond the reach of any interested person was used in locating them.

It should be noted in considering the results, that the White Leghorn cockerels had more recorded high-producing ancestors back of them than either the Barred Plymouth Rocks or White Orpingtons. However, even in the case of the White Leghorns, the number of generations through which their ancestors had been consistently selected for high production appears to have been small, though there is reason

Fig. 14.—Third-generation Barred Plymouth Rock grades, legband Nos. 660 to 669, inclusive, comprising Pen XIV

TABLE I.—EGG RECORDS OF THE FEMALES IN PEN I AND OF THEIR RESPECTIVE DESCENDANTS (WHITE ORPINGTON GRADES)

Pen I, mongrels Mated with White Orpington 1E 1913–14			Pen V, White Orpington grades Mated with White Orpington 101E 1914–15			Pen IX, White Orpington grades Mated with White Orpington 2E 1915–16			Pen XIII, White Orpington grades 1916–17		
Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days
51	110	365	4	108	365	603	117	332	655	114	365
						607	158	366	654	115	214
52	147	365	5	42	365		No	pullets			
53	100	365	7	95	365	600	7	17		No	pullets
						601	128	366	653	0	0
54	27	365	6	216	365		No	pullets			
55	120	365	1	147	365	605	97	366	656	52	105
56	40	365		No	pullets						
57	100	365	3	170	365	606	127	366	651	142	365
									658	116	365
58	36	365		No	pullets						
59	164	365	2	88	365		No	pullets			
			8	101	365		No	pullets			
			9	189	365	604	157	366	659	81	266
						602	132	196	650	10	214
			10	112	365	608	28	80	657	73	365
						609	107	183	652	93	280
60	4	365		No	pullets						
Total egg production.....848			Total egg production...1268			Total egg production...1058			Total egg production.....796		
Average egg production.....84.8			Average egg production...126.8			Average egg production...105.8			Average egg production.....79.6		

to believe that the breeder of the Leghorn males used in this experiment, was among the earlier ones to turn his attention systematically toward egg production.

This simply emphasizes the fact that systematic breeding for high egg production is still in its infancy. Desirable cockerels from the production standpoint are undoubtedly more numerous now than when this investigation was begun and are becoming more numerous each year. But record-keeping breeders are still far too few, and unscrupulous promoters who advertise 200-egg strains without even using trapnests are unfortunately too many.

EGG RECORDS

The egg records of the females in Pens I, II, III, and IV, and of their descendants are shown in Tables I, II, III, and IV. The number of days represented by the record is indicated.

TABLE II.—EGG RECORDS OF THE FEMALES IN PEN II AND OF THEIR RESPECTIVE DESCENDANTS (BARRED PLYMOUTH ROCK GRADES)

Pen II, mongrels Mated with Barred Plymouth Rock 3E 1913–14			Pen VI, Barred Rock grades Mated with Barred Plymouth Rock 102E 1914–15			Pen X, Barred Rock grades Mated with Barred Plymouth Rock 5E 1915–16			Pen XIV, Barred Rock grades 1916–17		
Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days
61	123	365	15	168	365		No	pullets			
62	98	365		No	pullets						
			11	128	365	615	109	366		No	pullets
63	101	365	19	120	365	612	127	366	662	90	171
						617	175	366	663	250	365
									667	191	365
			20	161	365	614	166	366	666	164	339
64	76	365	17	125	365		No	pullets			
65	100	365	16	182	365	610	242	366	660	50	151
						616	208	366	664	248	365
						618	34	95		No	pullets
66	56	365	18	12	365		No	pullets			
67	126	365	13	106	365	611	185	366	661	99	365
						619	104	191	669	262	365
68	91	365	12	131	365	613	146	366	665	194	365
									668	8	23
69	134	365	14	192	365		No	pullets			
70	80	365		No	pullets						
Total egg production.....985			Total egg production....1325			Total egg production....1496			Total egg production.....1556		
Average egg production.....98.5			Average egg production...132.5			Average egg production...149.6			Average egg production....155.6		

If the bird completed her first laying year the number of days is indicated as 365 (366 for 1915-16, leap year). If the first year was not completed the number of days elapsing after the beginning of laying is indicated.

These tables also show the lines of descent. For example in Table I, first line, 655 is out of 603, out of 4, out of 51.

As is readily seen in Tables I, II, III, and IV, in no case did all the females in any of the original pens have female descendants in the third generation of offspring (Pens XIII to XVI, inclusive). Pen XIII had descendants from five of the females in Pen I. Pen XIV had descendants from four females

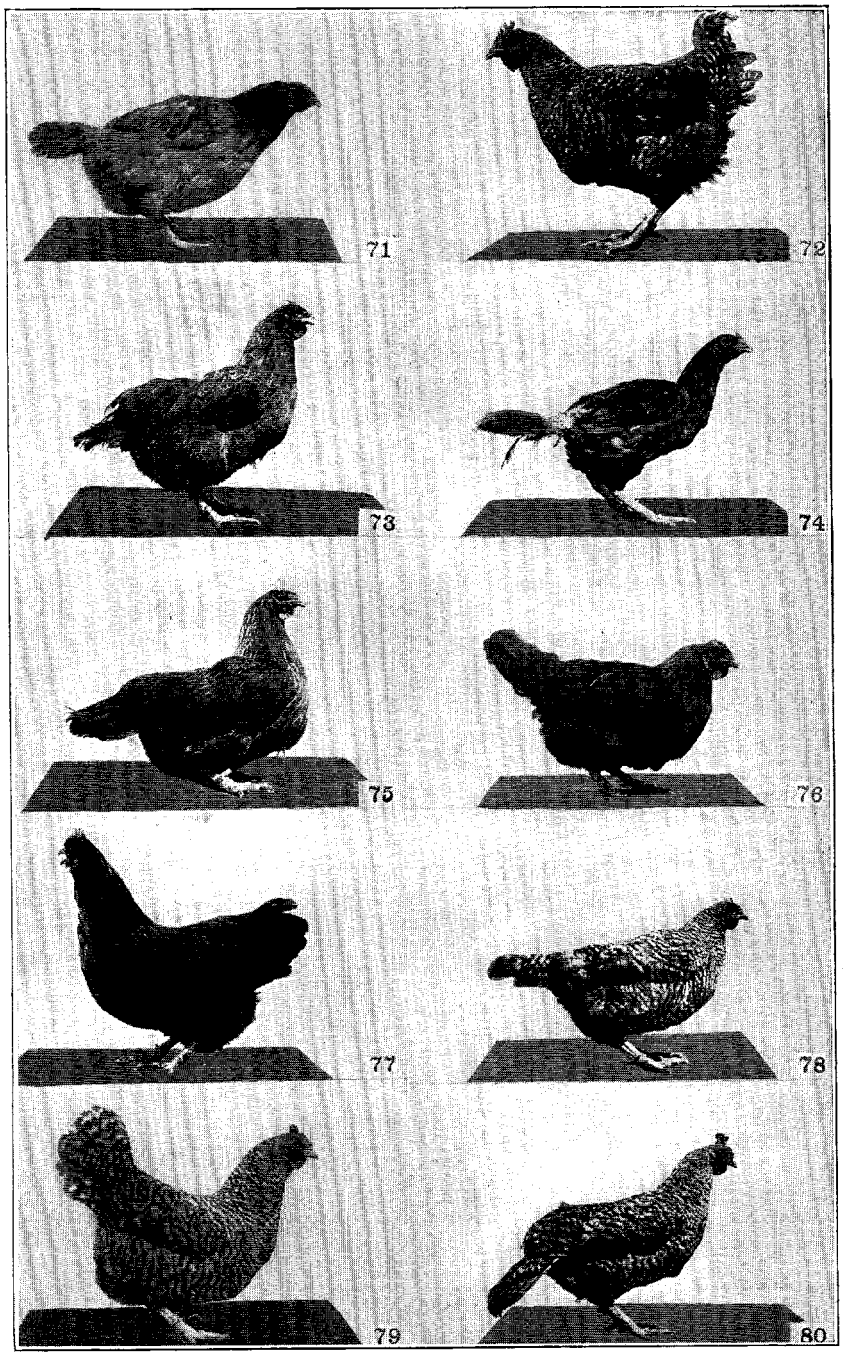


Fig. 15.—See opposite page for description

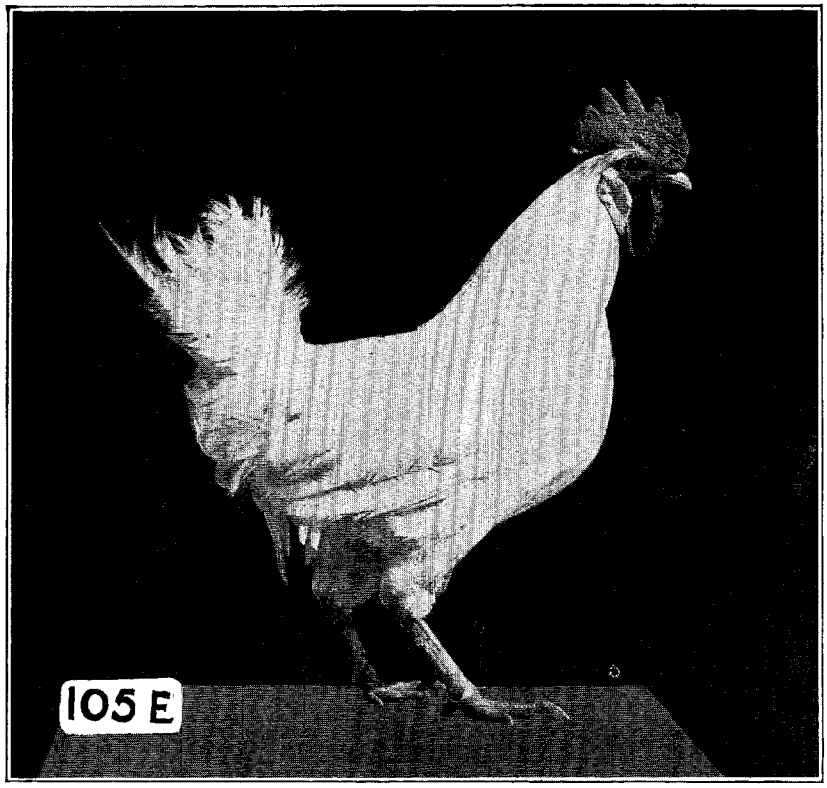


Fig. 16.—Single Comb White Leghorn male 105E mated with Pen III. Sire of females in Pen VII. His pedigree in so far as furnished by his breeder, Mr. D. Tancred, Kent, Wash., is as follows:

Sire—Cockerel 29640	Cockerel 6567	"Dewey"	Not recorded
			One of a pen with records of 200 eggs or more
		Hen with a record of 227 eggs	Not recorded
			Hen with a record of 243 eggs
	One of a pen with records of 200 eggs or more	Not recorded	
		Not recorded	
Dam—One of a pen with records of 232 eggs or more	Not recorded		
	Pen with records of 200 eggs or more	Not recorded	
		Not recorded	

Fig. 15.—Original mongrel females, legband Nos. 71 to 80, inclusive, comprising Pen III. Mothers of females in Pen VII (fig. 17)

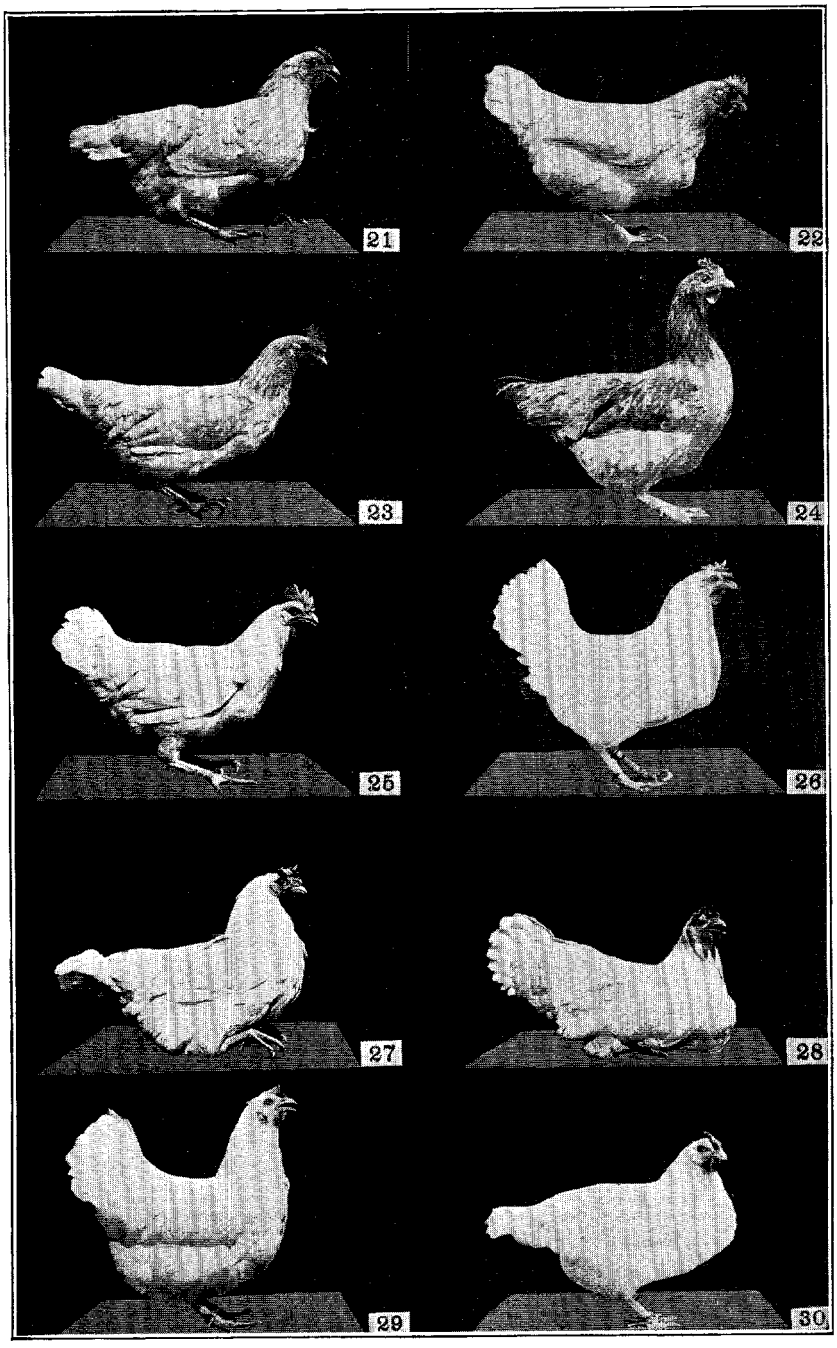


Fig. 17.—See opposite page for description

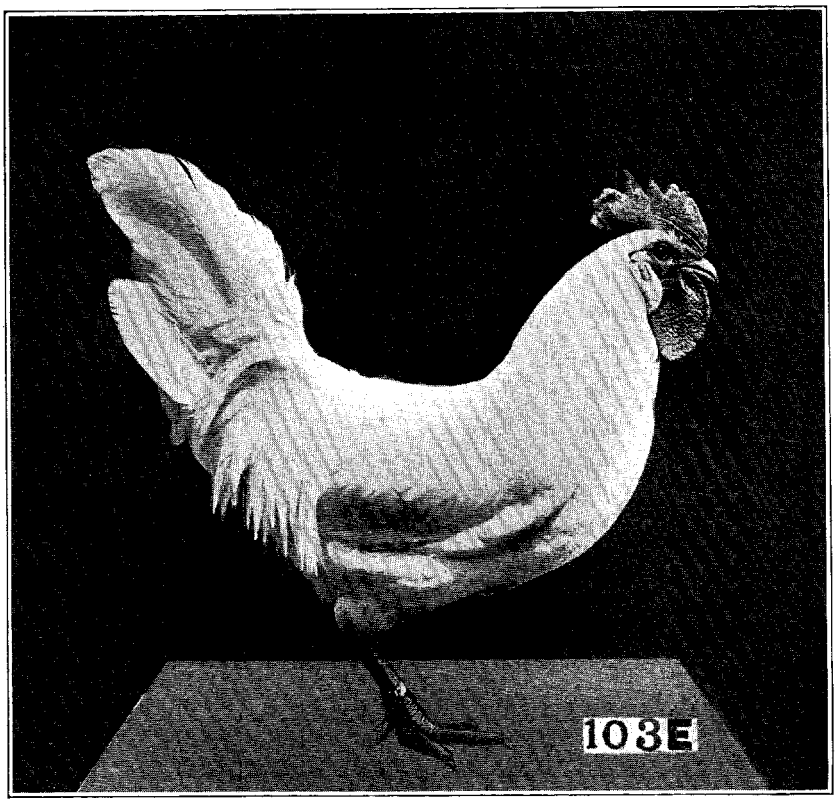


Fig. 18.—Single Comb White Leghorn male 103E mated with Pen VII. Sire of females in Pen XI. His pedigree in so far as furnished by his breeder, Mr. D. Tancred, Kent, Wash., is as follows:

- Sire—Cockerel 7567
  - Cockerel 9078
    - Cockerel 595
      - Not recorded
      - One of a pen with records of 200 eggs or more
    - Hen with a record of 252 eggs
      - Not recorded
      - One of a pen with records of less than 200 eggs
  - Hen with a record of 246 eggs
    - Cockerel 8746
      - Not recorded
      - One of a pen with records of over 200 eggs
    - Hen with a record of 262 eggs
      - Not recorded
      - One of a pen with records of less than 200 eggs
- Dam—One of a pen with records of 240 eggs or more
  - Cockerel 7992
    - Cockerel 9714
      - Not recorded
      - Hen with a record of 248 eggs
    - Hen with a record of 234 eggs
      - Not recorded
      - Hen with a record of 207 eggs
  - A pen with records of 240 eggs or more
    - Not recorded
    - A pen with records of 200 eggs or more
      - Not recorded
      - Not recorded

Fig. 17.—First-generation Single Comb White Leghorn grades, legband Nos. 21 to 30, inclusive, comprising Pen VII. Mothers of females in Pen XI (fig. 19)

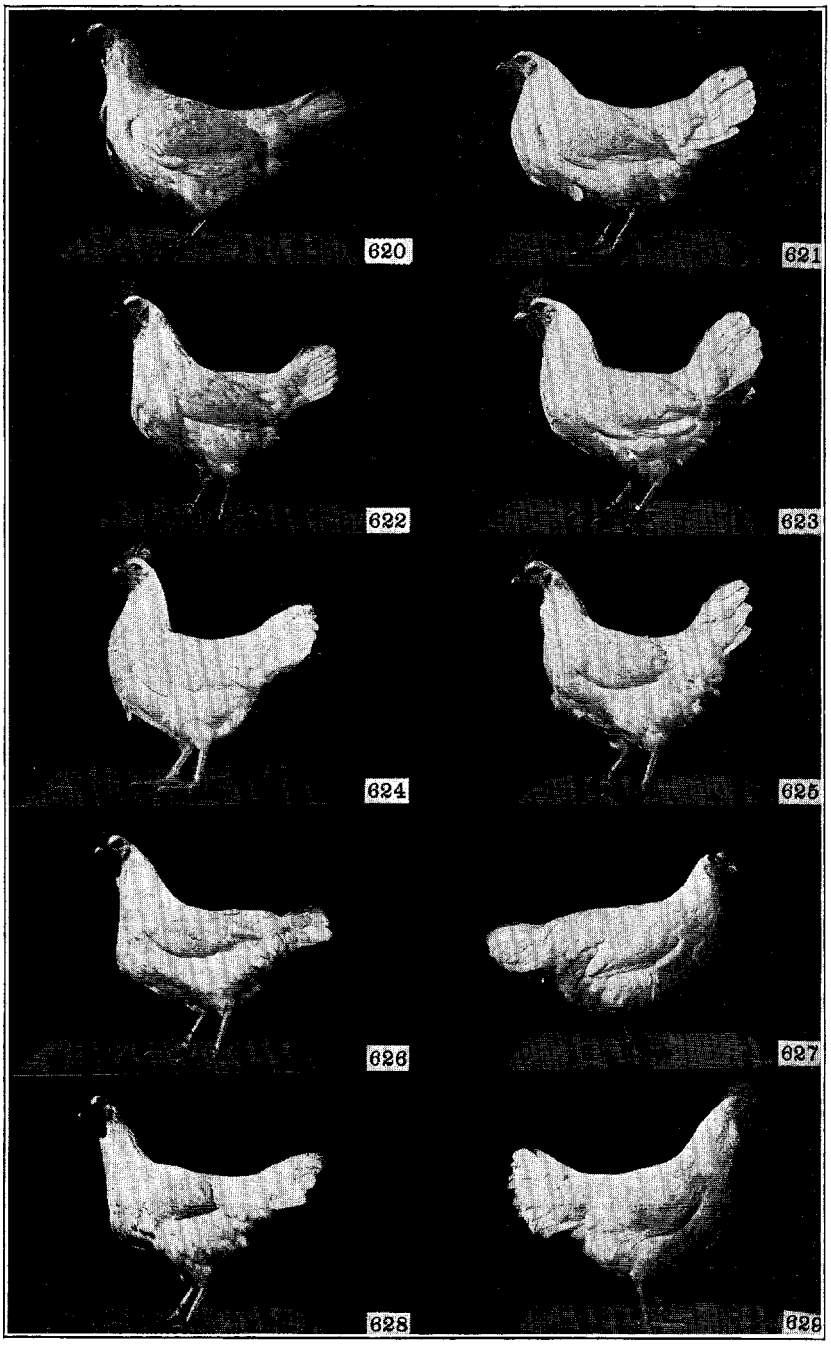


Fig. 19.—See opposite page for description

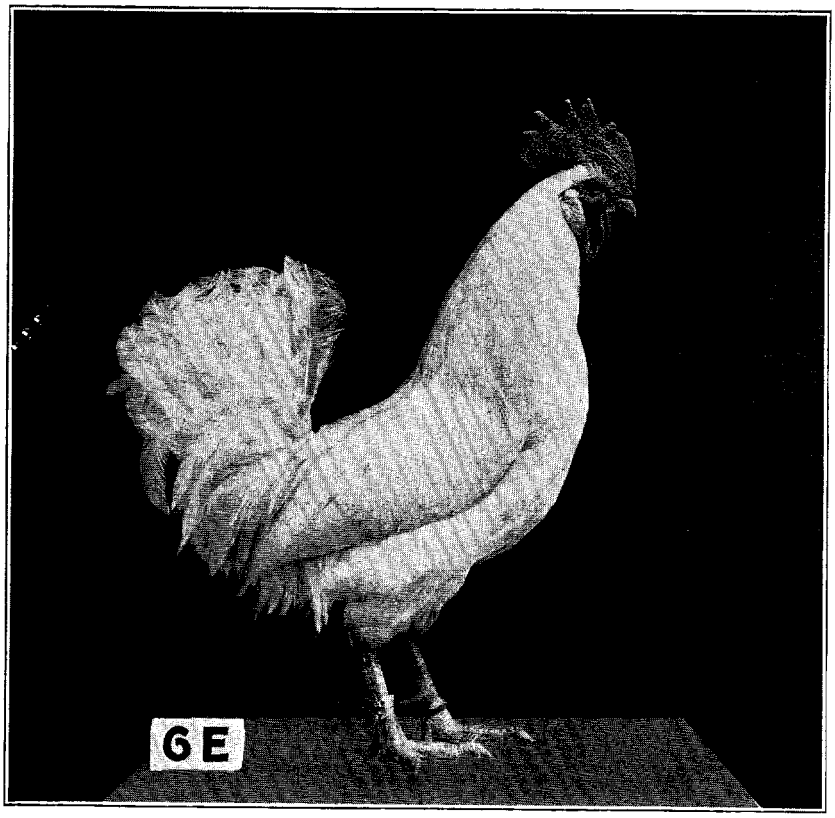


Fig. 20.—Single Comb White Leghorn male 6E mated with Pen XI. Sire of females in Pen XV. His pedigree in so far as furnished by his breeder, Mr. D. Tancred, Kent, Wash., is as follows:

Sire—Cockerel	Cockerel	Cockerel	Not recorded
			One of a pen with records running from 240 to 248 eggs
		Hen with a record of 285 eggs	Not recorded
			One of a pen with records running from 165 to 199
	Hen with a record of 282 eggs	Cockerel	Not recorded
			Hen with a record of 221 eggs
		Hen with a record of 260 eggs	Not recorded
			One of a pen with records running from 200 to 239 eggs
Dam—One of a pen with records running from 242 to 265 eggs	Cock	Cockerel	Not recorded
			One of a pen with records running from 165 to 199 eggs
		Hen with a record of 221 eggs	Not recorded
			Hen with a record of 243 eggs
	A pen with records running from 240 to 251 eggs	Cockerel	Not recorded
			One of a pen with records of 200 eggs or more
		A pen with records of 240 eggs or more	Not recorded
			A pen with records running from 165 to 253 eggs

Fig. 19.—Second-generation Single Comb White Leghorn grades, legband Nos. 620 to 629, inclusive, comprising Pen XI. Mothers of females in Pen XV (fig. 21)

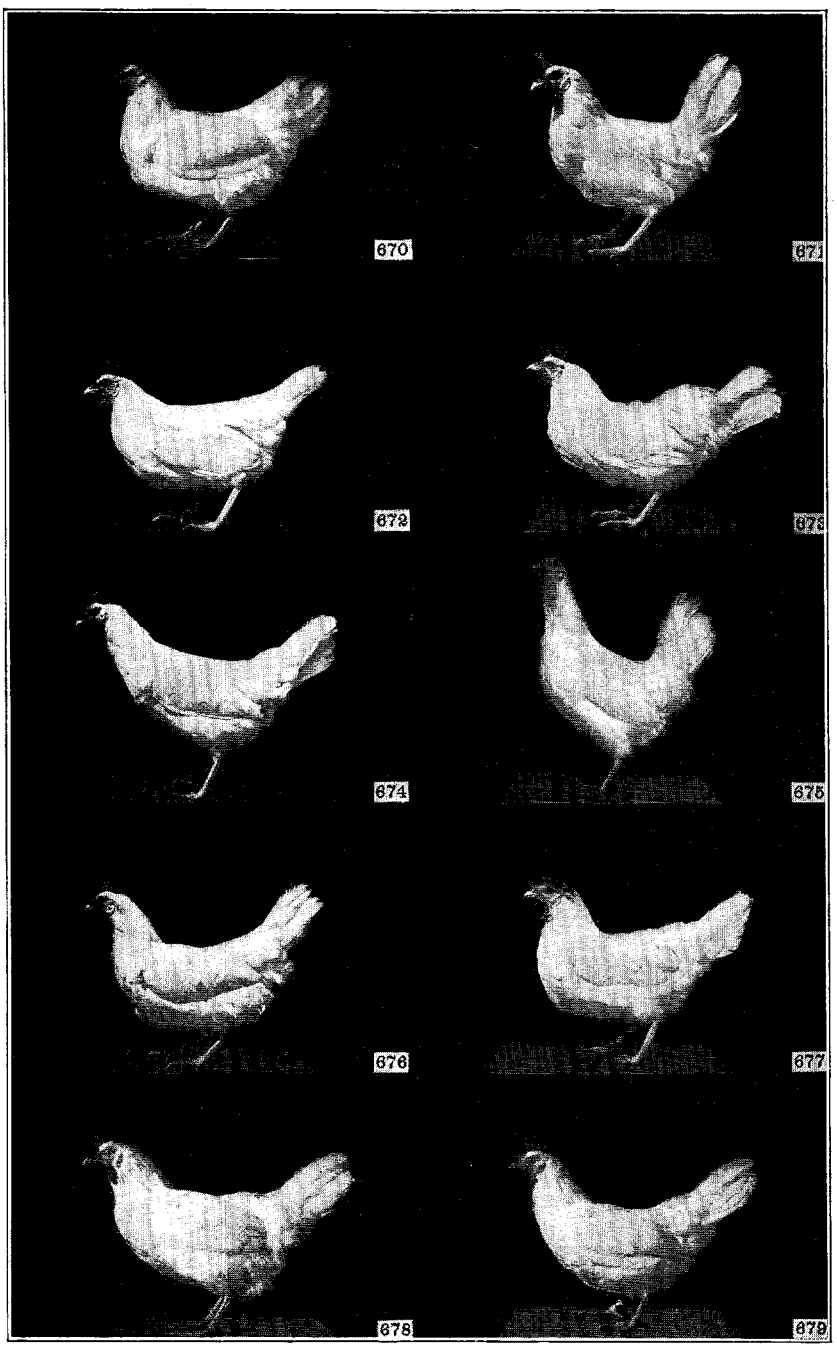


Fig. 21.—See opposite page for description

in Pen II. Pen XV had descendants from five of the females in Pen III and Pen XVI, from six of the females in Pen IV. This arose from a variety of causes. In some cases there was low fertility, in others poor hatchability in spite of fair fertility, while in others an apparent lack of vigor was responsible for the failure of any pullets to survive. In one or two cases surviving pullets disappeared, probably through theft or destruction by natural enemies. Where the line of descent was broken, the fact is indicated in the tables.

As has been suggested, a number of the females in the various pens which left pullet offspring failed to complete their first laying year. In all cases except Pen XII this was due to the death of the bird. Pen XII, through a blunder, was marketed on November 1, 1916, when only one of the birds had laid the full 366 days. The number of days each bird had laid is indicated in the tables.

POINTS OF INTEREST IN RESULTS

In order to get the full significance of the results obtained it is desirable to examine them from several angles. The point of interest of the general farmer who cannot conveniently pedigree his flock, is the flock average with regard to both uniformity and egg production, irrespective of deaths, accidents, and the like. The constructive breeder who keeps careful breeding records is interested particularly in the average production of those original mongrel females which had female descendants in the third generation, in comparison with the average production of their daughters, granddaughters, and great granddaughters. Other matters of interest and significance are the different types of pedigrees of high producers, the great difference in production between pullets of the same blood lines, and the comparative numbers of pullets in the different groups laying a large number of eggs. For convenience 200 eggs is taken as the standard for a high producer.

With regard to improvement in uniformity, figures 1 to 28 tell the story much better than could a verbal description. The difference in the rapidity with which the White Leghorn and

Fig. 21.—Third-generation Single Comb White Leghorn grades, legband Nos. 670 to 679, inclusive, comprising Pen XV

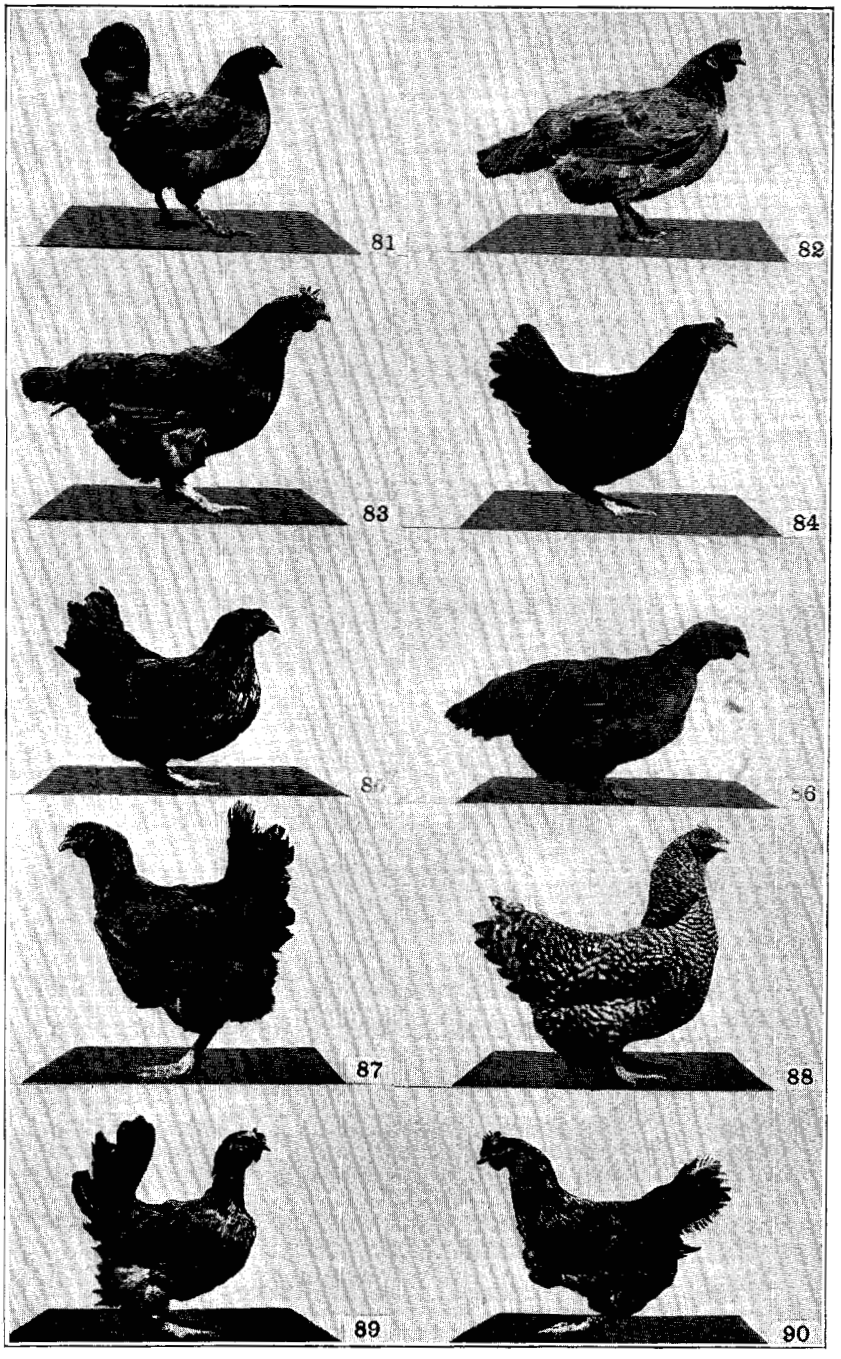


Fig. 22.— See opposite page for description

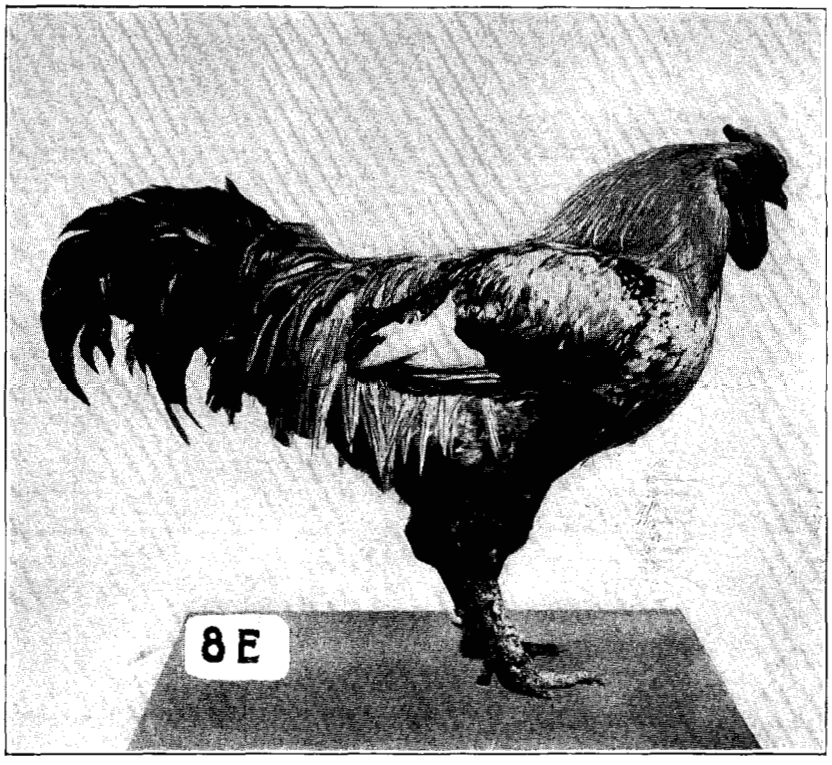


Fig. 23.—Mongrel male 8E mated with Pen IV. Sire of females in Pen VIII

White Orpington grades became uniformly white seems to be due to the fact that the white of the Leghorn is dominant to black pigment (though not necessarily to red, see legband 24) while that of the Orpington is recessive.1

AVERAGE IMPROVEMENT IN EGG PRODUCTION

The relative increases and decreases in the egg production of the respective groups all birds considered are shown graph-

[1] Since two individuals exhibiting a recessive character breed true for that character when mated together, the presumption is that if the White Orpington grades of the third generation had been mated among themselves they would have produced only white offspring. On the other hand the White Leghorn grades mated together would very probably have produced some colored offspring. Barring is also a dominant character and the mating together of Barred Rock grades would probably have produced some nonbarred offspring. For this reason, if for no other, the practice, once started, of using either White Leghorn or Barred Rock standardbred males for grading, should be continued if the uniformity of the flock is to be improved or even maintained.

Mothers of females in Pen VIII (fig. 24)

Fig. 22.—Original mongrel females, legband Nos. 81 to 90, inclusive, comprising Pen IV.

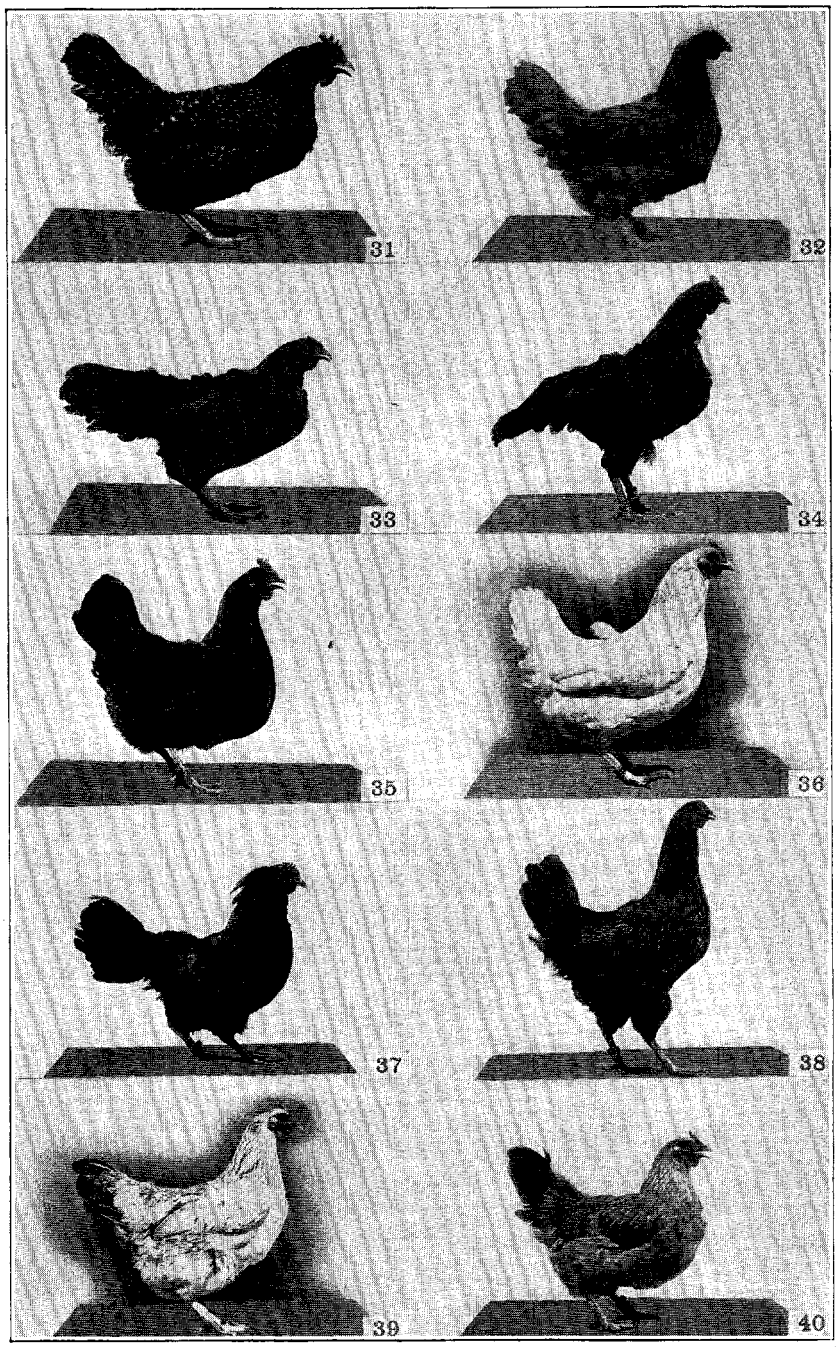


Fig. 24.—See opposite page for description

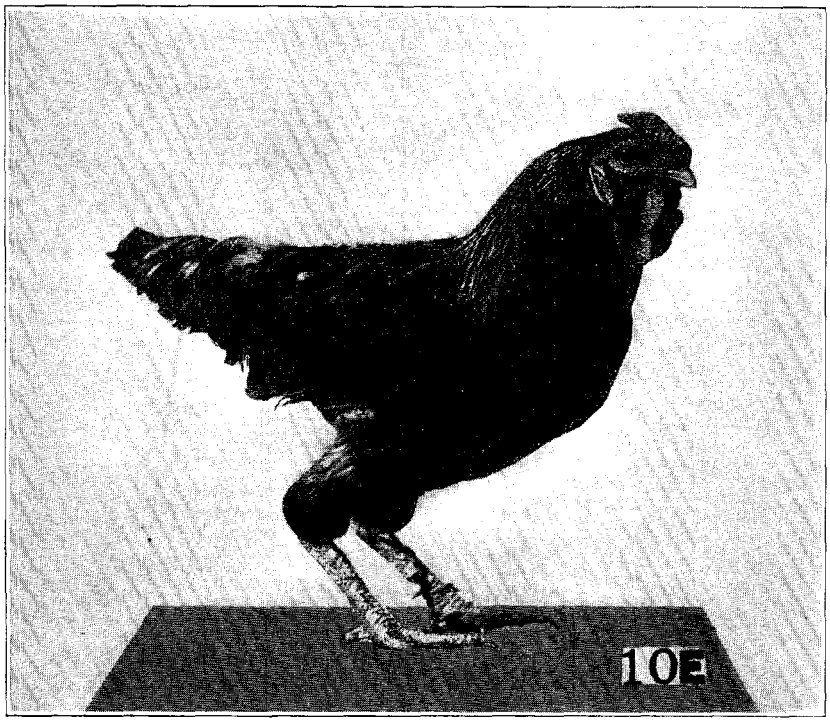


Fig. 25.—Mongrel male 10E mated with Pen VIII. Sire of females in Pen XII

ically in figure 29 and in percent in Table V. The average number of eggs laid by each pen will be found at the bottom of Tables I to IV, inclusive.

In the first generation it is noticeable that there was marked improvement in all three groups of grades in comparison with their mongrel mothers. With the mongrels of this generation there was some improvement but it is not nearly so marked as with the grades, and might easily be accounted for by earlier hatching and the more systematic care they received during the growing period, than was probably the case with their mothers.

In the second generation the improvement continued for the Leghorn and Rock grades but the Orpington grades did not lay as well as had their mothers. The mongrels, however,

Fig. 24.—First-generation mongrel female offspring, legband Nos. 31 to 40, inclusive, comprising Pen VIII. Mothers of females in Pen XII (fig. 26)

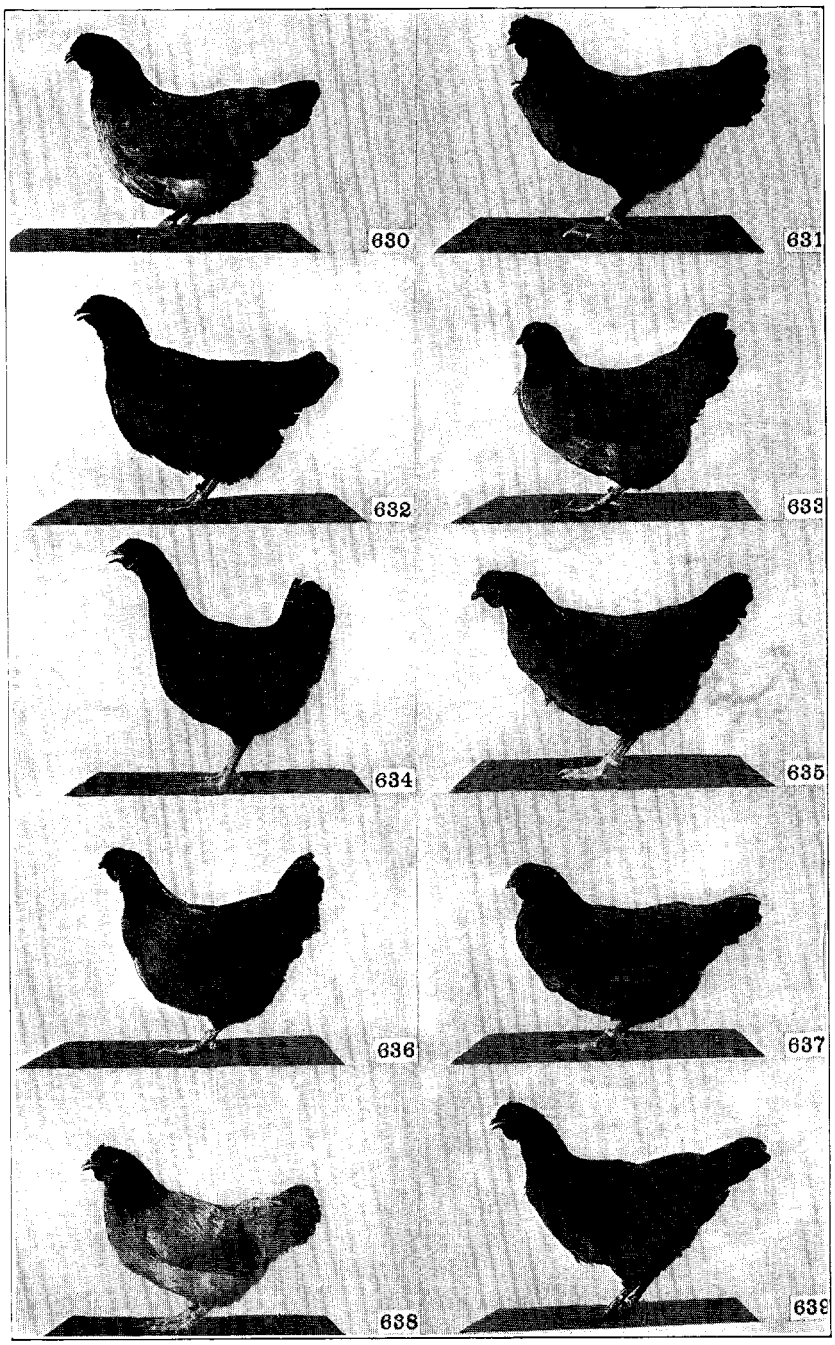


Fig. 26.—See opposite page for description

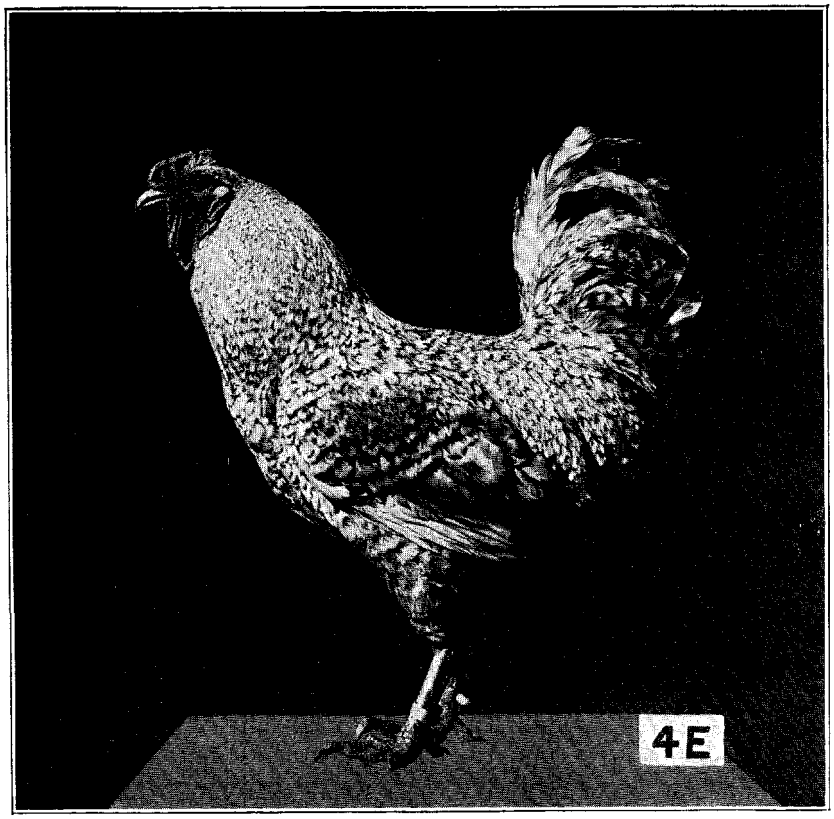


Fig. 27.—Mongrel male 4E mated with Pen XII. Sire of females in Pen XVI

showed a marked improvement as compared with their mothers. The actual improvement was undoubtedly greater than the figures show, owing to the fact previously noted that only one of these birds had completed her first laying year when the pen was sold. It appears probable that but for the blunder, these mongrels might have surpassed the Barred Rock grades of the same generation. The average length of the laying period of the birds of this group (Pen XII) was 338.9 days.

In the third generation the improvement continued for the Rock and Leghorn grades though at, a considerablv reduced

Fig. 26.—Second-generation mongrel female offspring, legband Nos. 630 to 639, inclusive, comprising Pen XII. Mothers of Pen XVI (fig. 28)

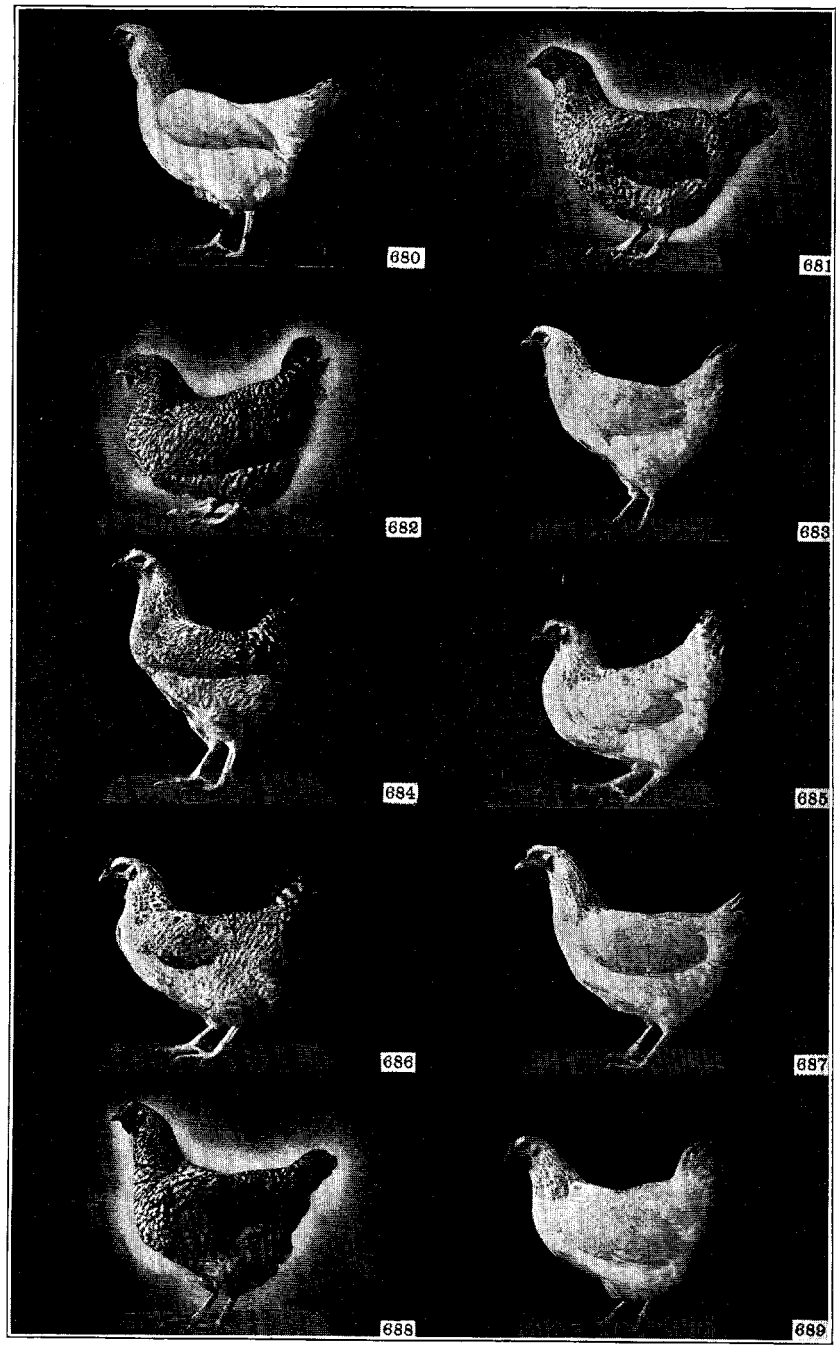


Fig. 28.—See opposite page for description

TABLE III.—EGG RECORDS OF THE FEMALES IN PEN III AND OF THEIR REPECTIVE DESCENDANTS (SINGLE COMB WHITE LEGHORN GRADES)

Pen III, mongrels Mated with S. C. W. Leghorn 105E 1913–14			Pen VII, White Leghorn grades Mated with S. C. W. Leghorn 103E 1914–15			Pen XI, White Leghorn grades Mated with S. C. W. Leghorn 6E 1915–16			Pen XV, White Leghorn grades 1916–17		
Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days
71	74	365	21	181	365	620	223	366	674	116	365
			29	190	365	624	172	366	679	171	337
			30	148	365	629	207	366	677	210	365
72	54	365	24	85	365	625	136	366	675	171	342
73	85	365		No pullets							
74	94	365		No pullets							
75	88	365		No pullets							
76	98	365	22	139	365	627	211	366	670	157	365
			23	166	365	628	191	366	672	218	365
			25	199	365		No pullets				
			26	196	365	626	194	296	673	242	365
						622	181	366	671	131	365
77	76	365		No pullets							
78	91	365	28	94	365	623	177	366	678	250	365
79	35	365	27	161	365	621	194	366	676	260	365
80	28	365		No pullets							
Total egg production.....723			Total egg production...1559			Total egg production...1886			Total egg production.....1926		
Average egg production.....72.3			Average egg production...155.9			Average egg production... 188.6			Average egg production.....192.6		

rate. The Orpington grades fell below their dams and in fact slightly below their mongrel great granddams in average production. There was a lowered production in the case of the mongrels.

CHANCE IN THE SELECTION OF COCKERELS

All the Leghorn and Plymouth Rock males used during the three years begot daughters which were, on the average, better producers than the females of the preceding generation. This was not true of the White Orpington or mongrel males. It should be noted, however, that the daughters of 1E, the first White Orpington male used, showed an improvement in production of 49.52 percent over their mongrel mothers. This was greater than the improvement, 34.51 percent, brought about by the first Barred Rock male, 3E, used

Fig. 28.—Third-generation mongrel female offspring, legband Nos. 680 to 689, inclusive, comprising Pen XVI

TABLE IV.—EGG RECORDS OF THE FEMALES IN PEN IV AND OF THEIR RESPECTIVE DESCENDANTS (MONGRELS)

Pen IV, mongrels Mated with Mongrel 8E 1913–14			Pen VIII, mongrels Mated with Mongrel 10E 1914–15			Pen XII, mongrels Mated with Mongrel 4E 1915–16			Pen XVI, mongrels 1916–17		
Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days	Band No.	Record	Length of laying period in days
81	82	365	36	170	365		No	pullets			
			40	103	365	633	126	360	683	99	365
						638	142	337	688	104	365
82	109	365	35	101	365	631	163	316		No	pullets
						639	121	323	689	123	365
83	129	365		No	pullets						
84	103	365	37	101	365	630	163	328	680	141	365
			39	92	365		No	pullets			
85	67	365	33	60	365		No	pullets			
86	86	365	32	121	365	636	175	351	686	172	365
						637	132	358	687	154	365
87	123	365	31	116	365	634	140	315	684	127	365
						635	125	366	685	140	365
88	107	365	38	120	365	632	165	336	681	106	365
									682	130	365
89	72	365	34	56	365		No	pullets			
90	80	365		No	pullets						
Total egg production.....958			Total egg production....1040			Total egg production....1452			Total egg production.....1296		
Average egg production.....95.8			Average egg production...104.0			Average egg production...145.2			Average egg production...129.6		

One of the white Orpinington male's daughters (legband 6) laid more than 200 eggs and was the only first-generation grade to accomplish that feat, although two of the Leghorn grades (legbands 25 and 26) came very close to 200. However, considering his breeding, chance certainly favored in the selection of 1E, and failed to favor in the cases of 101E and 2E. While the choice of 101E and 2E (2d and 3d White Orpington males used) was not fortunate, it appears that the failure to make further progress was due to chance and not to the fact that increased production may not be introduced through Orpington males from high-producing families. It is entirely possible that a similar unsatisfactory result might occur in using White Leghorn cockerels whose ancestors had not been selected for egg production for more generations than is shown by the pedigrees furnished by the breeder of the White Orpington males. It is in fact highly probable that

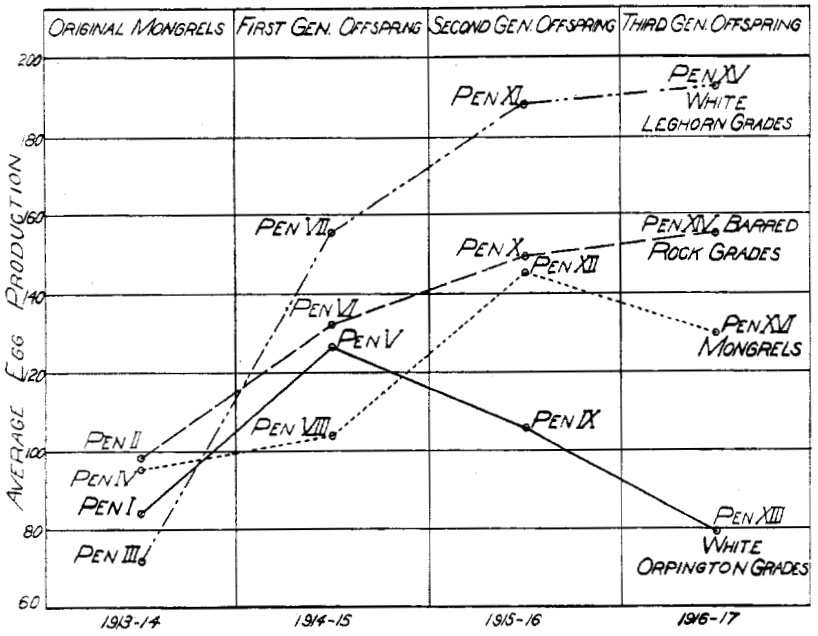


Fig. 29.—Graphs showing average improvement in egg production

TABLE V.—AVERAGE PERCENT OF INCREASE OR DECREASE IN FIRST-YEAR EGG PRODUCTION OF EACH GENERATION OF OFFSPRING COMPARED WITH THE ORIGINAL MONGREL PEN

	First generation	Second generation	Third generation
Single Comb White Leghorn grades	115.62	160.85	166.39
Barred Plymouth Rock grades	34.51	51.87	57.97
White Orpington grades	49.52	24.76	—6.13
Mongrels	8.55	51.56	35.28

such a result would occur. It furtner appears that it was largely a matter of good fortune that a poor selection was not made in the case of either of the first two Barred Plymouth Rock cockerels used, unless the ancestors of these individuals had been selected for high production for more generations than the information furnished by their breeder indicated.

It is well known among dairymen that there is an occasional scrub cow that is a phenomenal producer. Though such scrubs are few in number there are enough to make it quite evident

that not all the families carrying factors for high production are recorded on the pages of the herd books. While no one would be justified in taking the time and trouble to trapnest mongrel hens it would be strange indeed if among them there were not occasionally a good producer. It appears evident from the records of his daughters (Pen XII) shown in Table IV, that mongrel male 10E transmitted a very much higher production than was exhibited by the mongrel pullets with which he was mated. Comparing his daughters with their mothers and making no allowance for the fact that the former had their laying year cut short by an average of 26.1 days, there was an improvement of 39.62 percent, which is greater than that shwon by the daughters of Barred Plymouth Rock male 3E when he was mated to mongrel pullets.

ACTUAL IMPROVEMENT IN EGG PRODUCTION

In order to get at the breeding result of three years' grading it is simplest to consider first only those of the third-generation offspring which completed a full year's laying. It is obviously impossible to say what the production of those birds failing to complete the full year would have been, and it might be misleading to include their records as they stand.

Fortunately all of the mongrel great granddams completed their first laying year, so that it is possible to obtain a comparison between them and their great granddaughters. Tables I, II, III and IV list the third-generation female offspring in the right-hand division. Those which laid the full 365 days are so indicated. Their ancestors in the female line with their records are found in order toward the left.

The third-generation grade White Orpingtons (Pen XIII), of which there were but four that completed the first year's laying (see Table I), gave an average production of 111.25 (105.33) eggs as compared with a first-year production of 124.66 eggs by their mongrel great granddams.

The third-generation grade Barred Plymouth Rock pullets completing a full year's laying gave an average first-year production of 207.33(210.75)[1] eggs as compared with an average first-year production of 104.5 eggs by their mongrel great granddams.

[1] The figures in parentheses give the average production weighted according to the number of descendants from a single individual.

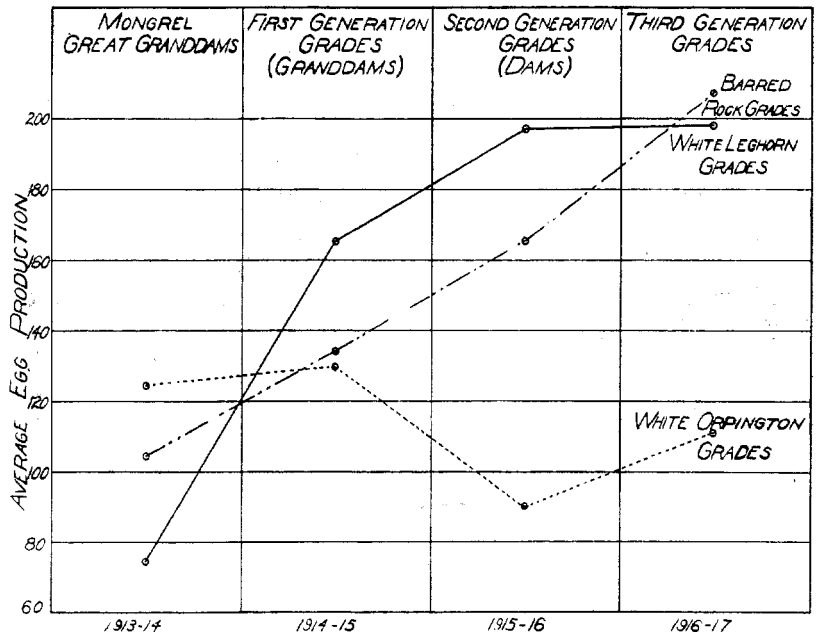


Fig. 30.—Graphs showing the relation of the average first-year laying record of the third-generation grades which completed a year's laying, to the first-year records of their dams, granddams, and great granddams. (See notes accompanying Table VI)

TABLE VI.—RELATION OF THE AVERAGE FIRST-YEAR LAYING RECORD OF THIRD-GENERATION GRADES WHICH COMPLETED A YEAR'S LAYING, TO THE FIRST-YEAR RECORD OF THEIR DAMS, GRANDDAMS, AND GREAT GRANDDAMS

GRADES	Great granddams (mongrels)	Granddams (first generation)	Dams (second generation)	Third generation
Single Comb White Leghorn	74.50	165.71	(*a*) 197.25	198.00
Barred Plymouth Rock	104.50	134.75	(*b*) 165.50	207.33
White Orpington	124.66	130.00	(*c*) 90.66	111.25

(*a*) One bird laid only 296 days.
(*b*) One bird laid only 191 days.
(*c*) One bird laid only 332 days, and one only 80.

The third-generation grade Single Comb White Leghorn pullets completing a full year's laying gave an average first-year production of 198 (215)[1] eggs as compared with an average first-year production of 74.5 eggs by their mongrel great granddams.

The third-generation mongrel pullets completing a full year's laying gave an average first-year production of 129.6 (130) eggs as compared with an average first-year production of 101.66 eggs by their mongrel great granddams.

There was thus a very marked improvement in the case of both the Barred Rock and White Leghorn grades (98.4 percent for the Barred Rocks and 165.77 percent for the White Leghorns), when compared with their mongrel great granddams. At the same time there was a decreased production by the White Orpington grades (10.76 percent) and a noticeable improvement with the third generation of mongrel offspring (27.48 percent).

It so happened that those pullets in the group of original mongrels which were mated to a White Orpington cockerel, and which had third-generation descendants, laid more eggs than the great granddams of either the White Leghorn or Barred Rock third-generation grades.

Similarly, as it turned out, the original mongrel pullets which were mated to a White Leghorn cockerel, and which had third-generation female descendants, laid fewer eggs than the great granddams of the third-generation Barred Rock and Orpington grades. That this was so, was a matter of chance and not design. The original mongrel pullets were mated before they had begun to lay. Furthermore there was no way of foretelling which birds in each group would have third-generation descendants. It serves, however, to emphasize the fact that the egg production of the original mongrel females gives no basis for predicting the probable production of their descendants. The facts strongly suggest rather that the production of the grades was largely determined by the sires used.

The relation of the average first-year production of the third-generation grades which completed a full laying year, to the average production of their dams, granddams, and great granddams is shown graphically in figure 30 and numerically in Table VI.

[1] The figures in parentheses give the average production weighted according to the number of descendants from a single individual.

RECORDS ABOVE TWO HUNDRED

Among the Leghorn grades there were eight individuals (26.66 percent) with records above 200. These were Nos. 620 (223 eggs), 627 (211 eggs), and 629 (207 eggs) in the second generation; and 672 (218 eggs), 673 (242 eggs), 676 (260 eggs), 677 (210 eggs), and 678 (250 eggs) in the third generation.

Among the Barred Rock grades there were five individuals (16.66 percent) laying above 200 eggs. These were Nos. 610 (242 eggs) and 616 (208 eggs) in the second generation; and 663 (250 eggs), 664 (248 eggs), and 669 (262 eggs) in the third generation.

Among the Orpington grades but one individual (3.33 percent) laying more than 200 eggs appeared. This was No. 6, among the first-generation offspring, which produced 216 eggs.

No individuals laying above 200 eggs appeared in any of the mongrel pens.

The highest individual producer was a Barred Rock third-generation grade, No. 669, which laid 262 eggs during her first year. The next highest was a White Leghorn third-generation grade, No. 676, which laid 260 eggs during the same period.

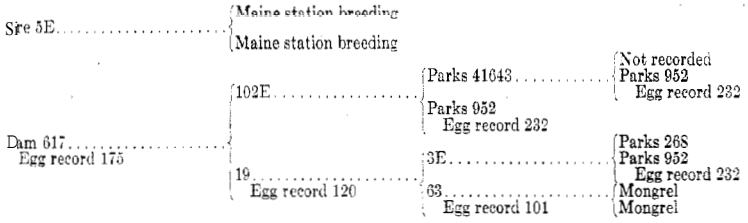
TYPICAL PEDIGREES

As already intimated in another connection, a study of the lines of descent strongly suggests that a pullet's egg production bears a closer relation to the breeding of her sire, than to the production of her mother.

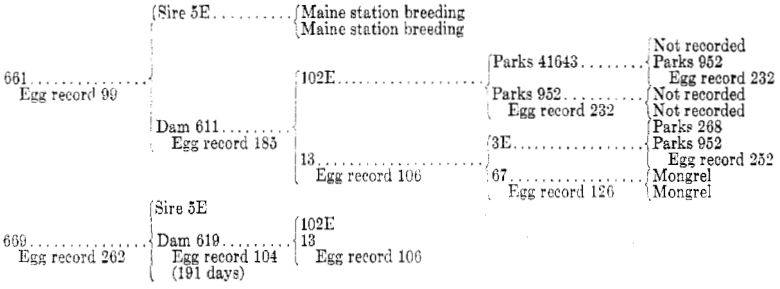
A study of the pedigrees of various high- and low-producing grades suggests just as strongly that not one of the standardbred cockerels used was pure for high production, assuming that, as Pearl found for the Barred Plymouth Rock, high winter production is dominant. If these cockerels had been pure for high production their get would undoubtedly have been more uniform with regard to production. It is hardly to be expected that they should be, however, considering the comparatively few generations through which their ancestors had been consistently and vigorously selected for high production.

Some lines of descent show consistent progress throughout the three years though full sisters may differ considerably in total production. Other lines are marked by progress and regression, alternately.

Barred Rock grades Nos. 663 and 667 were full sisters and hence had exactly the same ancestry. Their pedigree is fairly typical of those in which consistent progress is made throughout the three years grading; yet there was a difference in production of 59 eggs between these birds, No. 663 having laid 250 eggs and No. 667 but 191. Their pedigree is as follows:



Barred Rock grades 661 and 669 had the same granddam and great granddam. They had the same male ancestors for three generations that were common to all the Barred Rock grades. Their dams were full sisters. Yet there was a difference in their production of 163 eggs. The pedigrees of these two third-generation grades are as follows:

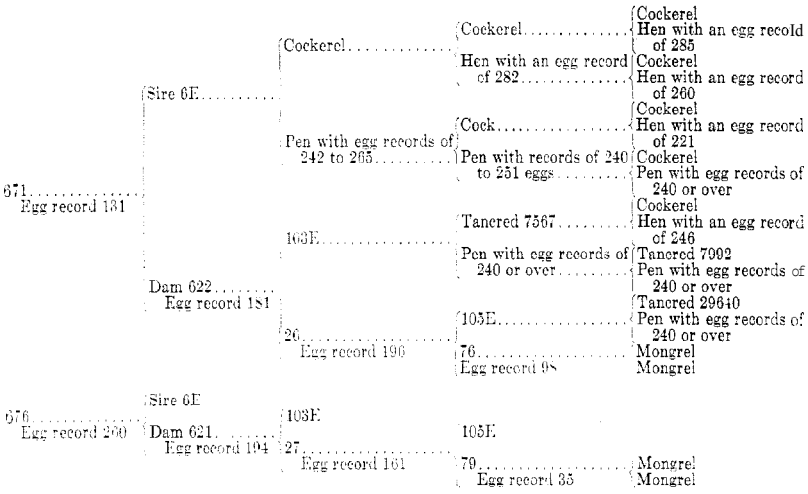


It is interesting to note that their granddam, No. 13, laid fewer eggs than their great granddam, No. 67, and hence, apparently, was not in the line of progress. One of the daughters of No. 13, No. 611, laid 185 eggs, whose daughter, No. 661, in turn produced but 99, the lowest production recorded for a third-generation Barred Rock grade which completed her first laying year. The other of No. 13's daughters used for breeding, No. 619, produced 104 eggs and died after a laying period of 191 days. It is obviously impossible to say what her production might have been, but the indications were that she would not have been the equal of her sister,

No. 611, which was March hatched and began laying the following November, while she was February hatched and failed to lay until the last of the following February. Nevertheless her daughter, No. 669, produced 262 eggs. Thus, of the third-generation Barred Rock grades completing a year's production, two birds by the same sire and out of full sisters, gave the highest and the lowest first-year production.

All of the Barred Rock grades were somewhat linebred with regard to Parks 952 which appears twice in the pedigree of 102E and once in that of 3E.

Among the Leghorn grades the pedigrees of No. 676, 260 eggs, and No. 671, 131 eggs, show consistent progress and the lack of it, resspectively These pedigrees are as follows:



FUTURE WORK

Goodale[1] has recently presented evidence which indicates that the manner of inheritance of high winter egg production in the Rhode Island Red breed of chickens may differ from that of the Barred Plymouth Rock, and that a pullet may inherit high egg production from her mother. In the light of this evidence it appears highly desirable to test Rhode Island Red cockerels for grading. This test will be carried out in the near future. The test with White Orpington males will be repeated and one made with White Wyandotte males. Check pens of mongrels will be kept as before.

[1] Goodale, H. D. Inheritance of winter egg production. Science, n. s. **47**:542-543. 1918.

CONCLUSIONS

1. Very fair uniformity with regard to type and color may be secured from a mongrel flock of mixed types and colors, by the use of standardbred cockerels of the White Orpington, Single Comb White Leghorn, or Barred Plymouth Rock varieties, for three successive generations.

2. The egg production of a poor-producing mongrel flock of chickens may be quickly and markedly improved by grading, through the use of cockerels from high-laying families of the Single Comb White Leghorn or Barred Plymouth Rock varieties. It is probably true that a similar improvement may be brought about through the use of selected standardbred White Orpington cockerels.

3. There appears to be no reason why a *priori* the same statement should not be true for poor-producing standardbred flocks.

4. An occasional male may be found among mongrels which transmits high production, though the chance of discovering such birds appears to be small under the conditions of management which usually prevail.