DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

POULTRY DIVISION

REPORT OF THE DOMINION POULTRY HUSBANDMAN

F. C. ELFORD

FOR THE YEAR 1928

Pullets on clover range, Central Experimental Farm, Ottawa.

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POULTRY DIVISION

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GENERAL CONDITIONS

The year 1928 was another good year for poultry in Canada. The prices of new laid eggs dropped early in the new year and late broilers were somewhat of a drug on the market but the sale of production breeding stock was good, the day-old-chick business has increased, and the sale of turkeys has become quite a revenue-producing factor. As yet Canada does not produce sufficient for home consumption.

The increasing surplus of fresh eggs in British Columbia has been largely responsible for the early fall in egg prices.

THE DIVISION

The work in general has been satisfactory. The Central Farm has had a much needed extension and this division profited by the addition of some nine acres of very suitable soil immediately adjoining the main plant. Rearing range also is made available on the new Booth farm purchased in the spring. These new areas made the work of rearing much more satisfactory and have allowed room for the rearrangement of the plant and the construction of another permanent laying house with double yards.

At the branch farms the work is gradually developing and the farms that have an assistant superintendent in charge of the poultry, as a rule, are doing the best work. This division is striving to have a qualified poultry assistant upon each branch farm. With these throughout the system, and the additional scientific men at Ottawa, both of which are anticipated, the work should be of even more value than it has been in the past. During the year, under Mr. Greenwood's supervision, the special work of compiling the pedigrees of officially recorded hens of 300 or greater egg production in British Columbia was completed. The material has not been published though it does contain useful information upon methods used in breeding these high layers.

The Contests and Registration continue to develop, the demand for space is increasing, especially in British Columbia and Ontario. Both of these provinces are asking for increased contest accommodation, either in the space at the present contests or in the establishment of a new contest. The breeders of British Columbia have made repeated requests for a contest in the interior, preferably at Summerland, while those in Ontario ask for a contest in the more southerly portion of the province where the weather conditions are more favourable than at Ottawa.

Acknowledgments.—The men responsible for the activities of the division and for the parts of this report that deal with their particular departments are:—

Mr. Robertson, Chief Assistant, has charge of the breeding work and the oversight of the Central plant at Ottawa, and he has the direction of the division during my absence, which during the past few years has been considerable.

Mr. Taylor handles the contests, registration and inspection. This year in addition to his ordinary duties he prepared the first edition of the "Canadian National Poultry Record Association, Blue Book," this being a most creditable catalogue of the registered breeders of Canada.

Mr. Gutteridge has the oversight of experiments, the direct supervision of those conducted at the Central plant at Ottawa and assists in the direction of those carried on upon the branch farms. Also he has the responsibility of the compiling of this report.

Mr. Roy has charge of work in the province of Quebec, including the poultry upon the branch farms, co-operation with the provincial Department of Agriculture, registration, inspection, and survey work.

Mr. McConnell assists in the preparation of exhibit material for all shows where this division is represented, and he attends in person those places within distance of Ottawa. In addition to this he has charge of the poultry and egg account forms that are received from correspondents throughout Canada.

Dr. Weaver is the medium through which this division co-operates with the Health of Animals Branch. He has a laboratory and office in the poultry building and gives all of his time to poultry disease investigations. His services are so valuable and are appreciated to such an extent by the poultrymen of Canada that more assistance and larger and better equipped accommodations are greatly needed.

WORLD'S POULTRY SCIENCE ASSOCIATION

As the Dominion Poultry Husbandman is president of this association he has to spend a good deal of his time in its interests. A brief report of the year's activities may not be out of place in this report.

In an effort to establish this World's Association with its new name and widened constitution, and to urge participation in the 1930 Congress, it was necessary for the president to attend a number of International meetings in America, to visit the local executive of the 1930 Congress in London, England, and to interview a number of Europen countries. The countries in Europe, outside of the British Isles, that were visited were: France, Belgium, Holland, Denmark, Sweden, Finland, Latvia, Poland, and Germany.

In all of these countries a very kind reception was received from the ministers and officials of the Departments of Agriculture and others. A hearty response was given to the requests on behalf of the World's Association and the 1930 Congress. All countries that were represented at the 1927 Congress were most enthusiastic in their expressions of pleasure at the Canadian reception accorded, and those who were here were so delighted with Canada that they and others hoped to see more of Canada's wonderful possibilities. It is expected that this trip by the president will be continued in 1929, through other countries of Europe at least.

BREEDING

During the past breeding season at the Central Farm there were hatched 9,072 chicks of which 2,076 were sold as day-olds, 1,321 used in chick feeding experiments, 918 sold as broilers and the balance, after allowing for losses, reared for the replacement of stock, experimental work and the sale of breeding stock to farmers. For this latter purpose there were 331 birds disposed of, all the males being from dams that had produced at least 200 eggs in their pullet year and the females also of similar lines, being such as could be spared after meeting our own requirements. There were also disposed of for the improvement of farm stock 1,850 hen hatching-eggs and a limited number of duck eggs and breeding ducks and geese.

The addition of a new tract of land that had not previously been used for poultry work, and consequently has not been contaminated, has made possible an increase in the work. Not only has it been possible to increase the flocks but the stock in the future, being raised on clean ground will be much healthier and consequently results should be much more accurate than was formerly possible owing to the ravages of internal parasites and disease.

For a number of years breeding of fowl has been largely confined to Barred Plymouth Rocks and Single Comb White Leghorns. During the past year, however, owing to the improved condition for work previously noted, it was decided to make a start with White Wyandottes and Rhode Island Reds.

White Wyandotte hatching eggs were secured from the Branch Farm at Sidney, B.C., and Rhode Island Red eggs were purchased from a private breeder From 105 Wyandotte eggs put in the incubator, only 34 chicks were hatched, whereas from 36 Rhode Island Red eggs set 25 chicks were hatched. Both lots of chicks developed splendidly although the mortality in the Reds was quite heavy and there was also a heavy percentage of males. In the fall after culling, 19 Wyandotte pullets and 5 Reds were placed in the laying pens.

The egg production from the Wyandottes has been excellent and it is apparent that a good foundation stock has been secured, but with the Reds the production has been decidedly poor so that this line will be discontinued and a start made with another strain. While the hatch from the British Columbia eggs was not large it was sufficient to show that there is no reason why hatching eggs should not be interchanged between Eastern and Western Canada.

The value of the Dark Cornish as a top cross for the production of table poultry is being tested.

The females used in this work during the past season were Barred Rocks and Jersey Black Giants. The offspring of both matings showed decided Cornish type and when dressed the carcases presented the full round well meated breast, so characteristic of the Cornish. A considerable number of males of both these crosses were caponized and when developed were dressed. While both crosses presented splendid looking carcases those of the Cornish and Jersey Black Giant were much the plumper, smoother and more evenly fleshed. It is intended to continue this Cornish top crossing with a view to ascertaining what breeds are most suitable for crossing for the production of high class table poultry.

In cross breeding, sex-limited inheritance of colour character frequently occurs so that the sexes may be distinguished at birth. A demand has been in evidence for information as to what breeds may be used where sex differentiation at birth is desired.

Crosses of various breeds have been made from time to time, and in some cases this sex-limited inheritance has been apparent. In the offspring of the Cornish male and the Barred Plymouth Rock female the males have barred plumage and the females black plumage so that the sexes may be readily distinguished at birth by those familiar with the difference in appearance of chicks of the barred colour pattern from those of the black colour pattern. The Cornish male mated to Jersey Black Giant females produces black chicks of both sexes.

A Black Minorca male mated to Barred Plymouth Rock females produces cockerels of the barred colour pattern and pullets of the black colour pattern, whereas the reverse mating, that is, the Barred Plymouth Rock male mated to Black Minorca females, produces chicks of both sexes with the barred colour pattern.

A Black Leghorn male mated to White Leghorn females produces white cockerels and pullets white, ticked or splashed with black, whereas the reverse

mating, that is the white male mated to black females, produces chicks both sexes all white.

Speaking generally golden males mated to silver females will produce offspring which show sex-limited inheritance. In the golden class may be considered breeds of the black red colour type such as Dark Cornish and the partridge varieties and also reds and buffs. In the silver class may be considered all breeds of the silver type of colouring such as the Dark Brahmas, Dark Dorkings as well as all breeds carrying the silver prefix, and also the White Wyandotte which is a sport from the silver variety.

The most striking results during the past year in breeding for increased egg production were those obtained at the Summerland Experimental Station, where 25 females with an average egg production of 213 eggs, being those left after the flock had been blood tested and culled for Bacillus pullorum, produced 79 daughters which, without culling or deaths, gave an average egg production of 231 eggs. More than 25 per cent of the daughters laid 250 eggs or more, and 3 laid more than 300 eggs.

In the charts which follow will be found the egg production, fig. A, and pedigree, fig. B, of L 15, one of the 300 egg birds previously referred to.

In fig. C will be found the progeny record of the White Wyandotte Male K 373 F, the sire of L 15. This male has proven to be such an outstanding breeder that a study of this record should prove of interest. It will be noted that out of the total of 37 daughters tested only 2 laid less than 200 eggs, one laying 154 and the other 192, while three daughters laid more than 300 eggs, one laying 303, one 304, and the other 305. The average production for all the daughters was 248·7 eggs, a truly remarkable record.

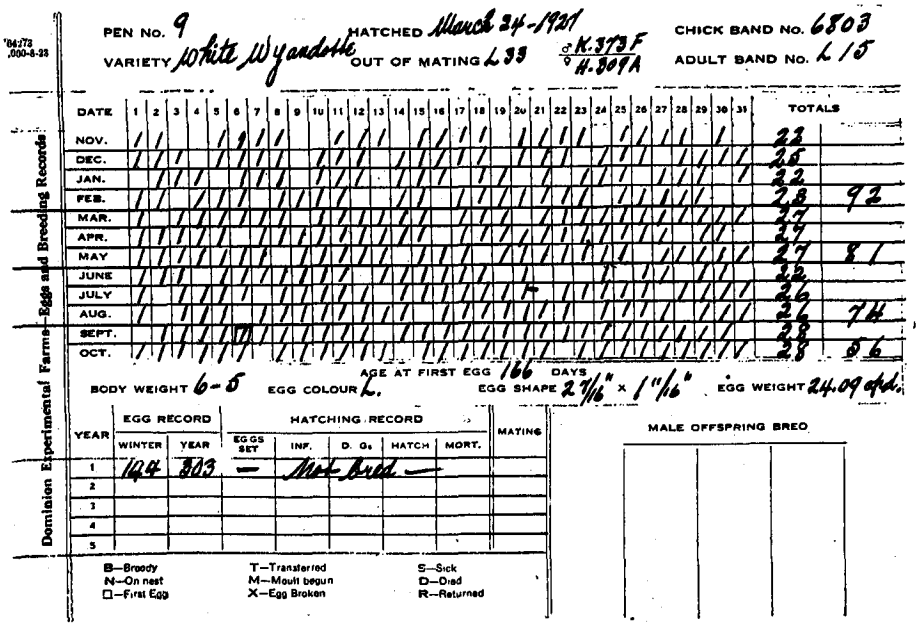

FIG. A.—Egg production chart of the White Wyandotte female L 15.

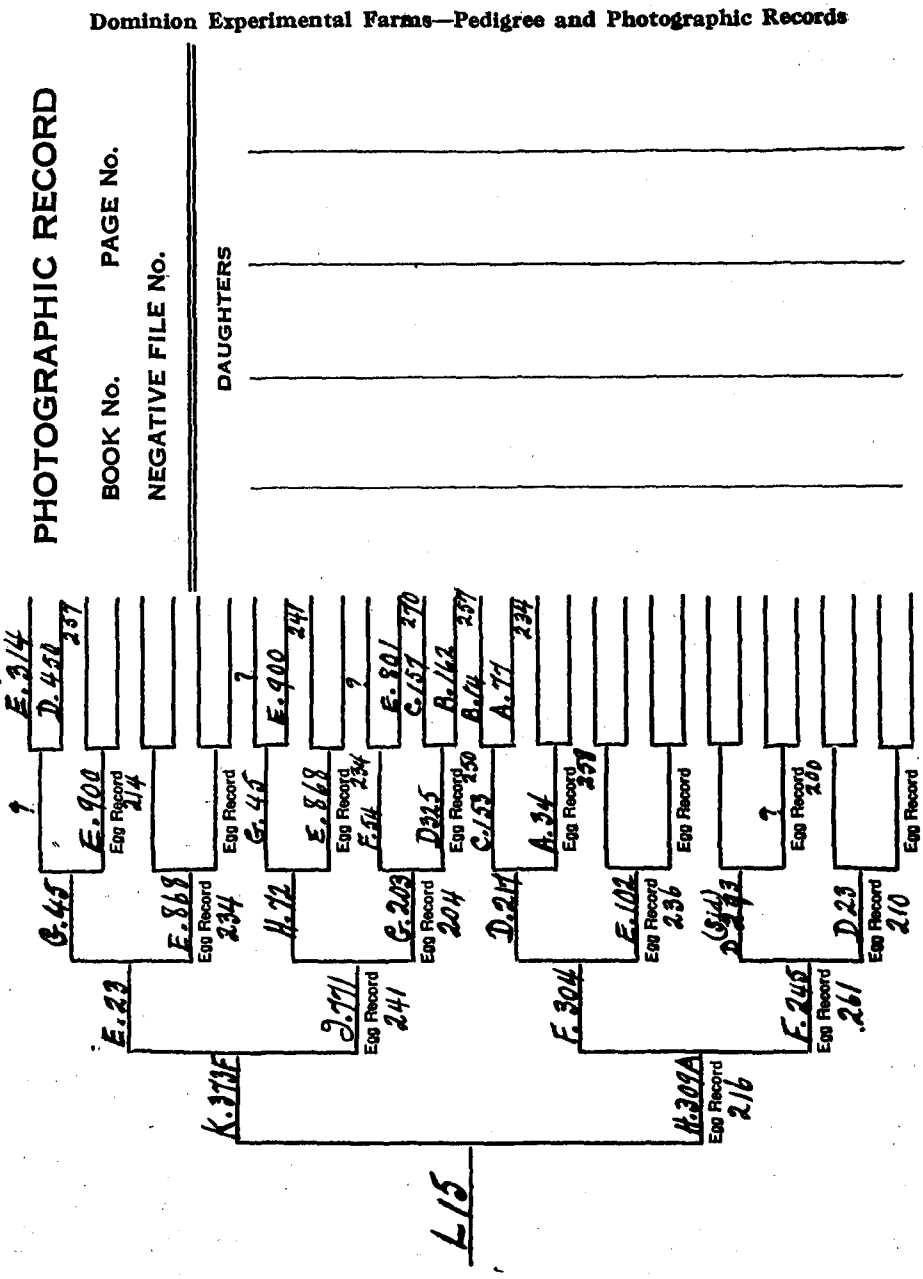

FIG. B.—Pedigree of the White Wyandotte female L 15.

YEAR 1927-28—FIG. C—VARIETY—WHITE WYANDOTTE (SUMMERLAND, B.C.)

Dominion Experimental Farms—Progeny Records

Sire Wt.	Dam Wt.	Daughters Wt.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Total	Egg Size	
																Wt.	Colour
K373F	H 121	L 2	15	16	10	12	7	7	12	10	3	6	26	20	154	23·1	L
7-12	5-7	6-4	67	83	93	105	112	129	141	151	154	.....	32	52	.....	.....	....
		L 5	21	23	23	21	27	25	24	18	25	22-4	28	24	285	22·4	L
		6-0	77	100	123	144	171	196	220	238	263	.....	32	56	.....	.....	....
		L 31	23	21	22	19	24	24	24	22	11	18	2-5	23	238	22·5	L
		5-2	51	72	94	113	137	161	185	207	218	236	.....	28	.....	.....	....
		L 67	26	23	22	22	24	16	22	19	19	21	17	10-8	249	23·6	L
		5-4	34	57	79	101	125	141	163	182	201	222	239	.....	.....	.....	....
		L 76	24	23	24	21	21	23	21	17	15	20	16	12-3	240	23·7	M
		5-0	27	50	74	95	116	139	160	177	192	212	228	.....	.....	.....	....
	H 209	L 12	24	22	23	22	13	19	19	16	12	11	2-17	18	218	23·3	M
	5-11	5-14	59	81	104	126	139	158	177	193	205	216	.....	35	.....	.....	....
		L 34	25	21	21	19	21	22	21	12	16	14	16-2	25	235	21·3	M
		5-4	52	73	94	113	134	156	177	189	205	219	.....	27	.....	.....	....
	H 309A	L 15	22	25	22	23	27	27	27	22	26	26	4-24	28	303	24·0	L
	5-4	6-5	74	99	121	144	171	198	225	247	273	299	.....	52	.....	.....	....
		L 63	25	24	23	22	26	21	22	18	16	20	14	5-12	248	23·5	L
		6-4	37	61	84	106	132	153	175	193	209	229	243	.....	.....	.....	....
	I 19	L 3	22	22	22	21	24	23	24	22	24	17-7	28	25	281	22·1	M
	5-15	5-11	82	104	126	147	171	194	218	240	264	.....	35	60	.....	.....	....
		L 7	25	22	21	24	22	16	20	23	3	22-1	27	14	240	21·3	L
		5-11	67	89	110	134	156	172	192	215	218	.....	28	42	.....	.....	....
		L 9	21	22	21	19	22	21	22	18	23	20	2-26	23	260	23·1	M
		5-3	70	92	113	132	154	175	197	215	238	258	.....	49	.....	.....	....
		L 14	15	17	15	24	17	17	15	15	17	16	2-23	19	212	23·2	M
		6-4	57	74	89	113	130	147	162	177	194	210	.....	42	.....	.....	....
K373F	I 19	L 45	23	20	21	20	24	24	20	13	17	21	21	2-21	248	22·3	L
7-12	5-15	5-10	44	64	85	105	129	153	173	186	203	224	246	.....	.....	.....	....
		L 51	29	21	25	23	27	25	16	18	16	15	23	10-17	260	20·0	M
		5-0	46	67	92	115	142	167	183	201	217	232	255	.....	.....	.....	....
		L 59	28	23	22	24	27	18	18	17	15	15	13	10-9	239	22·5	L
		5-9	37	60	82	106	133	151	169	186	201	216	229	.....	.....	.....	....
		L 69	28	27	23	21	25	18	17	14	18	14	16	11-9	241	21·9	M
		4-7	37	64	87	108	133	151	168	182	200	214	230	.....	.....	.....	....
	I 26	L 1	25	28	22	23	26	22	21	16	17	12-13	28	27	280	24·9	L
	6-1	5-8	93	121	143	166	192	214	235	251	268	.....	41	68	.....	.....	....
		L 16	14	11	14	22	19	12	18	13	15	12	5-21	16	192	23·2	M
		5-8	51	62	76	98	117	129	147	160	175	187	.....	37	.....	.....	....
		L 25	25	21	21	24	22	25	20	19	21	21	10-7	15	251	24·6	L
		5-5	47	68	89	113	135	160	180	199	220	241	.....	22	.....	.....	....
		L 27	23	20	22	20	20	15	8	17	14	12	10	28	209	24·0	L
		5-2	61	81	103	123	143	158	166	183	197	209	.....	38	.....	.....	....

YEAR 1927-28. FIG. C—VARIETY—WHITE WYANDOTTE (SUMMERLAND, B.C.)—*Concluded*

Dominion Experimental Farms—Progeny Records

Sire Wt.	Dam Wt.	Daughters Wt.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Total	Egg Size	
																Wt.	Colour
		L 29	25	23	22	20	23	21	20	16	21	17	11-6	23	248	25·1	M
		5-13	54	77	99	119	142	163	183	199	220	237	.....	29	.....	.....	....
		L 30	25	22	19	19	25	23	24	14	14	16	11-3	29	244	25·9	L
		5-8	57	79	98	117	142	165	189	203	217	233	.....	32	.....	.....	....
		L 61	23	23	21	19	25	24	17	19	18	13	15	9-11	237	22·1	M
		5-1	34	57	78	97	122	146	163	182	200	213	228	.....	.....	.....	....
		L 64	23	21	20	18	20	18	21	17	18	.....	6	13-10	210	24·6	M
		6-12	33	54	74	92	117	135	156	173	191	191	197	.....	.....	.....	....
		L 66	23	22	23	23	24	23	15	15	16	16	16	9-7	232	22·5	L
		5-9	30	52	75	98	122	145	160	175	191	207	223	.....	.....	.....	....
K373F	I 26	L 77	26	23	21	21	24	24	23	24	20	21	20	20-1	268	24·5	M
7-12	6-1	5-9	27	50	71	92	116	140	163	187	207	228	248	.....	.....	.....	....
	J 5	L 42	24	26	24	24	28	27	29	21	24	25	26	3-24	305	21·5	L
	5-5	5-12	48	74	98	122	150	177	206	227	251	276	302	.....	.....	.....	....
		L 53	21	23	21	21	24	24	25	22	23	23	20	8-14	269	25·7	L
		5-14	35	58	79	100	124	148	173	195	218	241	261	.....	.....	.....	....
		L 55	25	24	24	22	26	27	27	26	22	19	22	15	279	24·0	L
		6-1	40	64	88	110	136	163	190	216	238	257	279	.....	.....	.....	....
		L 57	24	19	21	21	21	22	24	24	24	22	18	9-13	262	22·3	L
		5-0	37	56	77	98	119	141	165	189	213	235	253	.....	.....	.....	....
		L 62	22	23	21	20	25	24	25	23	23	23	21	11-11	269	21·4	M
		5-14	33	56	77	97	122	146	168	191	214	237	258	.....	.....	.....	....
		L 68	24	23	21	22	25	25	26	21	9	.....	22	13-7	238	21·7	L
		5-13	31	54	75	97	122	147	173	194	203	203	225	.....	.....	.....	....
	J 13	L 17	25	25	22	21	22	18	13	20	21	1	2-16	29	235	22·5	L
	5-14	5-0	70	95	117	138	160	178	191	211	232	233	.....	45	.....	.....	....
		L 72	25	27	25	24	25	25	18	22	20	22	20	15-6	274	22·5	M
		5-4	31	58	83	107	132	157	175	197	217	239	259	.....	.....	.....	....
	J 62	L 48	23	22	23	23	28	25	29	28	27	28	25	6-17	304	21·6	L
	6-9	5-2	40	62	85	108	136	161	190	218	245	273	298	.....	.....	.....	....
	J 73	L 56	28	24	22	21	21	20	15	17	13	17	20	7-16	241	23·4	M
	6-9	7-4	44	68	90	111	132	152	167	184	197	214	234	.....	.....	.....	....

Above the dividing line Monthly Total.
Below the dividing line total to date. W—White. T—Tinted. L—Light. M—Medium. R—Rich.

EXPERIMENTAL WORK

In so far as experimental work is concerned the year 1928 was one of continued progress. A considerable amount of new work was undertaken during the year, and several projects which have been under operation for some years past were completed.

A factor of importance in the reliability of results obtained was that of freedom from disease. Whereas certain experiments carried on during the early summer of the previous year had to be abandoned for this reason, the birds were singularly free from any infection during the brooding experiments reported herein.

For the most part experiments are carried on with a view to obtaining practical results readily of use to the poultryman. To projects of this type have been added those of a more technical nature which, although not apparently of immediate practical use, yet furnish information which enables better understanding of the principles of feeding, breeding or some other poultry practice.

In the discussion upon experiments which follows it is essential to bear in mind that in most cases the experiments will be carried on over a period of from four to five years or until such time as it is felt that definite conclusions can be drawn. The material here given constitutes only a progress report. When it is considered that conclusions are justified a final report will be made. A considerable amount of experimental work is being done by the branch farms, results of which may be found in the annual report of the farm or station concerned. In some cases brief mention will be made of experiments upon the branch Farms which correspond with experiments carried on at this Division.

HATCHING SUMMARY

The hatching summary for the season 1928 covering the entire Experimental Farm system from Charlottetown, P.E.I., to Sidney, Vancouver island, gives interesting information upon hatching conditions throughout Canada. In such a summary are reflected conditions pertaining to climate, breeding and feeding in all their variations throughout the country.

With regard to fertility during the different months of the hatching season little difference is shown. Hatchability shown by percentage of fertile eggs hatched was best in May, with April, March and February following in the order named, or in other words hatchability increased as the season advanced over a range of 15 per cent. This is in accordance with results obtained during 1927. The same thing may be said of livability of chicks, there being a gradual increase in mortality of 12 per cent from May to February. This is the reverse of results for the previous two years.

Results obtained from the four different breeds carried upon the Farm System showed the Rhode Island Reds to be giving the best fertility, with the White Leghorns a close second followed by the Barred Plymouth Rocks and White Wyandottes in the order named. The comparative figures were 93·5 per cent, 90·4 per cent, 82·9 per cent and 63·5 per cent respectively, a variation of 30 per cent. Hatchability, as indicated by percentage of fertile eggs hatched, was 67·9 per cent for Rhode Island Reds, 64·9 per cent for the White Leghorns, 57·8 per cent for the White Wyandottes, and 55·5 per cent for the Barred Plymouth Rocks. Percentage of chicks hatched alive when wing banded (three weeks) was 93·7 for White Leghorns, 93·5 for Rhode Island Reds, 86·9 for White Wyandottes and 82·8 for the Barred Plymouth Rocks. Fertility and hatchability were better from hens than pullets, as is usually the case. Viability of chicks was 1 per cent superior from pullets.

The table following shows a comparison of hatching results from 1924 to 1928, inclusive:—

TABLE 1—HATCHING SUMMARY—EXPERIMENTAL FARMS AVERAGE—FIVE YEARS

Year	Total eggs set	Number fertile	Per cent fertile	Number of chicks	Per cent total eggs hatched	Per cent fertile eggs hatched	Number of chicks alive when wing banded	Per cent chicks hatched alive when wing banded	Total eggs required for 1 chick hatched	Total fertile eggs for 1 chick hatched	Total eggs required for 1 chick when wing banded
1924	63,820	49,528	77·6	21,813	34·1	44·0	14,605	66·9	2·9	2·2	4·3
1925	62,725	51,161	81·6	24,357	38·8	47·6	19,431	79·8	2·6	2·1	2·9
1926	75,169	60,010	79·8	27,761	36·9	46·3	17,293	83·7	2·7	2·2	3·3
1927	63,242	50,183	79·3	24,495	38·7	48·8	20,361	83·1	2·6	2·0	3·1
1928	85,066	68,979	81·1	39,303	46·2	56·9	29,970	87·2	2·1	1·4	2·36

DISCUSSION.—Over the five-year period little change was manifest in fertility. It will be noted, however, that there was an increase in total eggs hatched of twelve per cent in 1928 over 1924. The increase is especially marked in 1928 over 1927. The same increase is evident in percentage of fertile eggs hatched. It is rather difficult to account for this sudden increase over the entire system, since the spring of 1928 was in no way superior, in so far as weather conditions go, to the previous year.

It is gratifying to note that chick mortality over the system has decreased considerably, showing gradual improvement each year, with decided improvement during 1928. From 1924 to 1928 mortality decreased over 20 per cent. This is probably due to improved conditions and knowledge in brooding management and to the eliminating of reactors to the pullorum test, as has been done on most farms.

The table following shows the hatching results on the Experimental Farms according to the four natural agricultural divisions in Canada.

TABLE 2.—COMPARATIVE HATCHING RESULTS

Division	Per cent fertile	Per cent total eggs hatched	Per cent fertile eggs hatched	Per cent chicks alive when wing banded	Total eggs for one chick hatched	Total fertile eggs for one chick hatched	Total eggs for one chick when wing banded
Ontario and Quebec	88·2	57·7	64·3	78·9	1·7	1·5	2·2
Prairie Provinces	75·2	43·9	58·5	86·6	2·3	1·7	2·6
Maritime Provinces	80·9	38·2	50·8	90·3	2·6	2·0	2·9
British Columbia	79·8	50·6	63·4	92·2	1·9	1·6	2·1

MOISTURE IN THE INCUBATOR

Owing to the great variation in results obtained the results of this experiment during the past year will not be published but further work under different conditions will be done.

Up to the present time it would appear that no beneficial results were obtained by increasing moisture in the machine when the relative humidity of the air of the incubator room is 50 per cent or over. It is hoped to carry on this experiment in an incubator room showing much lower humidity than this.

DURATION AND CHANGE OF FERTILITY

This experiment, started in 1924, has been carried on each succeeding year with results corresponding fairly closely.

As in former years the mating of a white Leghorn male to Barred Rock females that had previously been mated to a Barred Rock male, was used, because the chicks from the Leghorn-Rock cross are white, and consequently can readily be distinguished from the chicks of the previous Barred Rock mating which are dark.

The following table shows in detail the results obtained:—

TABLE 3.—DURATION AND CHANGE OF FERTILITY

Male No.	Hen No.	Days after change of males																													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	L655	R	I	.	W	W	W	.	W	W	I	.	W	W	W	.	W	W	I	.	.	I	.	W	I	.	W	I	.	W	I	W	.
	657	.	R	.	.	I	W	I	.	W	.	W	W	I	.	.	.	.	.	.	.	.	.	I	I	.	I	.	I	I	.	I	I
	659	.	R	.	.	I	.	.	I	I	.	I	I	I	I	.	.	.	I	.	.	I	.	I	.	.	.	.	I	I	.	W	I
	664	.	R	W	.	W	.	W	W	.	W	W	W	W	W	.	.	W	W	W	W	.	W	W	W	I	.	.	I	W	W	W	.
	667	.	I	.	.	W	.	I	.	W	.	I	.	I	.	.	I	I	I	.	.	.	.	.	I	.	.	.	I	.	.	.	.
	673	R	.	R	R	R	.	R	W	.	.	W	.	.	W	W	.	.	.	.	.	.	.	I	I	I	.	I	W	I	.	.	W
	688	R	.	R	I	.	.	.	W	W	W	W	.	W	W	W	.	W	W	.	W	.	W	.	W	W	I	W	I	.	W	W	I
	689	R	R	R	.	W	W	W	.	.	.	W	W	.	W	W	.	.	.	.	.	W	W	I	I	.	I	I	.	W	I	I	I
00	525	R	R	.	R	W	W	.	W	W	.	I	.	.	.	W	I	W	W	W	.	.	W	I	I	W	I	.	I	I	.	.	.
	526	R	I	I	.	W	.	.	W	W	W	.	W	W	.	W	W	.	W	.	.	.	W	I	.	W	.	.	.	.	I	W	.
	527	I	I	.	.	.	W	I	I	.	W	.	I	.	.	.	I	I	.	I	.	W	I	W	I	.	I	.	.	I	I	I	I
	528	I	I	.	R	R	.	W	W	.	.	W	I	I	W	I	W	.	W	I	.	W	.	.	I	I	I	.	I	I	I	I	I
	533	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	W	.	W	.	W	.	I	.	I	.	W	W	.	.	.
	539	I	R	I	I	.	.	W	W	W	W	.	W	W	.	W	W	W	I	I	W	W	W	.	.	.	W	W	.	I	W	.	W
	544	.	I	R	W	R	W	W	W	W	I	W	.	.	.	W	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	I	.
	551	I	I	I	.	W	W	W	W	I	.	I	W	I	I	.	I	W	W	.	W	W	W	.	.	I	.	I	.	.	I	I	I
345	555	R	R	.	W	R	W	.	W	W	W	.	W	W	.	W	W	.	W	W	W	.	W	I	.	I	I	I	.	I	I	.	I
	559	R	.	R	R	.	W	W	W	.	W	.	W	W	.	W	.	.	.	.	.	I	W	I	.	I	.	.	.	.	.	.	I
	561	.	.	.	.	.	.	.	I	W	.	W	.	.	.	W	.	W	.	.	W	.	W	.	.	.	.	.	.	.	.	.	.
	568	.	I	R	I	W	.	W	I	.	W	W	W	I	.	I	W	W	W	.	W	.	.	I	I	I	.	.	I	I	I	I	.
	569	R	I	I	W	.	R	W	W	.	W	W	W	.	W	W	.	.	.	.	W	W	W	W	I	.	W	W	W	.	I	W	.
	570	R	R	R	W	W	.	W	W	.	W	W	W	W	.	W	W	.	I	I	.	I	W	I	I	.	I	.	.	.	I	.	.
	580	R	R	.	W	W	.	W	.	W	.	W	.	W	.	W	.	.	.	.	.	W	W	I	.	I	I	I	W	.	.	I	W

Key to Table.—R indicates a Barred Rock chick: W indicates a crossbred chick (white); I indicates in infertile egg or dead germ. A blank indicates that no egg was laid on that day. Eggs with chicks dead in shell were broken open and the colour of the chick determined.

NOTES.—Up to the present time the earliest that the Leghorn and Rock cross became apparent was the second day after the introduction of the Leghorn male to the pen. The greatest time elapsing before the effect of the second mating became apparent was four days.

During this experinent the effect of the second mating became apparent on the second day in one instance and was strongly apparent on the third day. The effect of the original Barred Rock mating was apparent up to the sixth day. In past years the range over which the effect of the original mating was apparent was from the sixth to the twelfth day.

In 1924 in three different matings, reversion to the original pure mating occurred after the cross mating was shown. In the 1925 and 1926 matings no evidence of this appeared, but in the 1927 matings this again appeared, a cross-bred chick having been produced from an egg laid the fourth day after the change of males, and a pure-bred chick on the fifth day after the change.

This experiment will be continued next year, when a number of males will be used in different matings so that final conclusions may be drawn.

During the present experiment (1928) this reversion occurred in three instances, namely from hens L544, L555 and L569. the reversion to a Rock chick occurring on the fourth day in the first two cases, and on the fifth day in the last instance.

DISCUSSION.—In view of the results obtained over the five-year period during which this experiment was under way certain definite conclusions may be drawn.

Since the average length of time during which the effect of the original Barred Rock mating was apparent was from five to seven days it is obvious that in replacing males in a breeding pen it will be necessary to allow at least seven days to elapse before saving eggs from the second male for incubation. If this is not done the chicks hatched may easily be from the original male rather than from the one by which it was replaced. It is probable that ten to twelve days would be a safer margin. The value of this information in pedigree breeding work is evident since substitution of males during the breeding season owing to death or for other causes is quite common, and it is desirable to have as little delay as possible.

In this connection it is well to bear in mind that, as has happened in this experiment, there is the occasional hen with which the new male may not mate. In the event of this happening the chicks produced from this hen will be from the original mating and may hatch if laid even as late as twenty-one days after the removal of the first male.

Direct evidence is shown by this experiment that after chicks have been hatched from a new male there may be reversion to the fertility of the old male and chicks sired by that male may be produced.

ULTRA VIOLET RAYS IN INCUBATION

The experiment with ultra violet rays in incubation was continued during 1928.

Two trays of eggs in an American incubator, hot water heated, were exposed to Ultra Violet Rays for a period of ten minutes twice daily. The rays were produced from the lamp suspended at a distance of two feet from the eggs. Two control trays were not thus exposed but were allowed to cool for a similar period to that of the radiation daily. A quartz tube mercury vapour arc lamp was used.

During 1926 results obtained were slightly in favour of the eggs exposed to Ultra Violet Rays. During this present experiment the unexposed eggs were superior to the extent of 7·6 per cent of fertile eggs hatched and 5 per cent of total eggs hatched.

This work will be continued as no conclusions may yet be drawn.

INFLUENCE OF QUALITY OF EGG SHELL ON HATCHING RESULTS

In order to determine the effect of quality of shell upon hatchability of eggs an American incubator, hot water heated, was set with four trays of fifty eggs each.

In two trays eggs were set indiscriminately without regard to apparent quality of shell except that all eggs were clicked lightly together in order to ensure that none were cracked prior to being placed in the incubator.

The eggs placed in the other trays were all clicked together as above and also were candled. Any apparently poor shaped eggs were discarded and those showing weak, rough ends, checks and other shell infirmities, under candling, were eliminated.

Results in this one year's experiment were slightly in favour of those eggs which were not candled and presumably had poorer shells. In this instance the labour of examination and candling was not repaid. This work will be continued before any conclusions whatever are justified.

HATCHABILITY FROM LARGE AND SMALL EGGS

In an effort to throw further light upon the comparative hatchability of large and small eggs an experiment covering some twenty-four hundred eggs was conducted during the spring of 1928.

For purposes of classification in this experiment eggs were divided into three size classes the standard twenty-four ounce egg being the key clas sas follows:—

Class 1.—Eggs 24 ounces to the dozen or larger.
Class 2.—Eggs 22 to 24 ounces to the dozen.
Class 3.—Eggs below 22 ounces to the dozen.

Two different types of incubator were used both being hot water heated machines.

In setting the eggs no attention was paid to shell texture but all were tested for cracked eggs. The eggs of each class were kept separate but at each setting all three sizes were put into the same machine to eliminate differences which might be due to different incubators.

A summary of the results obtained in the entire experiment is shown in the following table:—

RESULTS OF HATCHABILITY EXPERIMENT

Class	Per cent fertile	Per cent fertile hatched	Per cent total hatched
Class 1 (24 oz. +)	63·6	70·2	44·6
Class 2 (22–24 oz.)	65·8	55·8	36·7
Class 3 (22 oz. −)	62·4	67·9	42·4

NOTES.—Fertility, it will be noted, is quite similar with all classes, class 2 being slightly superior. Hatchability as best indicated by percentage of fertile eggs hatched is slightly superior for the eggs of class 1 followed closely by those of class 3. The same may be said of percentage of total eggs hatched. The fact that the largest eggs hatched best, but were followed in order in this respect by the smallest eggs makes the results obtained very unsatisfactory. This experiment will be continued.

STARVATION PERIOD FOR CHICKS

In continuation of work previously conducted, work with time of first feed for brooder chicks was again carried on. Five lots of forty chicks each were used and were removed from the incubator to the brooder as soon as dry after the completion of the hatch. Feed given consisted of the standard mash of equal parts shorts, middlings, yellow corn meal and oat flour with 12 per cent of animal feeds made up of 2 per cent each of bone meal, fish meal, powdered milk and 6 per cent of meat meal. One-half pound of salt per 100 pounds of mash was also added. After the first week a small amount of scratch grain was given. The mash was continually before the birds.

The completion of the hatch was considered as being the end of the twenty-first day. For example, if the eggs were set at 10 a.m. the completion of the hatch would be 10 a.m. on the twenty-first day.

The different groups were fed as follows:—

Group 1.—Fed 24 hours after completion of hatch.
Group 2.— " 40 " " " " "
Group 3.— " 60 " " " " "
Group 4.— " 72 " " " " "
Group 5.— " 96 " " " " "

The table following shows results of this experiment:—

TABLE 4—DETAIL—STARVATION PERIOD FOR CHICKS

—	Number at beginning	Average weight	Number of chicks end of 1st week	Average weight	Number of chicks end of 2nd week	Average weight	Number of chicks end of 3rd week	Average weight	Gain	Total mortality	Per cent mortality	Mash consumed	Gain per pound of feed consumed
		oz.		oz.		oz.		oz.	oz.				oz.
Fed 24 hours after completion of hatch	40	1·35	40	1·93	40	3·08	40	4·51	3·16	.....	.....	0·54	5·85
Fed 40 hours after completion of hatch	40	1·28	40	1·85	39	3·08	37	4·40	3·12	3	7·5	0·50	6·24
Fed 60 hours after completion of hatch	40	1·15	40	1·82	38	2·92	38	4·42	3·27	2	5·0	0·52	6·29
Fed 72 hours after completion of hatch	40	1·10	40	1·76	38	2·76	37	4·35	3·25	3	7·5	0·51	8·53
Fed 96 hours after completion of hatch	40	1·05	40	1·76	38	2·27	38	3·61	2·56	2	5·0	0·44	5·82

NOTES.—The most important feature of the above table is the fact that no mortality was experienced in the pen fed 24 hours after hatching. On the whole weight gains were quite comparable except in the case of those not fed until 96 hours. The greatest gain per pound of feed consumed was made by the later fed pens which is logical since their time in feeding hours was considerably less than the earlier fed pens, hence their consumption would be less correspondingly. The fact of their long starving would have a tendency to make them make better use of their feed.

DISCUSSION.—Three years work upon this subject has failed to show any greater mortality where chicks are fed twenty-four hours after the completion of the hatch than when fed at later periods such as forty, sixty, seventy-two or ninety-six hours. Apparently, although some yolk material may remain unabsorbed, the chick can still consume a small amount of feed without any detrimental effect. Again, since it takes chicks some little time to become accustomed to returning to hoppers for feed it is safe to say that their consumption will be small. During the first two years of experiment the chicks fed at twenty-four and thirty-six hours not only had no greater mortality but actually made greater weight gains and appeared more thrifty. In most cases birds fed as late as seventy-two and ninety-six hours after completion of hatch were at a decided disadvantage, both as to mortality and weight gains. At from twenty-four to forty hours after hatching, the chicks will chirp loudly and complainingly for food and when they exhibit this symptom they may be fed. Later on they will cease calling when it is only reasonable to suppose that they are losing strength and have not the energy to complain. Too great periods of starvation sometimes cause them to pick up litter, etc. to satisfy their craving with resultant inpaction in the crop, and death.

From the results obtained to date it would appear that chicks will do equally well, if not better, when fed prior to forty hours than if not fed until later periods. If chicks are fed at this time, or when they show unmistakable signs of hunger, as they will prior to forty hours, better results in both livability and weight gains may be expected. Certainly the matter of length of starvation period may be overdone. The fact that chicks will go as long as five days without food and show practically no ill effects should be taken as a fortunate circumstance which permits of shipment over long distances, rather than as the best method of handling them.

VITAMIN FEEDS AND VARIED RATIONS

In continuation of past work various rations and vitamin supplements were contrasted in order to determine their usefulness as feeds for brooder chicks. A slight but important variation was made during the experiment under consideration in that the period was increased from three to four weeks. For the most part, the different pens were carried through under their respective treatments for seventeen weeks and this work is reported under the heading of "Vitamin Feeds for Rearing."

The experiment comprised twelve pens of forty birds each except in the case of the last four pens which contained fifty birds. Each pen was accorded identical treatment except for the particular variation under experiment. All pens excepting the first four which were on different rations received the standard ration which has already been set forth (See experiment "Starvation Period for Chicks.") The feeding of all special feeds was commenced at time of first feeding which was thirty-six hours after completion of the hatch.

Accurate record was kept of weekly weights, feed consumption mortality and any conditions worthy of note in the experiment. All dead chicks were autopsied in order to determine if their condition might be due to the treatment or feed under experiment. From time to time their apparent condition was noted down and the symbols, P, poor; F, fair; VF, very fair; G, good; E, excellent, etc., were used to indicate such.

The following is the arrangement of the pens and the special treatment accorded each:—

1. A commercial ration—fed according to directions.
2. Dried whey—basal ration substituting one-half part soya bean meal and one part of dried whey for the animal feed of the mash.

3. Twenty-five per cent animal protein mash—basal ration but with 25 per cent animal feeds in the same proportion as in the basal mash.
4. Wisconsin ration.
5. Control pen—basal ration.
6. Crude cod liver oil—basal ration plus 1 tablespoon of oil per day in wet mash.
7. Refined cod liver oil—basal ration plus 1 tablespoon of oil per day in wet mash.
8. Cod liver meal—basal ration substituting 12 per cent cod liver meal for the animal feed of the mash.
9. Raw liver—basal ration moistening wet mash once daily with ground raw liver.
10. Fleischman's yeast 10 ounces to 100 pounds of mash increased to 1 pound per 100 pounds of mash.
11. Larro yeast (10 ounces to 100 pounds of mash.)
12. Chicadee yeast food ½ ounce to 6 pounds mash.

The Wisconsin ration consists of yellow corn meal 70 pounds, middlings 20 pounds, bone meal 5 pounds, pearl grit 5 pounds, common salt 1 pound, plus cod liver oil (two teaspoons per day in wet mash). They were given skim milk to drink ad lib and no grain or green feed. The table following shows results obtained:—

TABLE 5—DETAIL—VITAMIN FEEDS AND VARIED RATIONS

Ration	Number of chicks at beginning	Average weight	Number of chicks end of 1st week	Average weight	Number of chicks end of 2nd week	Average weight	Number of chicks end of 3rd week	Average weight	Number of chicks end of 4th week	Average weight	Condition	Total mortality	Per cent mortality	Average gain	Average per cent gain	Average cost of feed per chick alive at end	Feed cost per ounce of gain
		oz.		oz.		oz.		oz.		oz.						cts.	cts.
Commercial food	40	1·38	40	2·10	40	3·57	40	5·23	40	8·10	VG	.....	.....	6·72	486·96	2·91	0·43
Dried whey	40	1·33	40	1·98	40	2·98	40	4·30	40	6·36	G	.....	.....	5·03	378·19	1·70	0·34
25 per cent animal protein	40	1·18	40	1·83	40	2·88	38	4·34	38	6·65	G	2	5·00	5·47	463·57	1·37	0·25
Wisconsin ration	40	1·33	40	1·62	39	2·24	38	3·10	37	4·46	F	3	7·50	3·13	235·34	0·79	0·25
Cod liver meal	40	1·20	40	1·48	40	2·13	39	2·63	38	4·20	F	2	5·00	3·00	250·00	1·37	0·46
Control	40	1·35	40	1·93	40	3·08	40	4·51	39	6·68	G	1	2·50	5·33	394·82	1·49	0·28
Crude cod liver oil	40	1·13	40	1·75	39	2·90	39	4·32	39	6·18	G	1	2·50	5·05	446·90	1·58	0·31
Refined cod liver oil	40	1·13	40	1·75	40	2·75	40	4·00	40	5·37	G	.....	.....	4·24	375·22	1·35	0·32
Raw liver	50	1·34	50	2·14	49	3·45	49	5·04	49	7·00	VG	1	2·00	5·66	422·39	2·35	0·41
Fleischman's yeast	50	1·28	49	2·12	48	3·29	47	5·18	45	6·63	G	5	10·00	5·35	417·97	4·31	0·81
Larro yeast	50	1·20	49	2·08	48	3·13	47	4·55	46	6·80	VG	4	8·00	5·60	466·66	2·28	0·41
Chicadee	50	1·24	50	1·92	50	2·78	50	4·08	50	5·62	VG	0	.....	4·38	353·23	1·45	0·33

NOTES.—Of the six pens receiving the different rations it is noticeable that no mortality was experienced by those on the commercial ration and on dried whey. The greatest percentage gains were made on the commercial ration with the 25 per cent animal protein mash a fairly close second. The control and dried whey rations were inferior to the last two mentioned but were considerably superior to the Wisconsin and cod liver meal rations in this respect.

The efficiency of the rations as indicated by cost of feed per ounce of gain was greatest for the 25 per cent animal protein and Wisconsin rations. In the case of the latter, however, its low cost per pound of gain was due to low consumption rather than weight gains and the birds were very unthrifty. Over a period of three years very poor results have been obtained with this ration, the chicks being very unthrifty.

The control pen ranks very close to the lot receiving the 25 per cent animal protein mash in low cost of feed per ounce of gain. The commercial food and cod liver meal rations were expensive for the weight gains obtained. This applies to a lesser extent to the dried whey ration.

In considering those pens receiving vitamin foods as supplements the greatest percentage gains were made by the birds on Larro yeast and crude cod liver oil. These were followed by raw liver, Fleischman's yeast and the control pen respectively. Both rations supplemented by refined cod liver oil and Chicadee yeast food were inferior to the unsupplemented control ration.

Feed cost per ounce of gain was lowest for the control ration followed closely by those supplemented by crude cod liver oil, refined cod liver oil and Chicadee yeast food. Gains made on the ration supplemented by Fleischman's yeast were too expensive since outstanding gains were not made. This applies to a lesser degree to the raw liver and Larro yeast supplements.

Of the vitamin supplements used crude cod liver oil was outstanding, making second highest percentage gains at the lowest cost. The refined cod liver oil and Chicadee yeast food supplements were inferior to the unsupplemented ration both in weight gains and cost per ounce of gain.

DISCUSSION.—Over the period of this experiment both Fleischman's and Larro yeasts proved to be satisfactory supplements from the standpoint of weight gains. Mortality was comparatively low in both. From the viewpoint of economy, however, both supplements are somewhat lacking, Fleischman's yeast being particularly so. When equally good gains can be made at lower cost with crude cod liver oil it is obviously unnecessary to feed a yeast supplement.

It might be considered from the above that a combination of the oil and yeast would be more beneficial than either alone. Four years of experiment, however, have given very poor results from the feeding of a combination of crude cod liver oil and Larro yeast, even to the extent of being quite inferior to even the unsupplemented basal ration. Its cost was also quite high, although only half the amounts of both supplements were fed as was done when each was fed singly. Such poor results are rather difficult to explain and it is intended that further work will be done with this combination.

TABLE 6—VITAMIN FEEDS FOR BROODER CHICKS—FIVE YEAR SUMMARY

Ration	Year	Number of chicks at beginning	Average weight	Number end of 1st week	Average weight	Number end of 2nd week	Average weight	Number end of experiment	Average weight	Apparent condition	Total mortality	Per cent mortality	Average gain per chick	Average per cent gain per chick	Average cost of feed per chick alive at end	Feed cost per ounce of gain
			oz.		oz.		oz.					p.c.	oz.	p.c.	cts.	cts.
Basal ration	1924	40	1·3	35	1·94	35	3·14	34	4·94	G	6	15·0	3·64	280·0	0·8	0·418
	1925	50	1·28	50	2·16	50	3·67	48	5·23	VG	2	4·0	3·95	309·0	1·6	0·41
	1926	40	1·45	40	1·9	38	2·53	35	3·6	VG	5	12·5	2·14	148·0	0·9	0·42
	1927	105	1·12	104	1·63	101	2·44	99	3·48	G	6	5·7	2·36	210·0	1·8	0·76
	1928	40	1·35	40	1·93	40	3·08	40	4·51	G	.....	.....	3·16	234·1	1·4	0·46
Average	.....	275	1·30	269	1·91	264	2·97	256	4·35	.....	19	6·9	3·05	234·6	1·3	0·43
Larro yeast	1924	40	1·37	40	2·07	40	3·2	40	4·45	VG	.....	.....	3·08	225·0	1·9	0·62
	1925	50	1·28	50	2·28	49	3·88	49	5·35	VG	1	2·0	4·07	318·0	2·2	0·54
	1926	40	1·12	37	1·78	35	2·66	35	3·77	E	5	12·5	2·57	229·0	1·08	0·42
	1927	30	1·07	28	1·64	27	2·63	27	3·78	G	3	10·0	2·71	253·0	2·21	0·82
	1928	50	1·20	49	2·08	48	3·13	47	4·55	VG	3	8·0	3·35	279·7	2·23	0·67
Average	.....	210	1·21	204	1·97	199	3·10	198	4·38	.....	12	5·7	3·17	262·0	1·92	0·60
Fleischman's yeast	1924	40	1·32	39	2·05	38	3·21	37	4·68	G	3	7·5	3·36	254·0	2·1	0·62
	1925	50	1·22	49	2·14	49	3·71	49	5·1	VG	1	2·1	3·88	318·0	2·0	0·52
	1926	40	1·17	38	1·79	36	2·72	36	3·9	E	4	10·0	3·0	256·0	1·25	0·42
	1927	30	1·00	28	1·47	25	2·16	24	3·17	G	6	20·0	2·17	217·0	2·45	1·13
	1928	50	1·28	49	2·17	48	3·29	47	5·18	G	3	10·0	3·90	304·7	4·03	1·03
Average	.....	210	1·19	203	1·91	196	3·02	193	4·40	.....	17	8·1	3·21	269·7	2·37	0·74
Refined cod liver oil	1924	40	1·37	39	2·13	39	3·41	39	5·13	VG	1	2·5	3·76	274·0	2·3	0·61
	1925	50	1·18	47	2·04	46	3·61	45	5·04	G	5	10·0	3·86	327·0	1·9	0·49
	1926	40	1·28	36	1·75	36	2·36	36	3·16	VG	4	10·0	2·0	156·0	1·22	0·61
	1927	35	1·09	35	1·50	35	2·26	34	3·38	G	1	2·86	2·29	210·0	1·9	0·83
	1928	40	1·13	40	1·75	40	2·75	40	4·00	G	.....	.....	2·87	254·0	1·57	0·55
Average	.....	205	1·21	197	1·83	196	2·88	194	4·14	.....	11	5·4	2·93	242·1	1·78	0·61

TABLE 6—VITAMIN FEEDS FOR BROODER CHICKS—FIVE YEAR SUMMARY—*Concluded*

Ration	Year	Number of chicks at beginning	Average weight	Number end of 1st week	Average weight	Number end of 2nd week	Average weight	Number end of experiment	Average weight	Apparent condition	Total mortality	Per cent mortality	Average gain per chick	Average per cent gain per chick	Average cost of feed per chick alive at end	Feed cost per ounce of gain
			oz.		oz.		oz.					p.c.	oz.	p.c.	cts.	cts.
Crude cod liver oil	1924	40	1·37	39	2·13	39	3·41	39	6·13	VG	1	2·5	3·76	274·0	2·3	0·61
	1925	50	1·28	49	2·1	49	3·45	49	4·89	VG	1	2·0	3·61	282·0	1·7	0·47
	1926	40	1·12	38	1·83	38	2·66	38	3·63	VG	2	5·0	2·3	205·0	1·22	0·53
	1927	140	1·16	139	1·60	138	2·37	137	3·10	G	3	2·14	1·94	167·2	1·67	0·86
	1928	40	1·13	40	1·75	39	2·90	39	4·32	G	1	2·50	3·19	282·3	1·54	0·48
Average	.....	310	1·21	305	1·88	303	2·95	302	4·41	.....	8	2·6	3·20	264·4	1·69	0·53
Raw liver	1924	40	1·3	38	2·03	38	3·29	38	4·76	VF	2	5·0	3·46	266·0	1·8	0·52
	1925	50	1·18	46	1·96	45	3·18	41	4·54	F	9	18·0	3·36	285·0	1·7	0·51
	1926	40	1·33	39	1·8	39	2·69	36	3·45	F	4	10·0	2·16	162·0	1·41	0·65
	1927	30	1·03	26	1·50	26	1·80	21	2·57	F	9	30·0	1·54	149·0	2·68	0·72
	1928	50	1·34	50	2·14	49	3·45	49	5·04	VG	1	2·0	3·70	276·1	1·79	0·48
Average	.....	210	1·24	199	1·89	197	2·88	185	4·07	.....	25	11·9	2·83	228·2	1·88	0·67

NOTES.—Over a five year period the lowest percentage of mortality was experienced amongst the chicks receiving the crude cod liver oil supplement. Refined cod liver oil and Larro yeast pens were also quite low in mortality.

The greatest percentage gains were made by the birds receiving the Fleischman's yeast substitute followed very closely by crude cod liver oil and Larro yeast. The addition of refined cod liver oil only increased gains very slightly.

With regard to economy of gains as shown by feed cost per ounce of gain the basal ration is outstanding as is only logical since the cost of the supplement fed increased the cost of the other rations. Among the different vitamin supplements fed, crude cod liver oil is in a class by itself in this respect, followed by Larro yeast and refined cod liver oil. Both Fleischman's yeast and raw liver were quite costly per ounce of gain.

DISCUSSION.—Since this experiment has been carried on for a period of five years and since very definite results have been obtained, it will not be continued.

Over the five-year period crude cod liver oil has proven to be the most economical and efficient supplement. Mortality was lowest, feed cost per ounce of gain was lowest and percentage gain per chick, while not highest, was a very close second to the leading pen. The economy of gains and lack of mortality far over-shadow the slight inferiority in percentage gains. Since these striking results place the basal ration supplemented by crude cod liver oil very far above the basal ration alone it is concluded that crude cod liver oil is an efficient vitamin supplement to the ration of brooder chicks and it is recommended that it be fed during this stage of the chicks development regardless of time of hatch or weather conditions. The amounts fed in this experiment represent approximately 2 per cent by weight of the mash consumed, and may be mixed into the mash rather than fed in a wet mash at noon if desirable. It does not retain its beneficial properties if mixed and kept too long.

Refined cod liver oil has proven itself very inferior to the crude product and a great deal more expensive. Consequently its use in poultry feeding is not recommended.

VITAMIN FEEDS AND VARIED RATIONS IN REARING

The chicks in the above recorded experiment were carried through into the rearing period. Unfortunately, the value of the results obtained was very greatly reduced by an epidemic of coccidiosis which had a severe detrimental effect upon some pens. Although all pens were apparently affected the pens on dried whey, Wisconsin ration and the commercial feed experienced no mortality. This is interesting when it is considered that the pens mentioned were the only ones receiving milk products, namely, dried whey, sour skim-milk in the case of the Wisconsin ration, and milk powder in the commercial ration. Dried whey is a comparatively new milk product in the field of poultry feeding and may well have some possibilities particularly in the feeding of young stock.

Of the different vitamin feeds given, crude cod liver oil, raw liver, Fleischmann's and Larro yeasts gave good weight gains. Fleischmann's yeast gave good gains but was far too expensive to be of practical use for anything except the feeding of very young chicks when the amount consumed is too small to run up the expense.

The gains made on the commercial ration fed were greater than any for the first few weeks after which time some of the other pens of the experiment attained practically the same weight. The gains made on this ration were very expensive.

Owing to the amount of disease experienced, as was mentioned above, detailed figures will not be given for this experiment.

THE EFFECT OF SUNLIGHT UPON GROWTH OF CHICKS

In considering the role of sunlight in the growth of chicks it is necessary to take into account the protective value of its ultra violet rays against rickets. Since winter sunshine has been found to have very little protective power in these latitudes certain artificial agencies have been perfected to supply artificially the ultra violet rays so necessary to growing stock. Since it has been shown that common glass filters out these valuable ultra violet rays, certain glass substitutes have been manufactured which allow varying percentages of these rays to penetrate to the birds. A purely organic substance, cod liver oil, has been found to be protective against rickets, containing the anti-rachitic vitamin D and also the growth producing vitamin A.

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The experiment here reported contrasts these different protective agencies both as to their comparative protective ability and to their ability to cure a rachitic condition once established.

The experiment consisted of eight pens of fifty chicks each, twenty-five Barred Rocks and twenty-five White Leghorns. All pens received identical treatment except for the special treatment under consideration. All received the basal ration already described in the experiment, " Starvation Period for Chicks."

The arrangement of pens was as follows:—

Pen 1: Ultra Violet Rays—Birds exposed to ultra violet rays for a period of twenty minutes daily at a distance of three feet from the birds. A quartz mercury vapour lamp was used and they received no sunlight from any source.

Pen 2: Basal ration with sunlight through cel-o-glass only.

Pen 3: No sunlight but mash radiated one-half hour daily at a distance of one foot with the mercury vapour lamp.

Pen 4: Basal ration with sunlight through Vita glass only.

Pen 5: Control pen—Basal ration no sunlight from any source.

Pen 6: Basal ration—sunlight through common glass only.

Pen 7: Basal ration plus crude cod liver oil (one tablespoonful daily), no sunlight from any source.

Pen 8: Basal ration—direct sunlight through open windows.

By " no sunlight " is meant that the pens were separated with heavy brown paper. The windows were covered with the same material and daylight or skyshine as it is sometimes known experimentally, entered through north windows only.

The average daily hours of sunlight during the period of the experiment was 8·3 hours. Of this less than six hours were available to the inside of the pens.

Fresh cut clover was fed to all pens daily.

The experiment covered a period of six weeks at the end of which time subjects were taken from each pen for x-ray photographs and bone analyses.

The table following shows results of the experiment in detail:—

TABLE 7.—DETAIL—EFFECT OF SUNLIGHT UPON GROWTH OF CHICKS

Effect of sunlight upon growth of chicks	Number beginning	Average weight	Number 1st week	Average weight	Number 2nd week	Average weight	Number 3rd week	Average weight	Number 4th week	Average weight	Condition	Number 5th week	Average weight	Condition	Number, end of experiment	Average weight	Condition	Total mortality	Per cent mortality	Average gain per chick	Average per cent gain per chick	Feed consumption per bird	Gain per pound of feed consumed
		oz.		oz.		oz.		oz		oz.			oz.			oz.						oz.		oz.
Ultra violet	50	1·14	50	1·84	49	2·72	49	3·94	47	5·36	E	46	6·99	VG	46	7·74	VG	4	8·0	6·60	578·95	3·62	1·82
Cel-o-glass	50	1·26	49	1·86	49	2·84	49	4·41	49	5·57	VG	49	6·88	VG	49	7·31	VG	1	2·0	6·05	480·16	3·14	1·93
Mash radiated	50	1·26	50	1·96	50	2·90	50	4·28	50	5·78	VG	50	6·40	VG	48	6·94	G	2	4·0	5·68	450·79	3·86	1·47
Vita glass	50	1·22	48	2·00	48	2·86	48	4·19	48	5·35	VG	48	6·38	VG	46	7·13	VG	4	8·0	5·91	484·33	3·14	1·88
Control—no sunlight	50	1·24	49	1·79	49	2·88	49	3·82	49	4·57	P	48	4·92	VP	44	5·30	VP	6	12·0	4·06	327·42	3·47	1·17
Common glass	50	1·28	49	1·88	49	2·82	49	3·80	49	4·59	P	48	5·08	VP	46	5·37	VP	4	8·0	4·09	319·53	3·57	1·15
Crude cod liver oil	50	1·28	49	1·84	49	2·76	49	4·10	49	5·49	VG	49	6·37	VG	47	6·96	VG	3	6·0	5·68	443 75	3·17	1·79
Direct sunlight	50	1·26	48	1·90	48	2·94	48	4·19	48	5·19	E	47	6·62	VG	47	7·90	VG	3	6·0	6·64	526·98	3·37	1·97

NOTES.—Mortality was apparently of little significance, although it was high in the pen without sunlight and that with sunlight through common glass, in both of which leg weakness was apparent. Considerably the greatest gains were made by the pen upon ultra violet ray treatment, and the subjects in this pen were very thrifty indeed. Those receiving direct sunlight through an open window were next in order of merit.

A considerable gap separates the last mentioned pen with the next best, which were approximately equal and received sunlight through vita glass and cel-o-glass respectively.

The birds receiving radiated mash and those on crude cod liver oil were inferior to the glass substitute pens.

Those receiving no sunlight and sunlight through common glass were very poor and deficiency disease was plainly evident. The gain per pound of food consumed was poor only for those pens on no sunlight, common glass and mash radiated.

The following briefly summarizes the apparent condition of the various pens ten days before the completion of the experiment. There was bright sunlight when the chicks were examined. All birds show tendency to dryness, and ruffled condition of plumage.

Pen I: Ultra-violet rays—all birds active. Good comb development with good colour.

Pen II: Cel-O-Glass—Do.

Pen III: Mash radiated—less active, some dopey with evidence of leg weakness. Fairly good comb development with good colour.

Pen IV: Vita glass—active. One chick Xerophthalmia—left eye closed. Comb development and colour good.

Pen V: No sunlight—huddled, wings hanging, drowsy. Leg weakness pronounced. Tremors, gasping. No comb development.

Pen VI: Common glass—slightly better comb development than preceding pen. Dopey, listless. Nervous tremors with gasping (spasms). Leg weakness pronounced. Slightly more action than preceding pen.

Pen VII: Crude cod liver oil—fairly good comb development and colour, activity fair, few somewhat stilty gaited, with one showing spasms.

Pen VIII: Direct sunlight—good comb development and colour, visably better condition than preceding pen as to activity and body development. Xerophthalmia, one chick has left eye swollen shut.

BONE ANALYSES

At the completion of the experiment one Leghorn and one Barred Rock, typical examples of the pen, were removed for bone analyses. The femurs and tibiae-fibulae of the left limb of each chick were carefully dissected and analysed as to moisture, fat, nitrogen, calcium, phosphorous, magnesium and iron content. The calcium was determined as calcium oxide (CaO) the phosphorous as phosphoric acid (P_2O_5) the magnesium of magnesium oxide (MgO) and the iron as ferrous oxide (Fe_2O_3).

Tables 8 and 9 following show weight of green and dry bones for femur and tibia-fibula of each chick with the percentage water content of each.

TABLE 8.—INFLUENCE OF SUNLIGHT, ULTRA-VIOLET RAYS, ETC., ON THE DEVELOPMENT OF BONES IN SIX WEEKS OLD CHICKS, 1928.

Plymouth Rocks

Lab'y No.	Pen No.	Treatment	Femur			Tibia-fibula			Total	
			Weight of green bones	Water	Weight of dry bones	Weight of green bones	Water	Weight of dry bones	Weight of green bones	Weight. of dry bones
			grms.	p.c.	grms.	grms.	p.c.	grms.	grms.	grms.
94626	2	Ultra-violet rays	9·16	49·80	4·59	13·13	49·65	6·61	22·29	11·20
94627	3	Sunlight through cel-o-glass	7·01	50·27	3·49	10·57	47·58	5·56	19·58	9·05
94628	4	Mash radiated	6·08	58·76	2·51	8·64	55·87	3·81	14·72	6·32
94629	5	Sunlight through vita-glass	8·09	46·70	4·31	12·46	45·53	6·79	20·55	11·10
94630	6	No sunlight	6·04	64·24	2·16	8·52	63·33	3·13	14·56	5·29
94631	7	Sunlight through common glass	7·61	61·72	2·91	10·86	60·96	4·24	18·47	7·15
94632	8	Cod liver oil	8·66	32·65	4·10	11·82	51·31	5·75	20·48	9·85
94633	9	Direct sunlight through open window	7·28	46·69	3·88	11·07	45·21	6·07	18·35	9·95

TABLE 9.—INFLUENCE OF SUNLIGHT, ULTRA-VIOLET RAYS, ETC., ON THE DEVELOPMENT OF BONES IN SIX WEEKS OLD CHICKS, 1928

Leghorns

Lab'y No.	Pen No.	Treatment	Femur			Tibia-fibula			Totals	
			Weight of green bones	Water	Weight of dry bones	Weight of green bones	Water	Weight of dry bones	Weight of green bones	Weight of dry bones
			grms.	p.c.	grms.	grms.	p.c.	grms.	grms.	grms.
94634	2	Ultra-violet rays	6·66	43·80	3·74	9·51	44·71	5·26	16·17	9·00
94635	3	Sunlight through cel-o-glass	6·25	44·71	3·58	8·67	42·69	4·97	14·92	8·55
94636	4	Mash, radiated	6·56	43·57	3·70	9·11	43·46	5·15	15·67	8·85
94637	5	Sunlight through vita-glass	6·70	45·06	3·68	9·36	44·75	5·17	16·06	8·85
94638	6	No sunlight	4·98	59·96	1·99	6·96	60·03	2·78	11·94	4·77
94639	7	Sunlight through common glass	5·51	53·83	2·54	7·59	53·81	3·51	13·10	6·05
94640	8	Cod liver oil	6·72	52·48	3·19	8·71	50·97	4·27	15·43	7·46
94641	9	Direct sunlight through open window	6·20	43·32	3·47	9·68	44·96	5·32	15·88	8·78

NOTES.—It is worthy of note that particularly on the whole for both breeds the weight of dry bones was least for those under treatment with no sunlight, mash irradiated, and sunlight through common glass, the only notable exception being with mash irradiated among the Leghorns. The percentage of water in all bones was greatest for the birds with no sunlight and under common glass. In dissecting it was noticed that the joints of the subjects from these pens were enlarged and soft and could readily be cut with a knife.

The ratio of weight of dry to green bone shown in table 10 illustrates further the excess of moisture present in the bones of pens six and seven, as mentioned above.

TABLE 10.—RATIO OF DRY TO GREEN BONE

Pen No.	Treatment	Ratio weight of dry bone to weight of green bone	
		Plymouth rocks	Leghorns
2	Ultra violet rays	1 : 1·99	1 : 1·79
3	Sunlight through cel-o-glass	1 : 2·16	1 : 1·74
4	Mash radiated	1 : 2·33	1 : 1·77
5	Sunlight through vita glass	1 : 1·85	1 : 1·93
6	No sunlight	1 : 2·75	1 : 2·50
7	Sunlight through common glass	1 : 2·58	1 : 2·16
8	Cod liver oil	1 : 2·08	1 : 2·07
9	Direct sunlight through open window	1 : 1·84	1 : 1·81

In considering the analysis of bones for minerals, fat and nitrogen, tables 11 and 12 following give detailed information for Barred Rocks and Leghorns respectively.

TABLE 11.—INFLUENCE OF SUNLIGHT, ULTRA-VIOLET RAYS, ETC., ON THE DEVELOPMENT OF BONES IN SIX-WEEKS OLD CHICKS, 1928

(Results calculated on Green Bone)

BARRED ROCKS

Lab'y No.	Pen No.	Treatment	Femur										Tibia-fibula									
			Moisture	Fat	Nitrogen	CaO	P_2O_5	Ratio P_2O_5 : CaO	$Ca_3(PO_4)_2$ Calculated from P_2O_5	$Ca_3(PO_4)_2$ Calculated from CaO	MgO	Fe_2O_3	Moisture	Fat	Nitrogen	CaO	P_2O_5	Ratio P_2O_5 : CaO	$Ca_3(PO_4)_2$ Calculated from P_2O_5	$Ca_3(PO_4)_2$ Calculated from CaO	MgO	Fe_2O_3
			p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.
					theoretical			0·845														
94626	2	Ultra-violet rays	49·89	11·53	3·53	8·15	6·48	0·95	14·13	15·04	0·50	0·92	49·65	12·79	2·89	8·07	6·62	0·822	14·45	14·89	0·36	0·29
94627	3	Sunlight through cel-o-lgass	50·27	10·41	3·47	8·58	6·70	0·781	14·64	15·83	0·38	1·00	47·58	13·66	3·40	6·67	5·53	0·829	12·05	12·30	0·27	0·11
94628	4	Mash radiated	58·76	4·52	3·12	10·81	4·25	0·389	9·27	19·94	0·27	1·13	55·87	6·34	3·13	7·84	6·08	0·776	13·28	14·47	0·38	0·33
94629	5	Sunlight through vita-glass	46·70	12·59	3·03	9·07	7·15	0·788	15·62	16·73	0·48	1·07	45·53	13·39	2·74	8·26	6·69	0·810	14·60	15·23	0·30	0·27
94630	6	No sunlight	64·24	3·39	3·95	8·23	3·93	0·477	8·57	13·19	0·36	1·21	63·33	4·37	3·00	5·46	4·25	0·778	9·28	10·08	0·30	0·20
94631	7	Sunlight through common glass	61·72	3·31	3·70	6·01	4·65	0·774	10·16	11·08	0·50	1·14	60·96	4·98	3·41	5·52	4·78	0·865	10·43	10·19	0·33	0·16
94632	8	Cod liver oil	52·65	10·46	2·99	7·35	5·78	0·787	12·63	13·55	0·49	0·30	51·31	11·02	3·13	7·42	5·96	0·804	13·02	13·68	0·30	0·18
94633	9	Sunlight through open window	46·69	13·62	2·77	9·13	7·25	0·794	15·82	16·84	0·63	0·31	45·21	13·95	3·01	9·53	7·30	0·767	15·95	17·59	0·33	0·26

LEGHORNS

94634	2	Ultra-violet rays	43·80	13·91	3·72	9·67	7·41	0·767	16·95	17·84	0·60	0·48	44·71	15·16	3·21	8·29	6·59	0·795	14·39	15·30	0·32	0·47
94635	3	Sunlight through cel-o-glass	44·71	15·13	3·57	9·75	7·85	0·805	17·14	17·99	0·48	0·73	42·69	17·30	3·02	9·02	7·16	0·794	15·64	16·63	0·43	0·31
94636	4	Mash radiated	43·57	11·53	4·01	10·97	8·64	0·787	18·87	20·27	1·00	1·50	43·46	11·81	3·39	8·22	7·41	0·804	16·18	17·00	0·41	0·27
94637	5	Sunlight through vita-glass	45·06	13·02	3·69	10·01	7·94	0·790	17·34	18·55	0·79	0·33	44·75	14·32	3·28	8·35	6·85	0·820	14·95	15·40	0·25	0·28
94638	6	No sunlight	59·96	4·36	2·97	7·04	5·64	0·802	12·32	12·98	0·24	0·83	60·03	4·51	3·61	6·60	5·39	0·817	11·78	12·17	0·12	0·74
94639	7	Sunlight through common glass	53·83	5·57	3·13	8·80	7·32	0·831	15·98	16·23	0·58	0·95	53·81	6·61	3·22	8·17	6·52	0·799	14·24	15·07	0·09	0·44
94640	8	Cod liver oil	52·48	8·17	3·00	8·05	6·46	0·803	14·12	14·85	0·38	0·57	50·97	10·18	3·31	7·64	6·41	0·839	13·99	14·09	0·44	0·19
94641	9	Sunlight through open window	43·32	15·88	3·03	9·79	7·82	0·798	17·06	18·07	0·41	0·49	44·96	15·65	3·19	8·92	7·27	0·815	15·88	16·45	0·30	0·27

DISCUSSION.—Perhaps the most outstanding feature of the above table is the apparent tendency to low fat content of bone in the pens receiving no sunlight, sunlight through common glass, and irradiated mash. This is particularly true for the two first mentioned pens for both breeds, and for the last mentioned only is it true for the one breed, Barred Rocks. The pen receiving crude cod liver oil was noticeably low in fat among the Leghorns while those upon irradiated mash of the same breed were close to the average of fat content for the other pens. This apparent difference between breeds in the respect of fat content of bone is difficult to explain since in seven out of the nine pens no appreciable difference was evident. Since low fat is evidently associated with imperfect bone formation it would appear that cod liver oil did not have an effect upon Leghorns as beneficial as upon those chicks of the other breed. Conversely, irradiated mash seemed more efficient for the Leghorns than for the Barred Rocks. Apart from these apparent breed differences, however, it would seem that low fat content in bone is closely associated with those chicks which showed a severe affliction with leg weakness and poor bone development.

In so far as nitrogen content of bone is concerned, no significant difference is apparent for any pen.

Contrary to expectations, since lime (CaO) has often been considered as of paramount importance in leg weakness brought on by insufficient sunlight, no significant difference is apparent between pens in the calcium content of bone. In every instance calcium content is low in the pens with no sunlight and sunlight through common glass but not to a sufficient degree below the average of the remaining pens to be of high significance.

In the case of phosphorous content the difference is greater than for calcium, and again the pens without sunlight, sunlight through common glass and mash irradiated are low.

In general it may be said that poor bone development was associated with low calcium and phosphorous content which was in turn associated with complete lack of sunlight and sunlight through common glass. This also applies to a lesser extent to birds receiving irradiated feeds.

The percentage of magnesium and iron in the bones from various pens although varying considerably shows no definite trend.

RADIO-ANALYSIS

To further substantiate any results which might be obtained through bone analysis radiographs were taken of the femur and tibia-fibula of one limb from a Leghorn and Barred Rock chick from each pen.

The plates following (figs. 1 to 8) represent the left limb in each case of a Barred Rock and White Leghorn chick from each pen.

DISCUSSION.—It will be noted particularly that there is a significant lack of definition in the region of the diaphysis and epiphysis in those birds receiving sunlight through common glass and no sunlight whatever (figs. 7 and 8). No significant difference is noticeable between the pens under other treatments and bone development seems practically normal in all cases. The bones from the chicks on irradiated mash (fig. 5) do not possess the same apparent density as exhibited in most other pens. The pens under ultra violet rays, direct sunlight and vita glass are outstanding (figs. 1, 2 and 3). A noticeable feature is the fact that the Barred Rock bones from the pens without sunlight (fig. 8) and under sunlight through common glass (fig. 7) show greater evidence of malformation than do those of the White Leghorns. In the latter instance there is no apparent evidence of poor calcification while in the former the characteristic indistinct appearance in the region of articulation is present with also a slight excessive curvature of the tibia.

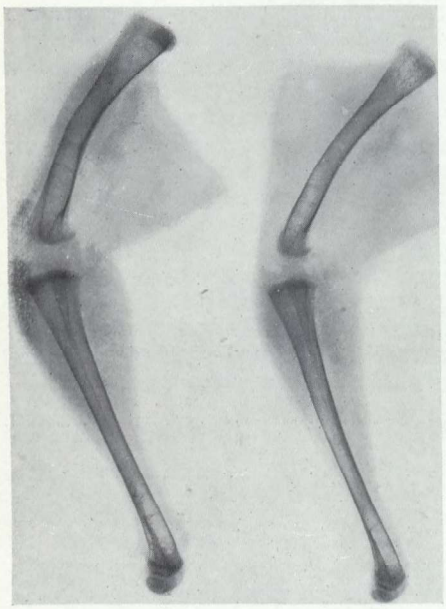


FIG. 1.—Ultra violet rays 20 minutes daily at a distance of 3 feet.

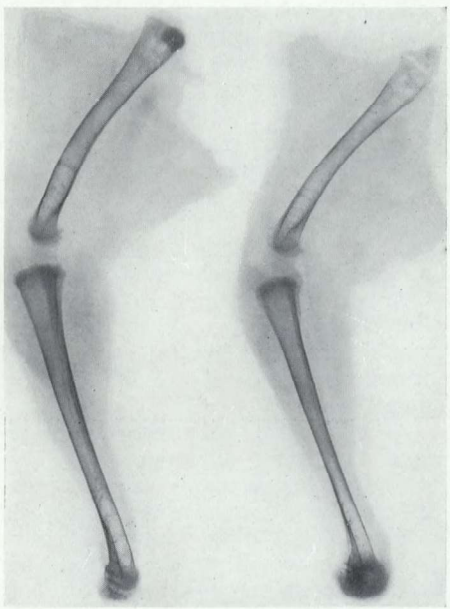


FIG. 2.—Direct sunlight, open windows.

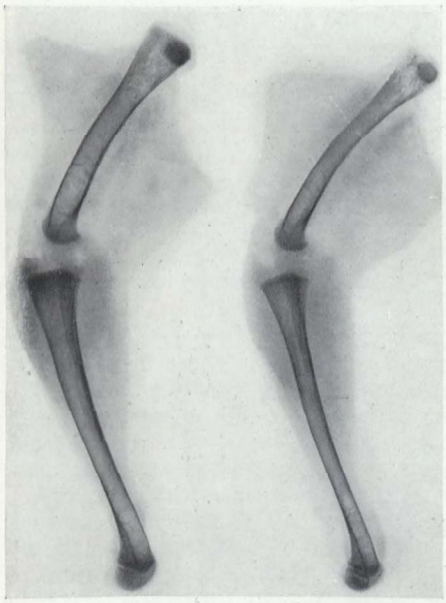


FIG. 3.—Sunlight only through vita glass.

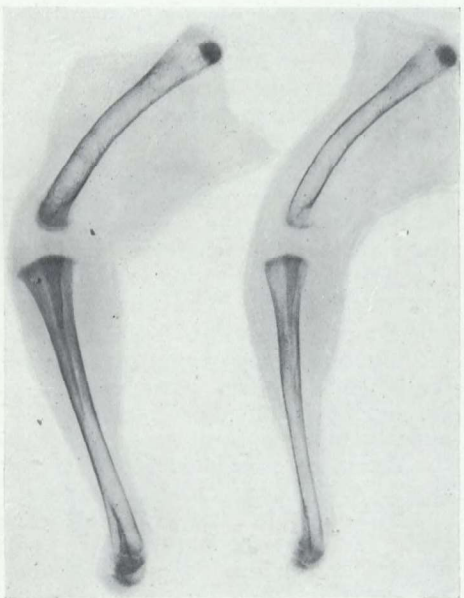


FIG. 4.—No sunlight—crude cod liver oil.

Left limb—Barred Rock, right limb—White Leghorn.

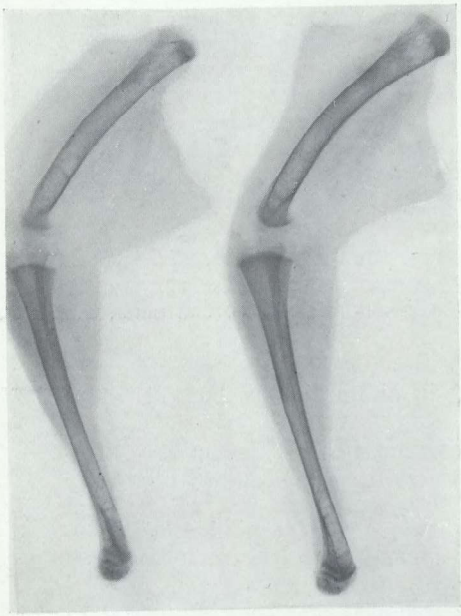


FIG. 5.—Mash radiated half an hour daily at a distance of one foot.

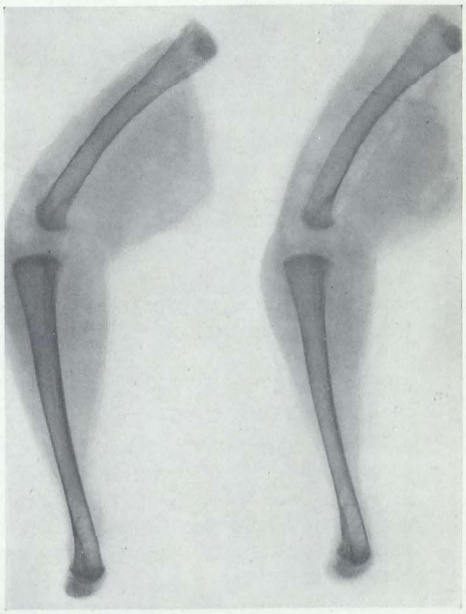


FIG. 6.—Sunlight only through cel-o-glass.

FIG. 7.—Sunlight only through common glass.

FIG. 8.—No sunlight, indirect light from behind only.

Left limb—Barred Rock, right limb—White Leghorn.

91864—5½

SUMMARY

In this experiment to date direct sunlight has proven the most efficient means of controlling proper calcium deposition in the bones of young chicks since bone analyses, apparent condition and radiographs have shown excellent bone condition throughout. In weight gains the chicks under ultra violet rays from a mercury vapour lamp have been slightly superior and these birds have also ranked high in bone condition as evidenced by radiographs and analyses. It is necessary to take into consideration, however, that the cost of the lamp, its operation and the extra labour required must be charged against the latter method. Over large numbers of chicks it becomes more practical.

Vita glass and cel-o-glass in the order named were also quite efficient but not so much so as direct sunlight. If for any reason, such as a very early hatch or inclement weather, it is impossible to allow sunlight into the pens, the use of these substitutes might be indicated.

Cod liver oil, a comparatively inexpensive product, has also proven quite efficient and would be particularly satisfactory in aiding normal bone development until such time as sunlight is available.

The irradiation of mash proved in this experiment to be ineffective in promoting good bone formation since leg weakness was present and a very poor bone analysis was obtained from this treatment. Common glass was of doubtful superiority to no sunlight whatever in this test and it was found impossible to raise chicks to six weeks of age without experiencing severe leg weakness under these treatments.

This experiment is being repeated when it is hoped that confirmatory data of value will be obtained.

THE CURATIVE EFFECT OF SUNLIGHT AND ANTIRACHITIC VITAMIN CONTAINING PRODUCTS IN CASES OF SEVERE RICKETS

Five pens of fifteen birds each were taken from the pens on no sunlight and sunlight through common glass in the last recorded experiment and given the following treatment:—

Pen I: Basal ration—irradiation with mercury vapour lamp for a period of forty minutes daily (20 minutes a.m. and p.m.) At the end of two weeks this time was increased by one half.

Pen II: Basal ration—one tablespoonful of crude cod liver oil daily. Increased to 1½ tablespoonfuls after two weeks.

Pen III: Basal ration—mash irradiated for thirty minutes daily. Increased to forty-five minutes after two weeks.

Pen IV: Basal ration—cod liver oil meal fed in wet mash at the rate of 8 per cent of the mash consumed. Increased to 50 per cent of the wet mash fed after two weeks.

Pen V: Basal ration—control pen, no special treatment.

All the birds in the above experiment received sunlight only through common glass which should have no effect upon the results. The pens were evenly divided as to condition and in many cases the chicks were completely off their feet and had to be fed by hand.

The table following shows detail of results obtained:—

TABLE 13—CURATIVE EFFECT OF DIFFERENT TREATMENTS

—	Number of birds at beginning	Number of birds at end of 30 days	Mortality	Per cent mortality	Treatment at beginning of experiment	Apparent condition at end of 20 days	Change of treatment after two weeks	Apparent condition at end of experiment (30 days)
Ultra violet rays:...	15	12	3	20·0	40 minutes daily....	Birds active and almost recovered	60 minutes daily.....	Completely recovered.
Crude cod liver oil	15	12	3	20·0	1 tablespoon daily...	Birds active and almost recovered	1½ tablespoons.....	All but one bird completely recovered.
Mash radiated.....	15	7	8	53·3	30 minutes daily....	Recovery slow in poor shape	45 minutes daily.....	Birds in poor shape, a number still off feet
Cod liver meal.....	15	11	4	26·7	8% by weight of mash.	Recovery slow, fair condition	Wet mash with 50% cod liver meal	Apparently recovering rapidly no doubt due to increase in meal, some birds still off feet.
Control.....	15	5	10	66·6	No treatment.....	Recovery slow, fair condition	No treatment.....	Three birds out of five recovered, 2 birds size of week old chicks

NOTES.—It will be noted that mortality was least under ultra violet rays and crude cod liver oil and that these were the only pens in which recovery was complete. Ultra violet rays is here outstanding as a curative agent with cod liver oil the nearest competitor.

Mortality was quite high where the mash was radiated and a number of chicks were still off their feet at thirty days. Apparently the cod liver meal used was a very poor curative agent as recovery was slow on 8 per cent of meal. The *half in half* mash and cod liver meal increased rapidity of recovery but it was not complete at the end of thirty days. Cod liver oil proved to be a much more efficient restorative, a fact which is significant in view of the poor results obtained with cod liver meal in experiments previously carried on here.

Mortality was extremely high in the control pen only five birds being left at thirty days. Of these five two were little larger than week old chicks. The other three were apparently nearly normal. These three were no doubt very little affected by rickets at the beginning of this test.

It would appear that ultra violet rays and crude cod liver oil are excellent curative as well as preventative agents of rickets.

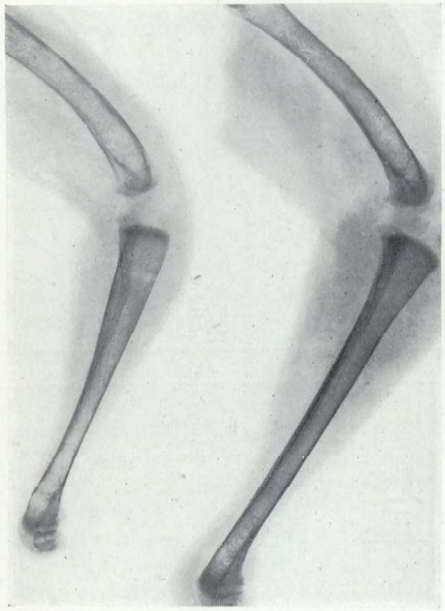


FIG. 9.—Ultra violet rays.

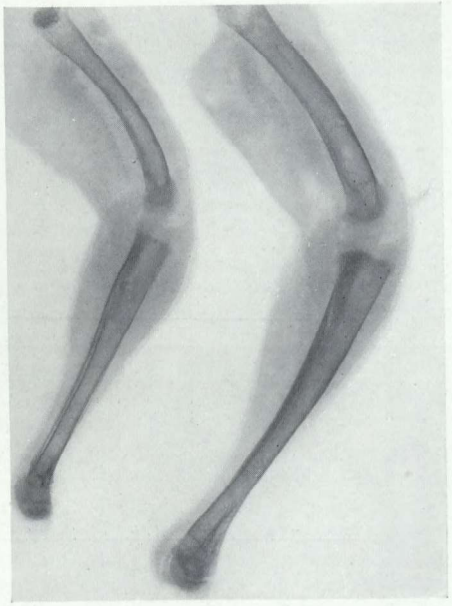


FIG. 10.—Crude cod liver oil.

FIG. 11.—Cod liver meal.

FIG. 12.—Mash radiated.

Left limb—poorest chick, right limb—best chick.

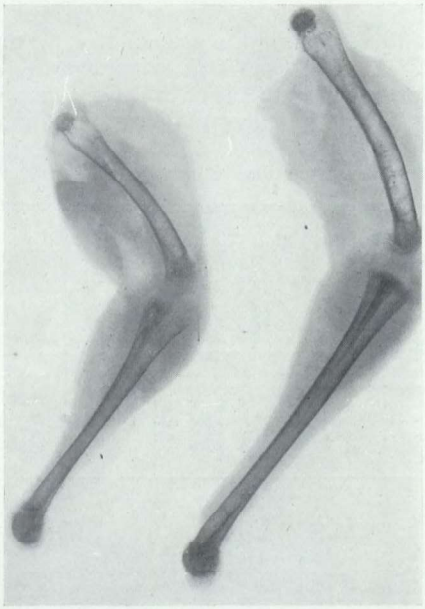


FIG. 13.—Control—sunlight through common glass. Left limb—poorest chick, right limb—best chick.

Radiographs were again taken of the best and poorest bird of each pen the femur and tibia-fibula of the right leg being used throughout.

Reference to the radiographs (figs. 9 to 13) shows clear definition and greater density of bone with the birds under irradiation and those receiving crude cod liver oil. Ultra violet rays gave outstanding results in these respects. Cod liver meal, irradiation of mash and the control pen show the characteristic cloudiness in the region of the diaphysis and epiphysis common to a rachitic condition. Particularly is this marked in the case of mash irradiation.

Acknowledgments.—The writer gratefully acknowledges the co-operation of the Department of Radiology of the Ottawa Civic Hospital in the taking of radiographs and for aid in interpreting the same; also of the Division of Chemistry of the Central Experimental Farm for bone analyses and for suggestions and aid in the arranging of the experiment.

FEED COSTS AND GAINS IN REARING PULLETS TO MATURITY

Experimental work to determine the cost of rearing pullets to maturity was carried on during 1927. At that time an inaccuracy was incorporated into the published table which underestimated the final rearing costs.

The table following gives the correct figures for this experiment:—

TABLE 14.—DETAIL FEED COSTS IN REARING PULLETS TO MATURITY

Breed	Average weight per chick at 10 weeks	Feed consumed per chick at 10 weeks	Cost of feed per chick at 10 weeks	Pounds of feed per pound of gain	Number of pullets at beginning (11 weeks)	Average weight	Number end of 12th week	Average weight	Number end of 13th week	Average weight	Number end of 14th week	Average weight	Number end of 15th week	Average weight	Number end of 16th week	Average weight	Number end of 17th week	Average weight
	lb.	oz.	cts.	lb.		lb.		lb.		lb.		lb.		lb.	lb.	lb.		lb.
White Leghorn..	1·15	11·48	11·60	4·40	100	1·58	100	1·75	100	2·03	100	2·15	100	2·20	100	2·36	100	2·52
Barred Rocks....	1·45	12·09	11·68	3·50	100	1·87	100	2·04	100	2·54	100	2·66	100	2·83	99	3·17	99	3·43

Breed	Number end of 18th week	Average weight	Number end of 19th week	Average weight	Number end of 20th week	Average weight	Number end of 21st week	Average weight	Number end of 22nd week	Average weight	Number end of 23rd week	Average weight	Number pullets at end of 24th week	Average weight	Feed consumed per bird from time of hatch	Cost of feed per bird to 24 weeks	Gain per bird (24 weeks)	Pounds of feed per pound of gain
				lb.		lb.		lb.		lb.		lb.		lb.	lb.	cts.	lb.	lb.
White Leghorns.	100	2·59	99	2·72	99	2·75	97	2·80	96	2·83	96	2·84	95	2·84	13·15	44·5	2·74	4·8
Barred Rocks....	99	3·55	99	3·70	99	3·75	96	3·79	96	3·82	93	3·93	96	3·96	15·58	49·1	3·86	4·03

NOTES.—The above table is quite self-explanatory. It shows among other things feed cost of 44·5 per bird for White Leghorns and 49·1 per bird for Barred Rocks to raise to maturity; and that the Barred Rocks made the most economical use of feed, requiring but 4·03 pounds of feed for one pound of gain, as compared with 4·8 pounds for the Leghorns. Very little mortality was experienced. At the twenty-first week two birds of each breed were removed and later replaced, causing a variance of two numbers in the birds weighed at that time.

Allowing 15 cents per chick for Leghorns and 20 cents for Barred Rocks to cover cost of incubation, the total cost per bird, labour neglected, to twenty-four weeks of age would be 59·5 cents and 69·1 cents respectively.

CAPONS VS. ROASTERS

During the season of 1928 comparative work with capons and roasters as sources of profit was continued. Both White Leghorns and Barred Rocks were used as in previous work. In caponizing White Leghorn cockerels it was intended to gain further information which would throw more light upon the question as to whether, by caponizing, the killing of Leghorn cockerels immediately their sex is apparent, might not be eliminated from poultry practice. Since the cost of feeding and caring for cockerels until three weeks of age must be charged against the pullets it was thought that greater weight and a higher price might be obtained by caponizing cockerels and raising them to roaster age.

In this experiment four pens of birds were used, two of each breed. The four pens consisted of thirty-four Barred Rock capons, twenty-three Barred Rock cockerels, thirty-two White Leghorn capons and twenty-five White Leghorn cockerels. The birds were caponized after nine weeks of age and were started on experiment at ten weeks to allow time for recovery from the effect of the caponizing operation. Mortality due to the operation was negligible. The birds were weighed once weekly and account of feed consumption kept weekly. At different times slips were removed from the pens of capons as they became evident.

The table following shows weight gains during the experiment or for a period of twenty-one weeks:—

TABLE 15.—CAPON VS. ROASTERS—WEIGHT GAINS

Lot	Beginning (10 weeks of age)	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week	10th week	11th week	12th week
Barred Rock capons	1·69	2·26	2·56	2·85	3·03	3·53	3·91	4·21	4·76	4·53	4·93	5·34	5·52
Barred Rock cockerels	1·74	2·26	2·67	2·96	3·33	3·74	4·09	4·30	4·52	4·74	4·98	5·50	5·64
White Leghorn capons	1·53	1·87	2·05	2·35	2·71	2·90	3·13	3·29	3·48	3·59	3·79	4·14	4·14
White Leghorn cockerels	1·48	1·84	2·14	2·36	2·54	2·83	2·94	3·00	3·33	3·21	3·50	3·77	3·83

Lot	13th week	14th week	15th week	16th week	17th week	18th week	19th week	20th week	21st week	Gain 16th week	% Gain at 16th week	Gain 21 weeks	% Gain 21 weeks
Barred Rock capons	5·59	6·21	6·33	6·41	6·86	6·80	7·03	7·38	7·24	4·72	279·3	5·55	328·4
Barred Rock cockerels	5·82	6·23	6·45	6·68	7·18	7·14	7·27	7·64	7·50	4·94	283·9	5·76	331·0
White Leghorn capons	4·29	4·36	4·54	4·43	4·54	4·77	4·72	5·04	5·10	2·90	189·5	3·57	233·3
White Leghorn cockerels	3·96	4·25	4·25	4·37	.....	.....	.....	.....	.....	2·89	195·3	.....	.....

NOTES.—The most outstanding feature of the above table is the fact that the Barred Rock cockerels slightly exceeded the capons in weight gains. In this particular instance, two birds among the capons, one of which was unthrifty and the other a small bird, may have had some influence upon the results. Among the Leghorns the capons made slightly greater weight gains but were heavier at the commencement of the experiment, consequently their percentage gains were lower than the cockerels. From the weight gains mads it is evident that returns would have been greater had the birds been disposed of at seventeen weeks in the case of the Rocks and fifteen weeks for the Leghorns, or at twenty-seven and twenty-five weeks of age respectively. This agrees with last year's results. After this time weight gains were not sufficient to balance the cost of food, maintenance, etc. The White Leghorn cockerels were disposed of at sixteen weeks, owing to a slight outbreak of infectious bronchitis.

TABLE 16—CAPONS VS. ROASTERS—DETAIL

—	Number at beginning	Number at end	Feed consumption per bird		Total value of feed	Weight at beginning (10 weeks)	Weight at end (26 weeks)	Gain per bird	Pounds of feed per pound of gain	Cost per pound of gain	Value as broilers (10 weeks)	Final value per bird	Total profit per bird	Profit after deducting feed cost
			Scratch grain	Mash										
			lb.	lb.	cts.	lb.	lb.	lb.		cts.	cts.	$	$	$
Barred Rock Capons	34	29	17·67	8·63	65·2	1·69	6·41	4·72	5·57	13·81	42·2	2 56	2 14	1 49
Barred Rock Cockerels	23	20	20·36	6·87	66·1	1·74	6·68	4·94	5·51	13·38	43·5	2 00	1 56	0 90
White Leghorn Capons	32	26	16·07	6·71	55·9	1·53	4·43	2·90	7·86	19·28	22·9	1 55	1 32	0 76
White Leghorn Cockerels	25	23	18·86	5·30	58·1	1·48	4·37	2·89	8·36	20·1	22·2	1 09	0 87	0 29

NOTES.—The above table covers a period of sixteen weeks or from ten weeks of age to twenty-six weeks. Mortality was very slight in all cases. Three slips were removed from the Leghorn capons and four from the Barred Rocks.

Grain consumption was greatest for the cockerels in each case, while mash consumption was greatest for the Capons, the total value of feed consumed was greatest for the cockerels of both breeds.

The Barred Rock cockerels made more efficient use of their feed as shown by pounds of feed per pound of gain. On the other hand the Leghorn Capons were superior to the cockerels in this respect.

With regard to total profit per bird over value as broilers, the Barred Rock Capons are quite superior to the cockerels there being a difference of 58 cents per bird. The same may be said of the White Leghorn Capons, the difference being 45 cents per bird in this case.

Net profit after deducting feed cost is in favour of the Capons of both breeds.

The following figures were allowed for the different types of bird:—Barred Rock and Leghorn broilers, 25 cents and 15 cents per pound respectively; roasters 30 cents and 25 cents per pound respectively; Capons 40 cents and 35 cents per pound respectively. These were prevailing and quoted prices in Ontario during the time of these experiments.

DISCUSSION.—In considering two years of experiment on this subject it becomes evident that any increase in profits is more likely to come through the advantage in market price of capons over cockerels rather than from the greater weight of the former since practically no greater weights have been attained by the capons of either breed over two years of experiment.

It is apparent that it is much more profitable to caponize Barred Rocks than to carry them through to the roaster stage, always providing of course, that the market available will pay a premium for good capons over roasters. In this case a premium of ten cents per pound was allowed for the capons.

In selling the Barred Rock capons at broiler age (10 weeks) in lieu of caponizing their market value would have been 42·2 cents. Subtracting the feed cost to ten weeks, approximately 13 cents per bird we have a profit of 29·2 cents per bird, labour, depreciation, etc., neglected. Figuring on the same basis we have a total value per bird as capons at twenty-six weeks of $2.56 cents less 65·2 cents and 13 cents for feed or a profit of $1.78 per bird. Before arriving at any conclusion as to the advisability of caponizing rather than selling as broilers it is necessary to consider labour costs, depreciation, interest, etc. Of these considerations, labour is perhaps the most important, but it must be remembered that practically the same amount of labour would suffice for a much greater number of capons than was carried in this experiment with a resultant decrease in labour cost per bird. Under ordinary conditions a profit of $1.78 per bird at twenty-six weeks would be a better profit than 29·2 cents at ten weeks and it is suggested that where Barred Rock cockerels are raised it is more profitable to caponize them and carry them over to twenty-six weeks of age or thereabouts, than to sell as broilers unless much higher prices are obtained for broilers than was done under this experiment. Similarly it is more profitable to caponize than to carry over as roasters providing that a premium can be obtained for capons, as is usually the case. In this experiment the capons gave a greater profit by 59 cents per bird than the roasters.

In considering the caponizing of White Leghorns as opposed to selling as broilers smaller profits throughout are the rule. At broiler age the profit per Leghorn after deducting a feed cost of twelve cents would be 10·9 cents per bird. On the same basis the profit per capon after deducting feed costs would be 87·1 cents or a difference of 76·2 cents in favour of the capons. It resolves itself then into a question of whether the labour cost, interest on investment, depreciation, etc., would be so great as to reduce the profit from Leghorn capons to such an extent that the net returns would be less than the profit which might have been obtained if sold as broilers.

The answer to the above question depends entirely upon individual circumstances. On the general farm, where lack of space is not a factor and where consequently little labour is required and the birds will forage for themselves to some extent, it would be profitable to caponize. On the specialized poultry plant, where land is expensive, and space very limited it would not be profitable. The individual farmer or poultryman must decide for himself taking into consideration his particular conditions.

The results of this experiment over two years definitely indicate that it is far from profitable to keep Leghorns to the roaster stage.

In the question of capons vs. roasters there is the added consideration that the former may be allowed to range with the pullets whereas the cockerels must be kept separate, thus increasing maintenance cost and labour.

POTATOES VS. CORN MEAL IN FATTENING

Owing to bronchial infection in the stock with which it was intended to carry on this experiment, it had to be discontinued. Better equipment is now available for work of this type and it is hoped that this work will be continued in the near future.

EXPERIMENTS FOR WINTER EGG PRODUCTION

A group of experiments was again carried on to contrast different feeds and conditions in their effect upon winter egg production, and also upon fertility, hatchability and viability of chicks. All pens were carried under identical conditions and were housed in a long house of fifteen pens. Single Comb White Leghorn pullets were used, fifteen to a pen. No dead birds were substituted and all results are worked out on the basis of one bird. Pen No. 5 was used as the control pen for all experiments.

The following is the list of experiments and the number of pens devoted to each:—

Substitutes for fresh greenfeed—4 pens.
Ultra Violet Rays for egg production—1 pen.
Vitamin feeds for egg production—2 pens.
Fish meal vs. meat scrap—2 pens.
The use of a glass substitute in poultry houses—1 pen.
Animal protein vs. vegetable protein plus a mineral mixture—1 pen.
The comparative value of grainless, gritless, green feed lacking rations—3 pens.
Control pen for all experiments.

The experiments covered a period of six months or from November 1 to April 30, inclusive. Careful account was kept of all feed consumed and of mortality and cause where possible.

The standard basal ration was fed to all pens with whatever variations were necessary for each experiment, and was as follows:—

Grain—A commercial scratch mixture.

Mash—Equal parts by weight of bran, middlings, corn meal, ground oats with three quarters of a part of meat meal and 1 pound of salt per 100 pounds of mash. Greenfeed, charcoal, grit and shell were available unless otherwise stated. Greenfeed consisted of sprouted oats and mangels, except where otherwise noted. Scratch grain was fed in the litter night and morning. Dry mash was always available in hoppers.

The average cost of feeds given per cwt. is as follows:—scratch grain $2.40; mash $2.70; grit 87 cents; shell 93 cents; mangels 50 cents; sprouted oats 2.25.

In determining the effect of the various feeds and treatment accorded to the different pens, upon fertility, hatchability and viability of chicks, all pens were mated during the breeding season in the regular way and a hatch run off. The males were then alternated, from pen to pen daily, in order to nullify the effect of individuality in the males upon the hatching results. All chicks from both hatches were toe-punched and carried over to three weeks of age to determine mortality.

SUBSTITUTES FOR FRESH GREENFEED

Experimental work with various substitutes for fresh greenfeed was continued during the past season, raw potatoes, cooked potatoes, alfalfa meal and sweet clover meal being contrasted with mangels and sprouted oats as fed to the control pen, both as to egg production and for hatchability and viability of chicks.

Four pens were used and received the basal ration plus the following treatment:—

Pen 1.—Basal ration without greenfeed plus raw potatoes (50 cents per cwt.) chopped and fed in wet mash—equal quantities mash and potatoes.

Pen 2.—Basal ration without greenfeed plus cooked potatoes mixed with wet mash as for pen 1.

Pen 3.—Basal ration without greenfeed plus alfalfa meal ($1.90 per cwt.) fed at the rate of five ounces per twelve birds daily in the wet mash.

Pen 4.—Basal ration without greenfeed plus sweet clover meal ($2 per cwt.) fed as for pen 3.

The potatoes used were small and culls, hence their low valuation.

The table following shows detailed results of this experiment:—

TABLE 17—SUBSTITUTES FOR FRESH GREENFEED

Pen and special feed	Total mortality	Weight gain or loss	Scratch grain	Value	Mash	Value	Green feed	Value	Grit	Value	Shell	Value	Total value feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed
		lb.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	cts.		cts.	cts.	cts.
Raw potatoes	1	.....	20·84	50·01	31·74	85·68	9·10	4·57	1·41	1·17	2·42	2·27	143·70	92·3	434·42	18·7	290·72
Cooked potatoes	4	−0·47	21·09	50·61	25·89	69·89	9·10	4·57	1·05	0·91	1·91	1·77	127·75	90·7	433·33	16·9	305·55
Alfalfa meal	1	−0·08	21·71	52·10	26·95	72·75	3·07	5·83	1·03	0·89	2·61	2·43	134·00	91·5	424·67	17·6	290·67
Sweet clover meal	2	−0·1	22·53	54·07	29·84	80·65	3·18	6·36	1·21	1·05	2·12	1·97	144·10	94·8	438·93	18·2	294·83
Control	5	+0·1	25·66	61·53	27·36	73·87	6·86	9·31	1·47	1·28	1·85	1·72	147·71	79·4	362·60	22·3	214·89

NOTES.—It will be noted first that mortality apparently had little significance on the whole. It is interesting to note that three out of four deaths in the pen on cooked potatoes were caused by cannibalism, whereas there were no deaths from this cause in the other pens excepting the control pen.

Feed consumption was also lowest for the birds of the pen on cooked potatoes. In number of eggs laid there is practically nothing to choose, except in the instance of the control pen which was low. Profit over cost of feed was quite similar in all pens. The birds on cooked potatoes produced cheaper eggs owing to the low feed consumption.

An important aspect of the above experiment is the fact that the green and succulent feeds fed were all superior to mangels and sprouted oats (the control pen) in this instance.

TABLE 18.—HATCHING RESULTS

Treatment	Mating period	Number set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
Raw potatoes	Regular	25	24	13	96·0	54·2	52·0
	Males alternated	37	29	18	78·4	62·1	48·7
	Total	62	53	31	85·5	58·5	50·0
Cooked potatoes	Regular	32	27	11	84·4	40·4	34·4
	Males alternated	18	15	10	83·3	66·6	55·5
	Total	50	42	21	84·0	50·0	42·0
Alfalfa meal	Regular	31	25	15	80·6	60·0	48·4
	Males alternated	39	28	19	71·8	68·0	48·7
	Total	70	53	34	75·7	64·2	48·6
Sweet clover meal	Regular	44	38	19	86·4	50·0	43·2
	Males alternated	50	44	30	88·0	68·2	60·0
	Total	94	82	49	87·2	60·0	52·1
Control	Regular	24	21	13	87·5	62·0	54·2
	Males alternated	29	21	15	72·4	71·4	51·7
	Total	53	42	28	79·3	66·6	52·8

NOTES.—Fertility was highest from the pens on sweet clover meal and on raw and cooked potatoes. It was poorest with alfalfa meal. Hatchability as shown by per cent of fertile eggs hatched was highest from the control pen followed by alfalfa and sweet clover meal pens. Percentage of total eggs hatched was practically equal for all pens with cooked potatoes being slightly inferior.

TABLE 19.—THREE YEAR SUMMARY, SUBSTITUTES FOR FRESH GREENFEED

Special treatment	Year	Cost of special feed	Total cost of feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed	Eggs set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
		cts.	cts.		cts.	cts.	cts.						
Raw potatoes	1926	19·0	139·91	95·0	519·2	17·6	379·2	120	97	25	75·8	27·4	20·8
	1927	16·4	130·68	78·5	462·2	20·0	331·5	29	19	4	65·5	21·1	13·8
	1928	4·6	143·70	92·3	434·4	18·7	290·7	65	53	31	85·5	58·5	50·0
	Average	13·3	138·09	88·6	471·9	18·7	333·8	214	169	60	79·0	35·5	28·0
Cooked potatoes	1926	18·0	128·6	84·2	493·7	18·3	365·0	112	83	20	74·1	24·7	17·8
	1927	15·4	136·27	78·8	478·4	20·7	342·1	22	18	14	81·8	77·7	63·6
	1928	4·6	127·75	90·7	433·3	16·9	305·5	50	42	21	84·0	50·0	42·0
	Average	12·7	130·87	84·6	468·5	18·6	337·5	184	143	55	77·2	38·6	29·9
Alfalfa meal	1926	19·2	141·39	96·6	563·5	17·6	422·1	99	61	23	61·7	37·7	23·2
	1927	9·2	137·1	83·1	505·3	19·8	368·2	34	13	6	38·2	46·2	17·6
	1928	5·8	134·0	91·5	424·7	17·6	290·7	70	53	34	75·7	64·2	48·6
	Average	11·4	137·5	90·4	497·8	18·3	360·3	203	127	63	62·6	49·6	31·0
Sweet clover meal	1926	20·6	133·71	90·5	537·2	17·7	403·3	120	97	25	75·8	27·4	20·8
	1927	4·9	125·26	79·2	460·0	18·9	334·7	67	50	21	74·6	42·0	31·3
	1928	6·36	144·10	94·8	438·9	18·2	294·8	94	82	49	87·2	60·0	51·2
	Average	10·6	134·36	88·2	478·7	18·3	344·3	281	229	95	81·5	41·5	33·8
Control	1926	.....	136·8	77·0	441·2	21·3	304·4	79	59	9	74·7	15·3	11·4
	1927	.....	168·1	100·7	592·9	20·0	424·8	72	49	20	68·1	42·0	27·8
	1928	.....	147·7	79·4	362·6	22·3	214·89	53	42	28	79·3	66·6	52·8
	Average	.....	150·9	85·7	465·6	21·2	314·8	204	150	57	73·5	38·0	27·9

The greatest feed cost was experienced by the control pen over a three-year period, and the lowest by the pen receiving cooked potatoes. Highest egge production was obtained with alfalfa meal. Raw potatoes and sweet clover meal gave almost equally high production. Feed cost per dozen eggs was practically equal for all but the control pen, in which it was high.

Profit over cost of feed was greatest on alfalfa meal followed by sweet clover meal. The control pen was outstandingly poor again in this respect.

Fertility was highest with sweet clover meal and raw potatoes. Hatchability as indicated by percentage of fertile eggs hatched was highest on alfalfa meal followed by sweet clover meal and poorest on raw potatoes. There was little difference in percentage of total eggs hatchsd.

DISCUSSION.—In the experiment as so far conducted all pens have been superior to the control pen in value of eggs laid and profit over cost of feed. Except in the case of alfalfa meal, fertility was superior to the control pen in every case. Hatchability as indicated by percentage of fertile eggs hatched was greatest in the alfalfa meal pen and poorest in that on raw potatoes.

It is apparent from the above that any one of the four supplementary feeds given in this experiment is a very good addition to a ration when fresh greenfeed is not available. Good quality alfalfa leaf meal apparently is the best substitute of those listed. Sweet clover meal, a food of very similar qualities is next in order of merit. All supplements given were superior to a combination of mangels and sprouted oats as fed to the control pen.

An interesting consideration in this connection is the fact that although fresh greenfeeds may not be available it is always possible to obtain alfalfa meal, and it can be fed with much less trouble than sprouted oats and requires no equipment. It is suggested that the same purpose would be served if the alfalfa meal were incorporated into the dry mash, at the time of mixing. A simple and satisfactory method of doing this is to substitute alfalfa meal for one half of the bran of the mash. This applies also to sweet clover meal, but it is more difficult to obtain.

With regard to potatoes, it is obvious that they are, like mangels, in the nature of a succulent feed, and not a green feed. Consequently they are not a substitute for green feed since they are inferior to fresh green feeds, in mineral and vitamin content. It is interesting to note, however, that while it is very doubtful if mangels contain vitamins and that if they do the quantities are very small, potatoes are a good source of both the antineuritic and antiscorbutic vitamins as well as a fair source of the antirachitic.

In view of the good results obtained with potatoes in this experiment and of the above mentioned facts it would seem to be good policy to feed potatoes when fresh green feed is not available, rather than mangels. It would appear that if alfalfa meal is fed in the dry mash as suggested, succulence may be added to the ration by feeding potatoes.

Apparently potatoes are as efficient raw as cooked thus saving a great deal of labour. The feeding of cull potatoes in this manner would be a great saving to the general farmer who usually has a quantity of these as well as to the poultryman who can purchase them cheaply.

VITAMIN FEEDS FOR EGG PRODUCTION

In continuation of work with vitamin feeds, crude cod liver oil and cod liver meal, both carriers of the antirachitic vitamin, were contrasted as to comparative efficiency and also with a control pen receiving no supplement.

The pens consisted of White Leghorn pullets, 15 in each, and were handled similarly, except for the difference in vitamin feeds.

Pen 7.—Basal ration plus two teaspoonfuls (one-quarter ounce) of crude cod liver oil daily.

Pen 8.—Basal ration substituting an equal amount (15·8 per cent) of cod liver meal for the meat meal of the mash.

By crude cod liver oil is meant the No. 2 oil which is pressed from the livers after steam cooking and which is next in grade to the refined. It should not be confused with the crude oil rendered by sun rotting of livers.

All birds received such winter sunlight as was available through the house front.

The table following shows details of the experiment:—

TABLE 20—DETAIL, VITAMIN FEEDS FOR EGG PRODUCTION

Pen and special feed	Total mortality	Weight gain or loss	Scratch grain	Value	Mash	Value	Green feed	Value	Grit	Value	Shell	Value	Special feed	Value	Total value feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed
		lb.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	cts.		cts.	cts.	cts.
Crude cod liver oil	2	−0·1	23·21	55·69	29·70	80·19	6·42	8·11	1·42	1·23	2·26	2·10	3·29	1·99	149·31	97·1	458·78	18·4	309·47
Cod liver meal	3	.....	24·19	58·04	22·65	65·69	6·71	8·47	0·85	0·73	1·90	1·74	.....	.....	134·67	90·1	427·18	17·9	292·51
Control	5	+0·1	25·66	61·53	27·36	73·87	6·86	9·31	1·47	1·28	1·85	1·72	.....	.....	147·71	79·4	362·60	22·3	214·89

NOTES.—In considering the above table it is noticeable that there was practically no gain or loss in weight in any pen. Feed consumption was greatest by the pen on cod liver oil and the control pen and consequently total cost of feed was also greatest for these pens. Egg production was greatest for the crude cod liver oil pen followed by that on cod liver meal. Production was considerably lower for the control pen. Feed cost per dozen eggs was least for cod liver meal due to the low feed consumption; crude cod liver oil was a close second in this respect.

Profit over cost of feed was greatest for crude cod liver oil, followed fairly closely by cod liver meal. The control pen was quite inferior.

TABLE 21—HATCHING RESULTS

Treatment	Mating period	Number set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
Cod liver oil.....	Regular.....	17	15	8	88·2	53·3	47·1
	Males alternated....	21	20	9	95·2	45·0	43·0
	Total.....	38	35	17	92·1	48·6	44·7
Cod liver meal....	Regular.....	35	33	20	94·3	60·6	57·1
	Males alternated....	30	22	19	73·3	86·4	63·3
	Total.....	65	55	39	84·6	70·9	60·0
Control.....	Regular.....	24	21	13	87·5	62·0	54·2
	Males alternated....	29	21	15	72·4	71·4	51·7
	Total.....	53	42	28	79·3	66·6	52·8

NOTES.—Fertility as shown by percent fertile was greatest for cod liver oil followed by cod liver meal Percent fertile eggs hatched was highest for cod liver meal followed by the control pen.

TABLE 22.—FOUR-YEAR SUMMARY, VITAMIN FEEDS

Special traetment	Year	Cost of special feed	Total cost of feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed	Eggs set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
		cts.	cts.		cts.	cts.	cts.						
Crude cod liver oil.....	1925.....	2·0	126·0	75·0	427·0	20·2	301·0	30	29	18	96·7	62·1	60·0
	1926.....	2·1	142·1	90·8	524·0	18·7	383·0	57	45	14	79·0	31·1	24·6
	1927.....	2·7	164·1	89·6	536·2	21·9	372·1	50	35	17	70·0	48·6	34·0
	1928.....	2·0	149·3	97·1	458·8	18·4	309·5	38	35	17	92·1	48·6	44·7
	Average....	2·2	145·4	88·1	486·5	19·8	341·4	175	144	66	82·3	45·8	37·7
Control.....	1925.....	.....	131·0	82·4	495·0	19·1	364·0	191	179	106	93·7	59·2	55·5
	1926.....	.....	136·8	77·0	441·2	21·3	304·4	81	70	20	86·4	28·6	24·7
	1927.....	.....	168·1	100·7	592·9	20·0	424·8	72	49	20	68·1	42·0	27·8
	1928.....	.....	147·7	79·4	352·6	22·3	214·9	53	42	28	79·3	66·6	52·8
	Average....	.....	145·9	84·9	472·9	20·7	327·0	397	340	174	85·7	51·2	43·8

NOTES.—The above table covers four years of experiment with crude cod liver oil.

Over the four-year period the pen on crude cod liver oil was superior to the control pen in egg production, feed cost per dozen eggs, and profit over cost of feed.

Fertility and hatchability were slightly poorer from the pen receiving crude cod liver oil.

It would appear from the above that crude cod liver oil plays a less important part in egg production, fertility and hatchability than it does in growth.

It must be remembered, however, that the birds used were pullets, had received plenty of cod liver oil and sunlight from hatching time to time of entering the laying house, and might therefore have been able to store up sufficient in the way of vitamins for the wintsr period. In the second year, if they had been confined in the interim, cod liver oil might be expected to show better results.

The additional profit obtained in this experiment, however, is sufficient to make its feeding worth while even under these conditions, especially since a great many flocks are not reared under as favourable conditions with respect to sunshine and vitamin feeds as were those under experiment.

THE COMPARATIVE VALUE OF GRAINLESS, GRITLESS, AND GREEN-FEED LACKING RATIONS FOR EGG PRODUCTION

Of recent years poultry investigators have claimed that laying birds will produce equally well on rations devoid entirely of scratch grain and with dry mash as the main source of nutriment. It has also been claimed that the addition of grit to the ration of confined laying birds is absolutely unnecessary, that the gizzard of the fowl is entirely capable of grinding all kinds of feed without further mechanical assistance, and that the fowl picks up grit only for the

mineral (lime and phosphorus) which it may contain. In other experiments greenfeed has been dispensed with, and no resultant ill effect has been noted among the fowl thus treated.

In order to further test these theories, experiments were carried on during the past season feeding no grain in any case and removing grit and greenfeed from the ration of two different pens. The birds in all three pens received oyster shell since this material is fairly readily soluble, and is necessary for the production of sound egg shells in any number.

In feeding mash only the formula of the mash was changed in that the amount of animal protein feeds was reduced by half, since approximately twice the amount of mash would be consumed and the animal protein intake should remain the same. The ground grain feeds were changed in such a way that the nutritive ratio of the mash was the same as that of the grain and mash of the ordinary ration combined. In doing this the proportion of corn meal in the mash was increased considerably.

The following tables show the results in detail of the experiment:—

TABLE 23—DETAIL, NO GRAIN, NO GREENFEED, NO GRIT

Pen and special feed	Total mortality	Weight gain or loss	Scratch grain	Value	Mash	Value	Green feed	Value	Grit	Value	Shell	Value	Total value feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed
		lb.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	cts.		cts.	cts.	cts.
No grain	6	−0·2	.....	.....	44·75	116·29	7·18	9·96	0·79	0·68	2·24	2·08	129·01	73·3	331·32	21·1	202·31
No grain—no greenfeed	6	−0·4	.....	.....	45·05	117·12	.....	.....	2·24	1·93	2·09	1·93	120·98	94·7	443·79	15·3	322·81
No grain—no grit	2	−0·3	.....	.....	43·09	112·04	6·07	7·91	.....	.....	2·01	1·87	121·82	71·6	332·86	20·04	211·04
Control	5	+0·1	25·66	61·53	27·36	73·87	6·86	9·31	1·47	1·28	1·85	1·72	147·71	79·4	362·6	22·3	214·89

NOTES.—As was the case in last year's experiment, the outstanding feature of the above table is the showing made by the pen receiving no greenfeed. For this pen the total value of feed consumed was least, production was greater by fifteen eggs per bird than the nearest competitors, feed cost per dozen eggs was least, and profit over cost of feed per bird higher by over one dollar than the next highest pen.

No one of the other pens was outstanding and both the pen with no grain and that without grain and grit were inferior to the control pen. It is interesting to note that the control pen receiving grain was the only one in which the birds made weight gains.

TABLE 24—HATCHING RESULTS

Treatment	Mating period	Number set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
No grain	Regular	20	15	9	75·0	60·0	45·0
	Males alternated	20	15	11	75·0	73·3	55·0
	Total	40	30	20	75·0	66·6	50·0
No grain No green feed	Regular	22	19	3	86·4	15·8	13·6
	Males alternated	27	23	13	85·2	56·5	48·2
	Total	49	42	16	85·7	38·1	32·7
No grain No grit	Regular	28	25	13	89·3	52·0	46·4
	Males alternated	38	33	25	86·8	75·8	65·8
	Total	66	58	38	87·9	65·5	57·6
Control	Regular	24	21	13	87·5	62·0	54·2
	Males alternated	29	21	15	72·4	71·4	51·7
	Total	53	42	28	79·3	66·6	52·8

NOTES.—It is interesting to note that although the pen without green feed was superior in egg production it was quite inferior in hatchability. Among the other pens there is very little to choose both the control and no grain no grit pens being high.

TABLE 25.—SUMMARY GRAINLESS, GRITLESS, GREENFEED-LACKING RATIONS

—	Year	Total cost of feed	Eggs laid	Value	Feed cost per doz.	Profit over cost of feed	Eggs set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
		cts.		cts.	cts.	cts.						
No grain	1927	156·8	74·6	451·0	25·2	294·1	54	46	9	85·2	19·6	16·6
	1928	129·0	73·3	331·3	21·1	202·3	40	30	20	75·0	66·6	50·0
	Average	142·9	73·9	391·1	23·1	248·2	94	76	29	80·9	38·2	30·9
No grain No greenfeed	1927	116·1	73·7	447·2	18·9	331·0	14	9	1	64·3	11·1	7·1
	1928	121·0	94·7	443·8	15·3	322·8	49	42	16	85·7	38·1	32·7
	Average	118·5	84·2	445·5	17·1	326·9	63	51	17	81·0	33·3	27·0
No grain No grit	1927	141·9	66·6	395·3	25·6	253·4	44	28	17	63·6	60·7	38·6
	1928	121·8	71·6	332·9	20·0	211·0	66	58	38	87·9	65·5	57·6
	Average	131·8	69·1	364·1	22·8	232·2	110	86	55	78·2	64·0	50·0
Control	1927	168·1	100·7	592·9	20·0	424·8	72	49	20	68·1	42·0	27·8
	1928	147·7	79·4	362·6	22·3	214·9	53	42	28	79·3	66·6	52·8
	Average	157·9	90·1	477·7	21·1	319·8	125	91	48	72·8	52·7	38·4

NOTES.—A two years summary shows little difference between the control pen and that without green feed. Production was greater for ths control pen, but feed cost per dozen eggs was lower for the other. Profit over cost of feed was slightly greater for the pen on no grain or green feed.

Both the pen on no grain and that on no grain and no grit were quite inferior to the control pen.

With regard to hatching results, it is noticeable that the pen on no grain no green feed was very poor in hatchability. In this respect the pen on no grain and no grit was outstanding.

DISCUSSION.—It would seem to be somewhat of a surprising fact that a pen without greenfeed from any source should make the returns indicated in this two-year experiment. It must be remembered, however, that the pullets used were reared under ideal conditions and received a balanced ration in so far as our present knowledge allows with additional accessory factors in the form of

vitamin foods. Free range, greenfeed and sunlight were plentiful. Under such rearing conditions it is possible that the pullets went into the laying pens in a well nourished condition and with a good supply of minerals and vitamins. Consequently, egg production might not necessarily suffer during the winter months at least, and in the spring, fresh greenfeed and potent sunlight being readily available, even though the stored supply of minerals and vitamins might be exhausted, it could easily be replenished. In this experiment, Epsom salts was given in keeping with ordinary practice, only when the birds by their condition showed it to be necessary and the pen without greenfeed required this treatment no more often than the other pens of the experiment.

The fact that fertility and hatchability were poor from this pen, is no doubt an indication that the birds were inadequately supplied with some factors which they were consequently unable to put into the egg, with a resultant ill effect on hatchability. In other words, to leave a bird which may be used as a breeder without greenfeed is apparently poor practice. It is a question whether a bird producing at a higher rate than did those in this experiment might not, besides being unable to properly equip her egg with the necessary factors for hatchability, be also unable to sustain her body but might draw upon it to such an extent that some form of deficiency disease might result.

In the light of the experiment "Substitutes for Fresh Greenfeed" just reported, wherein several green feed substitutes were superior to mangels and sprouted oats as given to the control pen in this experiment, it is possible that if a superior source of green feed had been given to the control pen it might have exceeded the pen receiving no greenfeed.

Although this experiment throws some interesting light upon the laying bird's requirements for greenfeed, it is not suggested that it is good practice to eliminate greenfeed from the ration even for this short period.

In this two-year summary it is evident that no advantage was gained in feeding an all mash ration or in leaving out both grain and grit as was done.

THE VALUE OF GLASS SUBSTITUTES FOR USE IN POULTRY HOUSES

Experimental work with a glass substitute was conducted during the past season, a pen of fifteen leghorn pullets receiving sunlight only through the substitute used. The following tables show details of the experiment.

TABLE 26—DETAIL, GLASS SUBSTITUTES FOR POULTRY HOUSES

Pen and special feed	Total mortality	Weight gain	Scratch grain	Value	Mash	Value	Green feed	Value	Grit	Value	Shell	Value	Total value feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed
		lb.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	cts.		cts.	cts.	cts.
Glass substitute	5	.....	24·59	59·01	22·20	59·93	6·41	8·40	0·86	0·74	1·58	1·46	129·54	99·3	448·39	15·6	318·85
Control	5	+0·1	25·66	61·53	27·36	73·87	6·86	9·31	1·47	1·28	1·85	1·72	147·71	79·4	362·6	22·3	214·89

NOTES.—It is noticeable in the above table that feed cost was lower and egg production was higher for the pen under the glass substitute. Feed cost per dozen was much lower for the glass substitute pen and profit over cost of feed was considerably higher.

TABLE 27.—HATCHING RESULTS

Treatment	Mating period	Number set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
Glass substitute...	Regular.....	35	32	18	91·4	56·3	51·4
	Males alternated....	30	22	14	73·3	63·6	46·7
	Total.....	65	54	32	83·1	59·3	49·2
Control.....	Regular.....	24	21	13	87·5	62·0	54·2
	Males alternated....	29	21	15	72·4	71·4	51·7
	Total.....	53	42	28	79·3	66·6	52·8

NOTES.—Fertility was superior from the pen under the glass substitute, but hatchability was superior for the control pen.

TABLE 28.—TWO-YEAR SUMMARY—GLASS SUBSTITUTES FOR POULTRY HOUSES

—	Year	Total cost of feed	Eggs laid	Value	Feed cost per doz.	Profit over cost of feed	Eggs set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
		cts.		cts.	cts.	cts.						
Glass Substitute	1927.....	160·1	78·1	464·3	24·6	304·1	63	45	22	71·4	48·9	34·9
	1928.....	129·5	99·3	4.8·4	15·6	318·8	65	54	32	83·1	59·3	49·2
	Average....	144·8	88·7	456·3	20·1	311·4	128	99	54	77·3	54·5	42·2
Control	1927.....	168·1	100·7	592·9	20·0	424·8	72	49	20	68·1	42·0	27·8
	1928.....	147·7	79·4	362·6	22·3	214·9	53	42	28	79·3	66·6	52·8
	Average....	157·9	90·0	477·7	21·1	319·8	125	91	48	72·8	55·8	38·4

NOTES.—Total cost of feed was similar in both cases. Number of eggs laid per bird and profit over cost of feed per bird was slightly greater for the control pen. Fertility and hatchability were slightly in favour of the glass substitute pen. Over a two-year period no worth while improvement has been gained by the use of a glass substitute.

ANIMAL PROTEIN VS. VEGETABLE PROTEIN PLUS A MINERAL MIXTURE FOR EGG PRODUCTION

In order to determine whether a high quality vegetable protein supplemented by a suitable mineral mixture might not be a satisfactory substitute for the animal protein feed of the laying mash, this experiment was undertaken.

The ration fed consisted of scratch grain plus the basal mash of equal parts bran, middlings, corn meal and oat flour and substituting one part of soya bean meal plus 4 per cent of a mineral mixture for the meat meal of this mash. The mineral mixture was made up as follows:—

Fine ground bone meal, 60 per cent.
Ground limestone, 20 per cent.
Common salt (NaCl), 20 per cent.

During the month of November the production was high but decreased gradually until February and the birds appeared to be in unthrifty condition. Consequently, in view of the fact that cod liver oil has in the past been demonstrated to be of great assistance in aiding fowl to make use of minerals and particularly calcium and phosphorus, present in this mineral mixture, crude cod liver oil was fed in the wet mash at the rate of one quarter ounce (two teaspoonfuls) daily after February 3. During the remaining two months of the six, production reached a very high average. This average was not only maintained but increased during May and June when the birds had to be disposed of.

The following tables show the results over the regular six month period:—

TABLE 29—DETAIL, MINERAL MIXTURE

Pen and special feed	Total mortality	Weight gain or loss	Scratch grain	Value	Mash	Value	Greenfeed	Value	Grit	Value	Shell	Value	Total value feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed
		lb.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	cts.		cts.	cts.	cts.
Mineral mixture	4	−0·3	25·14	60·34	22·27	53·45	6·42	8·44	0·69	0·59	1·50	1·43	124·25	83·0	372·10	17·7	247·85
Control	5	+0·1	25·66	61·53	27·36	73·87	6·86	9·31	1·47	1·28	1·85	1·72	147·71	79·4	362·60	22·3	214·89

NOTES.—The total cost of feed was lowest for the mineral mixture pen owing to lower consumption and a cheaper ration. There was very little difference in number of eggs laid or their value but the feed cost per dozen eggs produced was lower on the mineral mixture. Profit over cost of feed was greater on the animal protein substitute ration.

TABLE 30.—HATCHING RESULTS

Treatment	Mating period	Number set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
Mineral mixture....	Regular.....	39	29	0	74·4	0 0	0·0
	Males alternated....	39	35	6	90·0	17·1	15·4
	Total.....	78	64	6	82·1	9·4	7·7
Control.....	Regular.....	24	21	13	87·5	62·0	54·2
	Males alternated....	29	21	15	72·4	71·4	51·7
	Total.....	53	42	28	79·3	66·6	52·8

NOTES.—Hatching results were very inferior on the substituted ration. The eggs were saved for hatching during March and April or after crude cod liver oil had been fed for a month.

MEAT MEAL VS. FISH MEAL FOR EGG PRODUCTION

In this experiment two different types and qualities of fish meal were contrasted, one with the other, and with the control pen, receiving meat meal. The rations fed to each pen were similar except that a like amount of each fish meal was substituted for the 15·8 per cent of meat meal of the basal mash. The three mashes thus contained 15·8 per cent of ordinary fish meal (57 per cent protein), 15·8 per cent of Fasterfat fish meal (70 per cent protein), and 15·8 per cent meat scrap (60 per cent protein) respectively.

The tables following show details of the experiment:—

TABLE 31.—DETAIL, MEAT MEAL *vs.* FISH MEAL FOR EGG PRODUCTION

Pen and special feed	Total mortality	Weight gain or loss	Scratch grain	Value	Mash	Value	Green feed	Value	Grit	Value	Shell	Value	Total value feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed
		lb.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	cts.		cts.	cts.	cts.
Fish meal (57 per cent protein)...	4	−0·1	26·37	63·27	23·39	57·00	7·10	9·43	0·88	0·77	1·67	1·55	132·02	93·1	444·81	17·0	312·79
Fasterfat fish meal (70 per cent protein)...	3	−0·1	25·04	59·89	18·81	66·78	6·59	8·68	0·53	0·45	1·70	1·57	137·37	84·4	405·15	19·5	267·78
Control.....	5	+0·1	25·66	61·53	27·36	73·87	6·86	9·31	1·47	1·28	1·85	1·72	147·71	79·4	362·6	22·3	214·89

NOTES.—Feed costs were greater for the control pen as was also feed cost per dozen eggs produced. Production was considerably the highest on ordinary fish meal as was profit over cost of feed. Apparently no advantage was gained in this experiment by feeding the more expensive fish meal of high protein content.

Both fish meals gave superior results to the pen on meat meal.

TABLE 32.—HATCHING RESULTS

Treatment	Mating period	Number set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
Fish meal	Regular	30	26	7	86·7	26·9	23·3
	Males alternated	35	30	15	85·7	50·0	43·0
	Total	65	56	22	86·2	39 5	33·8
Fasterfat	Regular	27	26	8	96·3	30·8	30·0
	Males alternated	21	17	4	81·0	23·5	19·0
	Total	48	43	12	90·0	28·0	25·0
Control	Regular	24	21	13	87·5	62·0	54·2
	Males alternated	29	21	15	72·4	71·4	51·7
	Total	53	42	28	79·3	66·6	52·8

NOTES.—Fertility was superior on Fasterfat, followed by fish meal and meat meal. Hatchability was superior from the control pen followed by ordinary and Fasterfat fish meals respectively.

THE INFLUENCE OF ULTRA VIOLET LIGHT ON EGG PRODUCTION

In continuation of past work a pen of pullets was exposed to the ultra violet rays of a quartz mercury arc lamp suspended three feet above their heads for a period of 20 minutes daily. The pen received the basal ration and was treated identically with the control pen. What sunshine was available during the winter months was allowed into both pens through open windows whenever possible. Such sunshine as would be received is probably of no significance since it is doubtful if any appreciable proportion of the Ultra Violet rays of the sun reach the earth during the winter months in this latitude.

The tables following show the detail of results obtained:—

TABLE 33.—DETAIL, ULTRA VIOLET RAYS FOR EGG PRODUCTION

Pen and special feed	Total mortality	Weight gain or loss	Scratch grain	Value	Mash	Value	Green feed	Value	Grit	Value	Shell	Value	Total value feed	Eggs laid	Value	Feed cost per dozen	Profit over cost of feed
		lb.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	lb.	cts.	cts.		cts.	cts.	cts.
Ultra violet rays.	7	none	27·29	65·50	24·89	67·19	5·83	10·21	1·05	0·90	1·83	1·69	145·49	103·5	474·47	16·9	328·98
Control pen.....	5	+0·1	25·66	61·53	27·36	73·87	6·86	9·31	1·47	1·28	1·85	1·72	147·71	79·4	362·6	22·3	214·89

NOTES.—Total cost of feed was practically the same for both pens. A difference of approximately twenty-four eggs per bird in favour of the pen under treatment was the deciding factor in the higher profit over cost of feed obtained. Mortality was high in both pens but no significance can be attached to this fact that would in any way be attributable to treatment given as causes of death were quite variable.

TABLE 34—HATCHING RESULTS

Treatment	Mating period	Number set	Fertile	Hatched	Per cent fertile	Per cent fertile hatched	Per cent total hatched
Ultra violet ray.	Regular.....	21	17	9	81·0	53·0	43·0
	Males alternated.....	26	20	15	77·0	75·0	57·7
	Total.....	47	37	24	78·7	64·9	51·1
Control.....	Regular.....	24	21	13	87·5	62·0	54·2
	Males alternated.....	29	21	15	72·4	71·4	51·7
	Total.....	53	42	28	79·3	66·6	52·8

NOTES.—Both fertility and hatchability were high from the two pens. Both fertility and hatchability were slightly superior for the control pen.

EGG PRESERVATIVES

In continuation of past work an experiment was carried on contrasting lime-water, Barral compound, and Columbus powders for the preservation of eggs.

Since the manufacturers of certain of the commercial compounds above mentioned claim that eggs may be stored for a brief period, then withdrawn from the fluid and still kept for some time before using without detrimental effects, one dozen of eggs preserved for six months during 1927 were removed from the fluids and kept in egg cartons at slightly lower than room temperature for six months.

Upon candling, all eggs were in fair shape considering the length of time of preservation. A few eggs with decidedly heavy yolks and others watery in appearance were found. In this respect those preserved in lime-water were best with little to choose between the remaining two lots. Upon breaking these eggs on to a flat surface very little difference was noticeable in consistency or odour.

The experiment during 1928 showed no appreciable difference between the different preservatives either in candling or after breaking open. The eggs were preserved for six months.

Experiments carried on at the Cap Rouge Station using nine different preservatives and over a period of twelve years have shown lime-water to be superior to all other preservative substances for this purpose.

Since these results are quite conclusive and in agreement with results at this division over the past four years, no further work will be done.

It is recommended that lime-water be used for the preserving of eggs for household use. Complete instructions for the preservation of eggs with lime-water are embodied in Circular 31, available free at the Publications Branch, Department of Agriculture, Ottawa.

HEATED VS. UNHEATED HOUSES

A special type of heated poultry house was tried out during the past season at this division. Owing to circumstances beyond our control certain factors detracted from the reliability of the results to such an extent that no report on the relative merits of the two types of houses will be made at this time. Work is continuing with this project and is already showing more definite and reliable results.

THE INFLUENCE OF AN ANTI-STERILITY VITAMIN SUPPLEMENT UPON FERTILITY

Some preliminary work was done upon a supplement supposed to contain a sufficient amount of what is known as the "Vitamin E" factor which it is thought has considerable effect upon fertility.

No very definite results were obtained however, and it is intended to continue this work if possible.

A STUDY OF RANGE OF EGG WEIGHTS AND POSSIBLE CAUSES

For the purpose of determining if climatic conditions or feeds have any effect upon egg size the eggs from the pens under course of experiment for egg production were weighed daily and calculated to average weight per egg. The scale used was an ordinary balance graduated in ounces and sixteenths consequently the results had to be tabled in sixteenths, the fraction thirty-two sixteenths representing the two ounce egg. This information was incorporated with the graph published herewith. The details of the manner of feeding on the treatment of the different pens will be found under the heading, "Experiments for Winter Egg Production" in this Report. Egg size for each day of the months February, March and April for each pen are indicated as are also the daily maximum and minimum temperatures for the same period.

Discussion.—One of the most striking features of the graph is the great variation in egg size from day to day. Apparently in a pen of this size (fifteen birds) the average and daily weight of eggs is subject to great variation. Whether this is due merely to individuality in the respective members of the pen or outside influences such as temperature, management, etc., very little indication is given. Since there is apparently no definite similarity in egg size between the pens from day to day although weather conditions and management were similar for each, it would seem that individuality might be the important factor here.

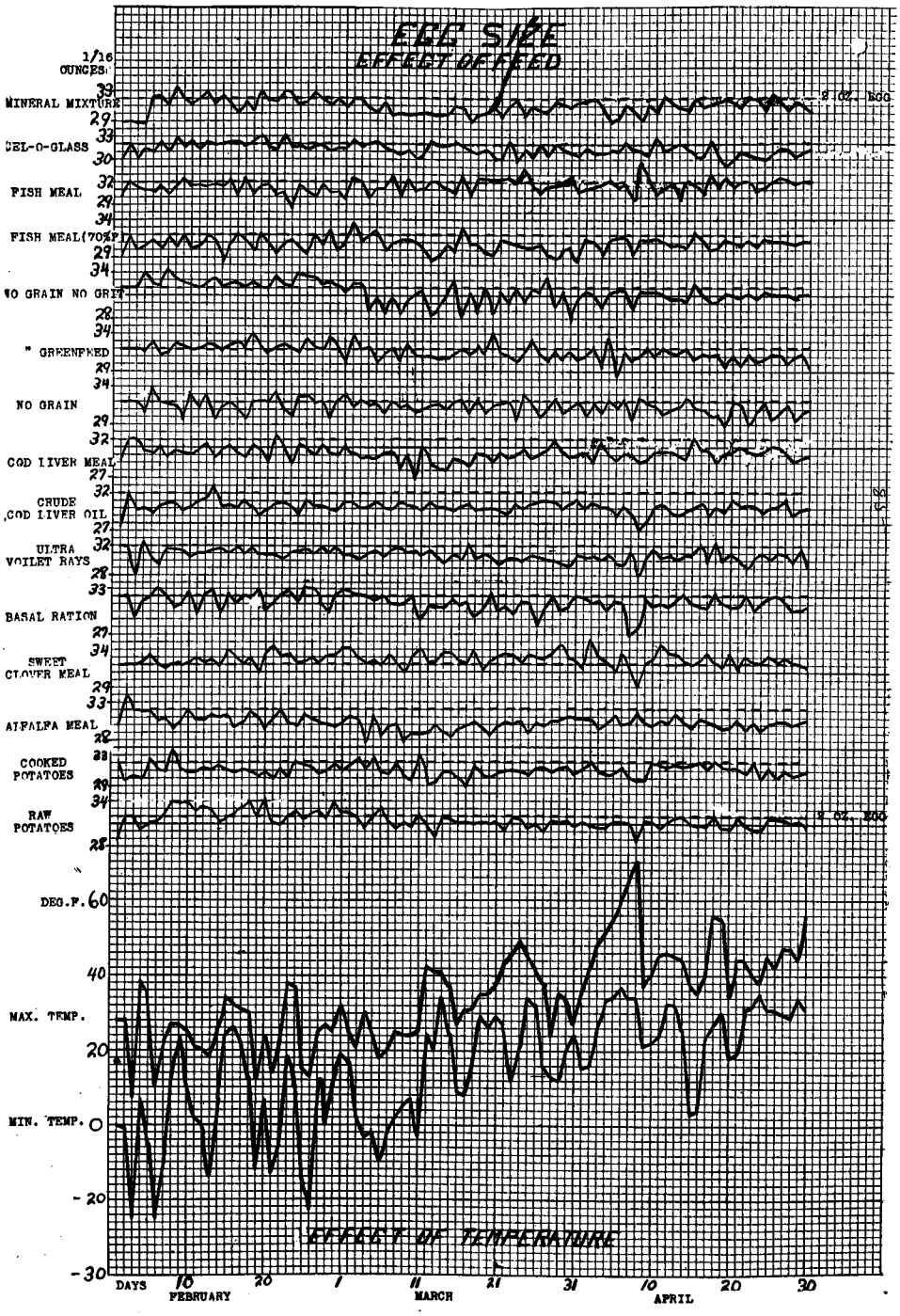
With regard to any possible correlation between temperature and size of egg very little may be said when considering this graph.

In one particular instance, however, there is apparently some sign of correlation. From March 31 to April 9, there was a sudden rise from a minimum of fifteen degrees above zero to a maximum of seventy degrees a very unseasonable temperature for that time of year. In keeping with this rise there was apparently a general decrease in size, in at least thirteen out of fifteen pens as seen by the graph. In most instances the lowest point of egg size corresponded quite closely with the highest temperature. In some cases the drop was just prior to this time and in others slightly after. In six cases the drop in egg size was either the greatest or equal to the greatest of any time during the three months.

It would appear that there is a distinct possibility that egg size may be adversely influenced by extreme unseasonable temperatures. Whether this also extends to high temperatures during the warmer months of the year is a point of interest which it is intended to follow up. A further point of interest is the fact that in most cases egg size decreased from February to the end of April. Pens which started out above the two-ounce egg line were consistently under it at the end of the period.

With regard to any effect on egg size due to feed or treatment, nothing definite is indicated.

The pen receiving a supplement of alfalfa meal in the wet mash was consistently poor in egg size. On the other hand sweet clover meal, a similar supplement gave the largest eggs throughout.


EGG SIZE
EFFECT OF FEED
1/16 OUNCES
MINERAL MIXTURE
DEL-O-GLASS
FISH MEAL
FISH MEAL(70%P)
NO GRAIN NO GRIT
" GREENFEED
NO GRAIN
COD LIVER MEAL
CRUDE COD LIVER OIL
ULTRA VOILET RAYS
BASAL RATION
SWEET CLOVER MEAL
ALFALFA MEAL
COOKED POTATOES
RAW POTATOES
2 OZ. EGG
1 OZ. EGG
DEG. F.
MAX. TEMP.
MIN. TEMP.
EFFECT OF TEMPERATURE
DAYS
FEBRUARY
MARCH
APRIL

Both the pens on cod liver oil and cod liver meal were very poor. It must be remembered that all pens were picked indiscriminately and would be expected to be similar in respect to egg size.

Those pens receiving the same ration (basal ration) namely, those on cel-o-glass, ultra violet rays and the control were all quite low in egg size but fairly consistent, a fact which gives more weight to those variations which appear in the other pens.

No other variations are worthy of note and no conclusions are justified until more work has been done.

The great variation in egg size between the different pens has indicated that the number of eggs produced is not a fair basis of comparison between the different pens, consequently all eggs will be weighed in future in experiments for egg production.

EXPERIMENTAL WORK ON THE BRANCH FARMS

A number of experiments carried on at various branch farms are here summarized. These results have been published individually in the report of the branch farm concerned. An analysis of the results obtained over a number of farms would seem to give information of greater reliability.

COMPARATIVE HATCHABILITY FROM HENS AND PULLETS

During the hatching season of 1928 superior hatchability was obtained from pullets on only three out of seventeen farms reporting these results. As this is in line with past year's results it would appear that it is a poor policy to use pullets for hatching purposes if numbers and quality of chicks are required.

SKIM MILK OR BUTTERMILK VS. MEAT MEAL

On five farms out of seven reporting results of this experiment, skim-milk or buttermilk has given superior results in eggs laid, feed cost per dozen eggs and profit over cost of feed. In two cases the results represented work over three- and five-year periods respectively. In the two cases where meat meal was superior the difference in its favour was relatively slight.

FISH MEAL VS. MEAT SCRAP

Considerable variation in results was obtained on the different Farms. Present indications are that both are suitable feeds. A great variety of fish meals are available.

ROOTS VS. CLOVER VS. SPROUTED OATS VS. EPSOM SALTS

Results on the Farms carrying this experiment to date show clover or alfalfa and roots to be superior to either epsom salts or sprouted oats. Epsom salts is here intended not as a substitute for the greenfeeds mentioned but as an alterative where they are not available and aids in reestablishing the healthy functions of the system.

HULLESS VS. COMMON OATS

Evidence is accumulating from experimental work on the Farms of the Prairie Provinces, where the subject is of particular interest, to the effect that hulless oats are superior to the common variety in rations for egg production.

THE EFFECT OF SUPPLEMENTARY FEEDS

On seven Farms experiments with breeding stock using crude cod liver oil, raw liver, bone meal and combinations of these in order to increase fertility, hatchability and viability of chicks were carried out. In five out of seven cases improvement was gained particularly with cod liver oil. On the average little improvement was evident with bone meal. Except in three instances raw liver also gave slight improvement. In some cases combinations of these feeds using half quantities to those used when fed singly gave improvement. In two cases no improvement was given with any supplement.

COSTS OF BROODING, REARING, EGG PRODUCTION, ETC.

Detailed reports of costs of incubation, brooding, rearing, egg production, etc., appear in the Annual Reports of the various branch farms. These results, under different conditions as to costs and availability of materials in different sections of Canada may be obtained from the Branch farms in the section desired.

CORN VS. BARLEY

Owing to its cheapness, and to the fact that it is widely grown throughout Canada, the substitution of barley for corn in poultry rations is of interest and particularly in the Prairie Provinces.

In five out of six Farms on which this experiment has been carried, in some cases for a number of years, barley fed in place of corn gave more economical production. In several cases greater production was made on corn but at a greater cost.

CANADIAN NATIONAL EGG LAYING CONTEST

REGISTRATION AND INSPECTION

During the year 1928 thirteen egg laying contests were conducted by this Division. The Canadian Contest was conducted at the Central Farm. This contest is international in scope. The remaining twelve contests are provincial in nature and were conducted on Experimental Farms or Stations in the various provinces.

TABLE 35--NAME OF CONTEST AND NUMBER OF BIRDS; AVERAGE POINTS PER BIRD; LEADING PEN, PRODUCTION AND POINTS OF HIGHEST REGISTERED BIRD IN EACH. NOVEMBER 1, 1927 TO OCTOBER 22, 1928.

Contest	Number of birds	Average eggs per bird	Average points per bird	Leading pen per number of points	Highest registered bird	
					Eggs	Points
Canadian	800	164·9	160·4	2,329·4	254	308·4
Prince Edward Island	200	163·7	170·3	2,070·2	248	260·9
Nova Scotia	190	162·5	158·4	1,915·6	231	277·5
Nova Scotia Southern	200	165·3	161·1	2,148·7	242	281·9
New Brunswick	190	177·6	184·9	2,453·3	324	354·6
Quebec Eastern	200	171·6	171·1	2,097·4	242	285·9
Quebec Western	190	183·2	192·3	2,285·0	271	317·0
Ontario	600	164·6	159·1	2,078·3	240	267·9
Manitoba	250	177·7	185·8	2,377·4	265	335·5
Saskatchewan	290	158·0	153·4	2,157·4	244	289·0
Alberta	320	168·9	169·5	2,181·2	254	287·9
British Columbia	460	205·0	214·7	2,551·0	271	341·7
Vancouver Island	340	201·6	214·5	2,528·4	318	326·6
Total	4,230	175·4	177·1	.....	.....	.....

NOTE.—Ten birds constitute a pen.

TABLE 36—NUMBER OF BIRDS AND AVERAGE PRODUCTION OF ALL CONTESTS, 1927-28

Variety	All contests		
	Number of birds	Average production	Average points
S.C. White Leghorn	2,130	177·7	180·9
Barred Plymouth Rock	1,420	177·9	175·7
White Wyandotte	340	167·2	168·6
S.C. Rhode Island Red	200	173·1	181·0
White Plymouth Rock	40	141·5	139·8
S.C. Ancona	40	123·7	127·0
Light Sussex	20	136·4	128·8
Black Minorca	10	177·0	198·9
R.C. White Leghorn	10	159·7	157·4
S.C. Black Leghorn	10	169·8	156·1
R.C. Brown Leghorn	10	130·4	133·6
Total and average	4,230	175·4	177·1

The Canadian National Egg Laying Contest has been in operation for nine years and a review of the work is worth while. Table 37 gives the number of birds entered each year, together with the average production.

TABLE 37—BIRDS ENTERED IN CONTEST—BY YEARS

Contest year	Total number of birds	Average production per bird
1919-20	1,610	122·5
1920-21	2,480	137·0
1921-22	2,590	146·3
1922-23	3,000	164·3
1923-24	3,710	169·6
1924-25	4,100	172·2
1925-26	4,220	179·5
1926-27	4,210	172·5
1927-28	4,230	175·4

The figures in the foregoing table show the gradual increase in number of birds each year. The number of birds in contests has remained fairly constant since the 1925-26 contest. This condition can be attributed wholly to the lack of contest accommodation, as during the past three years no additional contest pens have been built. The number of poultry breeders desirous of entering birds in laying contests has always been in excess of the pens available. This is especially true in the province of New Brunswick, Ontario and British Columbia, and in the Canadian Contest.

The above table also shows the very substantial increase which was made in average production per bird over the preceding year.

During the first seven years of contest work there was a gradual increase in production. A decrease in production took place during the 1926-27 contest and a slight increase took place in production during the 1927-28 contest.

The slight drop in production in the eighth contest year was not wholly unexpected. In all classes of breeding work improvement is very marked for the first few years but as the stock improves and a higher standard is reached fluctuations appear and as the drop in production is only slight it does not infer impaired breeding work. It is but fair to state that closer adherence to the regulations so far as egg weight is concerned was partly responsible for this

lower average production during the last two years. It will also be remembered that the spring of 1927 was late, there being a lack of sunshine and continued cold weather which is not conducive to high production. Much the same kind of weather was experienced in 1928. Cloudy days were frequent even during the late spring and summer. Even with the unfavourable weather the average production in 1928 was 2·9 eggs per bird higher than in 1927. As the 1927-28 contest year was only a 51-week contest as compared with 52 weeks for all previous contests it is but fair to say that the production during the contest years just closed compares favourably with that of any previous contest conducted by this Division.

1928-29 CONTESTS

The 1927-28 contest year closed October 22, allowing one week for returning the birds, cleaning the pens and putting in the incoming birds. Another series of Egg Laying Contests commenced November 1, 1928. No additional accommodation was provided for contest pens during the year so that the number of birds in contests remains practically the same as in the previous year. At present there are 4,390 birds in 439 pens and 878 spare birds, making a total of 5,278 birds in all contests.

Since egg laying contests in Canada are carried on primarily for registration purposes the regulations are drawn up in such a way as to encourage breeders who are paying particular attention to egg size in their breeding flocks. To accomplish this end birds are now scored on size of egg as well as on production. Points are allotted as follows:—

	Points
27 ounce eggs	1·3
26 ounce eggs	1·2
25 ounce eggs	1·1
24 ounce eggs	1·0
23 ounce eggs	0·9
22 ounce eggs	0·8
21 ounce eggs	0·7
20 ounce eggs	0·6

Eggs weighing less than 20 ounces to the dozen are disregarded entirely, and eggs weighing 27 ounces to the dozen or over are scored as being 27-ounce eggs.

REGISTRATION

During the year 1,093 birds were registered in Canada. This number was made up of 225 males and 868 females. Registration is granted to males which are bred from second or subsequent generation females and from approved or Registered males. These cockerels must be at least six months of age and be worthy specimens of the breed they represent. Registration was granted to all females which laid 200 eggs or over in any of the Canadian National Egg Laying Contests, providing the eggs laid averaged 24 ounces or over to the dozen and the birds were typical of the breed and free from standard disqualifications. Birds of the Mediterranean breeds which laid eggs with tinted shells were disqualified and refused registration.

There were 1,490 birds which laid the required number of eggs but of this number 674 failed to measure up to the required standard as to breed character,

size of egg, stubs or down on feet or legs, foreign colour in lobes or plumage, etc. The distribution by contests was as follows:—

TABLE 38—REGISTRATION

Contest	Number of birds in contest	Number laying 200 eggs or over	Qualified for registration	Disqualified		
				Small eggs	Stubs or down	Other causes
Canadian	800	231	115	110	0	6
Prince Edward Island	200	47	31	16	0	0
Nova Scotia	190	53	34	18	0	1
Nova Scotia Southern	200	54	32	21	0	1
New Brunswick	190	92	66	26	0	0
Quebec Eastern	200	62	32	29	0	1
Quebec Western	190	79	46	25	0	8
Ontario	600	148	68	79	0	1
Manitoba	250	92	53	31	2	6
Saskatchewan	290	69	28	34	2	5
Alberta	320	91	41	47	0	3
British Columbia	460	281	158	97	11	15
Vancouver Island	340	191	112	49	16	14
Total	4,230	1,490	816	582	31	61

In addition to the 816 contest females which qualified for registration there were 52 females which were spare birds which laid the required number of standard sized eggs to qualify.

During the year 1928 there were 294 breeders doing mating and hatching work with registered hens. The distribution of breeders and birds is shown in table 39.

TABLE 39—DISTRIBUTION OF BREEDERS AND REGISTERED HENS

—	Breeders	Registered hens
Prince Edward Island	17	30
Nova Scotia	27	64
New Brunswick	27	109
Quebec	29	115
Ontario	64	243
Manitoba	16	91
Saskatchewan	20	54
Alberta	18	78
British Columbia	74	606
Totals	294	1,390

REPORTS

At the end of each week a report was sent out from each office where an egg laying contest was held giving the individual production of each bird for the week. These reports also gave the total eggs and points to date. Reports were sent to all contestants and interested parties, not only in Canada, but in the United States as well. In addition to those already mentioned the mailing list also included many poultry breeders and egg laying contest managers in England, Ireland, Scotland, France, Holland, Australia, New Zealand and South Africa.

A four-weekly report of eggs laid was also compiled and sent to the Canadian poultry press.

At the completion of the 1927-28 contest year a production and identification chart was prepared and sent to each breeder giving him important detail

in connection with the performance of his birds while in the contest. The information on the chart gave pen and bird number, the wing label numbers if she was the daughter of a second or third generation registered hen, the flock name and breeder's mark, also the tattoo mark if the bird was registered, the body weight of the bird, the number of eggs laid, points secured and average weight of eggs laid, and disqualifications if such were present.

With such complete information at hand the breeder should be prepared to act wisely in the mating up of his registered hens the following season. These charts are especially useful in determining the worth of a bird not only from her egg producing ability, but also from the standpoint of the size of egg and size of bird as well.

BREEDER'S CATALOGUE

During the year 1928 poultry registration work made marked progress in Canada. Registered male birds are now showing up quite prominently and the demand for them is extremely keen. Many breeders with good average farm flocks are purchasing these registered males to head their breeding pen. They realize what the registered sire means in stock breeding and wish to secure the best male bird available to increase the production of the pullet offspring.

So numerous were the demands for information regarding registered poultry that the Canadian National Poultry Association decided to issue a breeders catalogue. This catalogue, known as the Blue Book, was issued in December, 1928. It contains the constitution of the association, the rules of entry to the egg laying contests and Canada's National Poultry Registration Policy. In addition it has advertisements from the leading poultry breeders throughout Canada. The catalogue has been distributed to all parts of the world, the large majority of the copies going to breeders in Canada and the United States.

The effect the catalogue has had on the poultry industry is very promising indeed. Inquiries are coming from far and wide for registered birds and numerous sales of registered males or of eggs or chicks from reliable breeders are ever on the increase.

The catalogue itself is neatly gotten up, contains 80 pages and we believe is the forerunner of a greater increased trade for Canadian registered poultry.

INSPECTION

During the year 1928 five registration inspectors have been employed in the work of inspection of registered stock. Assistance has also been given to these registration inspectors in British Columbia, Ontario and Quebec. In British Columbia a temporary appointment was made, while in Ontario assistance was given by the Poultry Exhibitor. In Quebec, J. D. Lang of the Lennoxville Station assisted in inspection work.

Inspections were made for the purpose of:

1. Identifying (by means of breeders registered tattoo marks) as qualified registered stock, the females mated for the season's hatchings.
2. Approving as to standard quality and fitness the males mated to registered females.
3. Examining trap-nests and hatching records and instructing breeders as to the best methods of handling same.
4. Checking up and identifying the sealing of bands on all chicks within a given time after hatching.
5. Examining and labelling those pullets that are qualified to enter a contest and to pass and tattoo qualified cockerels from registered matings.
6. Inspecting new breeders desirous of entering laying contests and tattooing all qualified females in the contests at the completion of the contest year.

7. Giving advice and instructions, when desirable, to the breeders in the carrying on of their pedigree breeding work.

As the work with registered poultry goes on from year to year it is interesting to know that intelligent effort on the part of the breeders to advance the quality of their stock is having its reward. The most successful breeders soon realized that their most hearty co-operation with the inspector in carrying out the program as outlined was the surest and most rapid way to success. At the present time the fullest co-operation exists between the breeder and the inspector. The remark often heard is, "why does the inspector not make more visits to the flocks doing work under the Registration plan?"

To those most closely associated with the work it is clear that even at this early date (the sixth year of registration) the calibre of the breeder and the consistent performance of his birds is quite evident in the laying contests.

TABLE 40—NUMBER OF REGISTERED HENS MATED AND CHICKS HATCHED, 1928

—	Hens mated, 1928	Chicks wing banded	Chicks wing labelled
Prince Edward Island	30	161	42
Nova Scotia	64	595	79
New Brunswick	109	1,337	150
Quebec	115	1,284	305
Ontario	243	3,471	645
Manitoba	91	470	39
Saskatchewan	54	364	38
Alberta	78	500	95
British Columbia	606	8.654	565
	1,390	16,836	1,958

During the 1928 hatching season there were 1,390 registered hens mated to registered or approved males. This was 166 hens less than was mated the previous year but the number of chicks banded in 1928 was considerably greater than in 1927. In 1928 the average number of chicks banded was 12·1 per hen while the previous year it was 10·2, which was considered excellent.

The number of birds wing labelled as suitable for entry into contests is low there being little or no reason for banding more pullets than can be accommodated in the contests. It is expected that in the near future provision will be made so that all suitable pullets from qualified registered matings may be listed for registration under the National Poultry Registration Policy.

WORK WITH POULTRY DISEASE

(In co-operation with Health of Animals Branch.)

Report prepared by Dr. C. H. Weaver, Pathologist, Health of Animals Branch

A corner of the Pathological Laboratory, Central Experimental Farm.

ROUTINE LABORATORY SERVICE

TABLE P. 1.—AUTOPSY REPORT FOR THE POULTRY YEAR 1928

Disease	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Total
Intestinal parasitism-pathological	26	23	26	27	19	10	11	36	43	41	15	24	301
Roup and chicken pox	.....	.....	.....	.....	.....	1	.....	.....	2	1	.....	.....	4
Roup only	18	49	28	11	12	9	10	2	2	2	4	3	150
Pox only	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	2
Tuberculosis	1	1	.....	5	5	6	6	2	5	4	4	1	40
Para-typhoid infections	1	.....	1	8	1	20	29	23	9	.....	.....	.....	92
Pericarditis	.....	.....	.....	.....	2	.....	1	1	3	.....	.....	1	8
Vent gleet	2	.....	.....	.....	1	.....	2	.....	1	.....	1	.....	7
Peritonitis	10	7	9	6	8	26	16	11	10	7	8	8	126
Diseases incident to egg production	3	4	5	3	11	10	12	7	13	5	4	4	81
Avitaminosis	1	8	10	7	3	12	13	10	6	7	11	10	98
Cannibalism	3	5	5	8	16	34	24	6	2	3	3	.....	109
Hemorrhage	1	5	3	5	7	7	10	9	3	3	3	2	58
Visceral gout	2	.....	2	1	3	3	1	4	2	3	4	1	26
Digestive and liver trouble	1	2	9	2	7	7	4	4	20	4	2	10	72
Tumor	.....	4	4	6	6	4	8	2	2	1	1	7	45
Leukemia	2	2	3	3	4	4	4	2	2	.....	3	6	35
Paralysis	1	1	1	5	2	.....	.....	1	1	2	.....	.....	14
Heat prostration	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1
Undetermined and decomposed specimens	3	6	4	2	1	11	15	23	24	14	9	5	117
Miscellaneous	4	3	4	1	2	3	1	3	3	2	2	6	34
Total	79	121	114	100	110	167	168	146	154	99	74	88	1,420

The above is a concise tabulation of the specimens examined during the year, consisting almost entirely of ailing fowl and fowl cadavers submitted for a determination of the causes for losses. They are listed accordingly to diagnoses and on a monthly basis with totals for each and for the year.

The examination of this large amount of material with reports and correspondence relative thereto is a heavy task on the laboratory, which is further handicapped by the difficulty of receiving adequate stenographic help.

Again as in each preceding year the monthly maximum occurs in the springtime, which is partly explainable from the figures of the table. Chicks dying of B. pullorum infection (listed as para-typhoid) commonly referred to as bacillary white diarrhoea, swell the figures seasonally. Further increase at this time results from a period of crisis for adult fowl in which production and nutritional diseases are seen at the greatest severity.

Intestinal parasites, which constitute a scourge to the industry, show no indication of recession in prevalence in the material examined. This preventable disease, like typhoid in the human, is direct evidence of a lack of adequate sanitary measures too frequently in evidence in poultry culture. Visible cleanliness though desirable however is no guarantee of freedom, but control must come through sanitary measures which go further and be based on other than the mere appearance of premises and equipment.

Peritonitis, oviduct troubles, cannibalism and avitaminosis so frequently encountered in pullet flocks under heavy production are emphasized in this table by virtue of their numbers.

Parasitism, with production diseases and avitaminosis resulting in lowered resistance followed by infectious diseases from organisms of a variable virulence, constitutes a vicious circle, which to the poultryman is a source of mental worry and financial loss.

INFECTIOUS BRONCHITIS OF FOWL

(A Brief Note on Symptoms and Control of the Disease)

Numerous communications, frequently by telegraph, are received at this laboratory advising of sudden outbreaks of disease with disastrous results in which the owners have failed or been unable to give sufficient symptoms to permit of diagnosis. Often one eventually learns the nature of the disease to be the condition under consideration. It, therefore, was considered advisable to give out certain information that may be of assistance.

The disease is easily diagnosed though it is frequently confused with others of which it may or may not form a part, such as roup and chicken pox. The infecting causes of these two are so generally prevalent and as all these conditions are of the same seasonal occurrence a combination among them is the rule. As a matter of fact, all cases of bronchitis coming under observation here have been preceded, accompanied or followed by typical roup cases, and frequently pox also has been present.

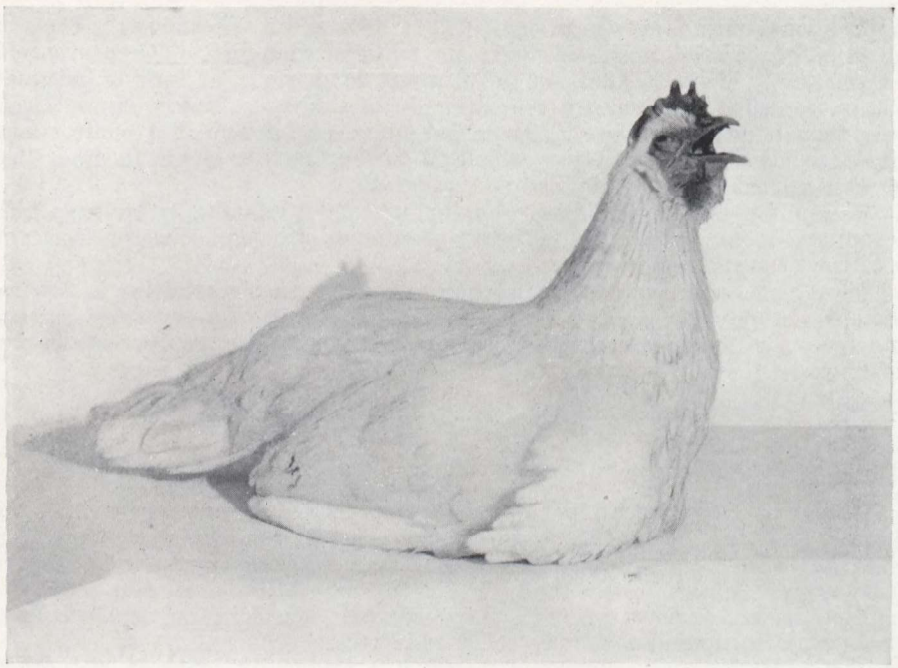
SYMPTOMS

History of an outbreak usually ineludes evidence of a severe or sudden environmental change, such as movement of birds for winter housing or for show or other purposes. It may be that clear cold weather is suddenly followed by warm moist conditions and with cottons still down at night the quarters take on a humid over-heated state, very much to the birds' discomfort.

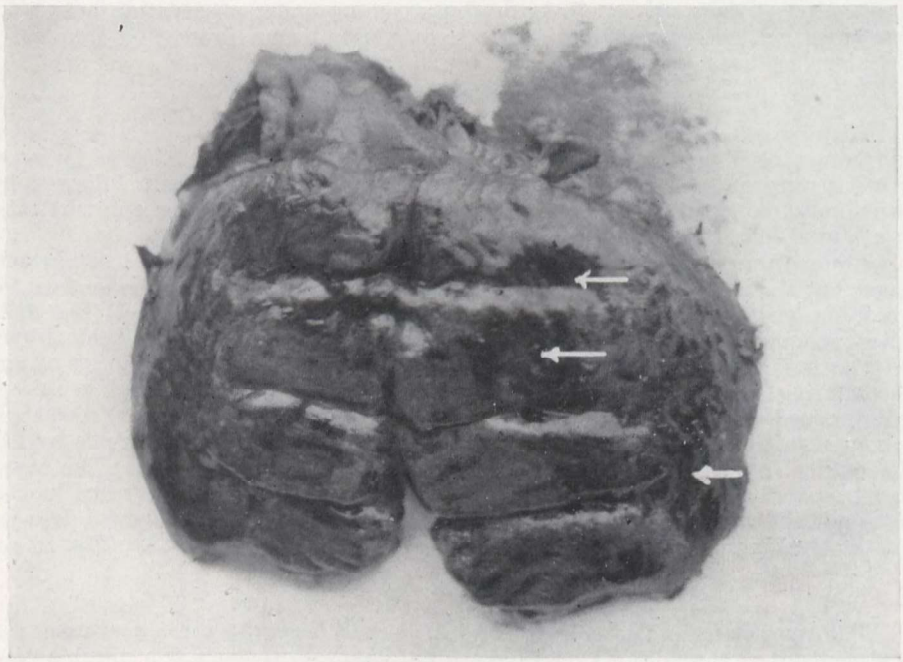
Premonitory symptoms or evidence of the approaching illness is not in evidence, but the birds are suddenly stricken with a difficult and diagnostic form of breathing, usually first seen when entering the house in the morning. The difficulty becomes intensified and the subject sits with neck arched and beak drawn in towards the breast. This is during exhalation or emptying of the lungs of air. Then during inspiration or replenishing the air in the lung the head is raised, beak opened and neck extended, followed by a brief pause when retracted. Laboured breathing continues only to be interrupted at varying intervals by fits of coughing in which blood is a prominent part of the expectoration. The blood may be readily detected, is a diagnostic symptom and should always be looked for about the roosting quarters. Among pullet flocks where the disease does its greatest damage usually the heaviest and best fleshed subjects are the first to go.

COURSE OF THE DISEASE

The course of the disease and termination will depend a great deal upon the treatment given the flock. Cases have been observed where under suitable care a cessation with total disappearance of dyspnoea or difficult breathing and cough-



Fowl showing typical symptoms of acute infectious bronchitis. Prostration, darkened comb and wattles, neck extended in a gasp for breath, particles of blood clot adherent to roof of mouth.



Lung of the above fowl. Arrows point to darkened areas of lung filled with extravisated blood.

ing of blood has occurred overnight. This is possible only in the early stages of the outbreak. Again an outbreak in a house of approximately one hundred pullets suffered a loss of eight birds per hour, but this ceased immediately with only one death subsequent to relief measures being instituted.

In any event a reduction in production follows which seemingly is unavoidable.

THE DISEASE PROCESS

In typical, uncomplicated cases changes in the body tissues are noticeably scant considering the alarming symptoms exhibited, the acute sudden course of the disease and the high mortality. In these, changes are confined to the lung where darkened areas are encountered, and are due to extravisated blood that has escaped from the blood vessels into the lung tissue. This is the source of the blood coughed up by the birds and some of it will be found in the trachea or windpipe if opened after death.

TREATMENT

Every care possible should be taken to prevent conditions occurring which are known as likely to be followed by this disease. Pullets should not be taken from open range to be suddenly closely confined to permanent houses. When moved they require the minimum handling, should be given some use of yards, and supplied liberally with succulent green feed. The change to concentrated laying rations should be gradual, bowel movement should be regulated by occasional doses of physic if necessary and particular care should be taken that the window cottons are not closed too closely during nights. Many outbreaks of respiratory disease are directly traceable to lack of care in this last requirement.

Birds intended for shipping should not be taken from open range and placed in shipping crates of inadequate size or lacking in ventilation, otherwise trouble may be anticipated.

As death from this disease is due to asphyxiation by the outpouring of blood into the lung tissue, the ailing birds as a flock or individuals should not be handled or treated but should be kept as quiet as possible, otherwise the lung hemorrhage will be aggravated. The oxygen starvation from which they suffer should be offset by additional fresh air supply. This is best accomplished by getting the birds outdoors even though straw must be spread on the snow in front of the houses in order to do so. If this is absolutely impossible all windows on the south side of the house must be entirely opened, and as much as possible should be kept open day and night. There is no danger of the birds taking colds therefrom during the acute stage of the disease. Fear of lowering production by this procedure should be ignored as it will occur in any event and the first consideration is to stop the mortality.

This laboratory for several years cared for the health of the birds at the Ottawa poultry shows from which valuable information was obtained. From this it was learned that the avenue of infection in this malady apparently is the upper respiratory tract, and by medicinal prophylaxis the disease never developed during those years though shipments were received with birds dead in the shipping coops due to this cause. One of the shows was annually held in the winter time and during this period the disease was prevalent in the country.

It seems probable that the cause of this disease, whatever it may be, is normally present on the mucosa of the upper air passage, consequently when birds are to be shipped to shows, contests or for sale purposes, the slight effort of instilling a few drops of a 10 per cent solution of argyrol or neo-silvol into the eyes, nostrils and throat may be time and effort well expended, in view of the excellent preventive effect of such treatment in the shows already mentioned.

THE AGGLUTINATION TEST AS A MEANS IN CONTROLLING CHICK MORTALITY WHEN DUE TO BACILLUS PULLORUM INFECTION (BACILLARY WHITE DIARRHŒA)

Sufficient progress has been made in applying the agglutination test to flocks on the Experimental Farms system as a diagnostic means for the detection of certain type infection in the breeding stock to warrant the drawing of conclusions relative to the usefulness of the test. Consequently thereto, and in reply to many inquiries received asking for information on the technique employed at this laboratory and the practical usefulness of the test a brief report is being made at this time.

Needless to say, aside from the test with the removal and slaughter of the reacting birds, other appropriate measures supplemental to the test have been taken into consideration in the control work on these flocks.

As a means of increasing the viability of the young stock this control work has been so satisfactory, particularly where a high death rate was suffered through heavy infection, that it has been extended until practically all flocks of the system are now under test.

Extensive infection adds very much to the financial cost of bringing the disease under control, hence, with the prevalence of the infection, it is economically sound to test, if facilities are available, and remove the source before it becomes deeply established. Even though no infection exists, which is not the rule, no harm would be done and necessary steps could be taken to guard against infection.

TECHNIQUE EMPLOYED

In the first years of testing the procedure advised by Beaudette[1] was followed. In this a one tube method was recommended, and was an important advancement in bringing the test within reasonable limits of effort.

Refinements were added to the test as time went by until a standardized technique was suggested by a committee under the chairmanship of Van Es[2] at the 1926 meeting of the United States Live Stock Sanitary Association. These recommendations, with some variations form the basis of the test as applied at this laboratory at the present time.

One of the chief changes made to our test in keeping with these recommendations was in the serum dilution, from $\frac{1}{80}$ previously used to $\frac{1}{40}$. This was made possible by certain means of preventing false agglutinations, consequently the sensitiveness of the test was favourably influenced as will be shown by examples.

A chief deviation from the standardized test is in determining the antigenic value of the antigen or test fluid. This laboratory titrates the concentrated antigen against known positive and negative sera and at the one time determines the potency and the dilution factor of the fluid.

In this, lots of five tubes are arranged for each positive serum and the same for the negative control being used. An appropriate amount of serum is placed in each tube to give the desired dilution, when varying amounts of concentrated stock antigen and saline are added in an adverse ratio one to the other, as follows:—

Antigen	parts	4	3	2	1
Saline		0	1	2	3

[1] F. R. Beaudette Jr. A.V.M.A. Vol. 64, pp. 225.
[2] Van Es et al Proc. U.S.L.S.S.A., 1926.

This standardizing test is incubated in the same manner as the regular agglutination test, after which a reading is made. The tubes giving the clearest and best reaction with the greatest ease in reading are taken as the dilution factor for the batch of antigen under test. It is believed that this arrangement affords a fair indication of the degree of balance between the antibodies present in the positive sera and certain properties associated with the bacteria in the antigen, whereby agglutination takes place.

The flocks, with but one exception, have been tested but once yearly and that usually in the fall of the year before the pullets were in regular production. All degrees of infection have been met with from no reactors at the one end to the opposite where it was deemed inadvisable to attempt to save any of the flock.

Examples follow of two badly infected flock and results obtained thereon.

TABLE P. 2—FLOCK, C.E.F.

Year	Chick mortality	Average	Reactors
	%	%	%
1923	20·6	24·7	No test
1924	33·4		"
1925	20·8		21·7
1926	10·8	9·7	3·4
1927	9·4		4·6
1928	9·1		1·2

The first test of this flock was in the fall of 1925 and would have its effect upon the following year's rearing. In four tests, starting with 21·7 per cent, reactors have dropped to 1·2 per cent, and this is reflected in a corresponding drop in chick mortality. Furthermore previous to testing the *B. pullorum* could be isolated from the majority of chicks dying during brooder age, whereas during the past two years the reverse has been the rule. The past year the only evidence encountered was at the very last of the season when one isolation was made. At no time since testing started have hatches suffered the acute heavy losses formerly seen, the outbreak terminating with diarrhoea, pasting, emaciated, pot-bellied and stunted specimens.

FLOCK F.E.F.

This second flock is given as an example of difficulties that may be encountered. The infection in this case is the *B. sanguinarium* or fowl typhoid of a strain transmissible through the egg, as in *B. pullorum* infection.

Chick losses were excessively high and continued to go up though every effort was given to assure perfect care and attention to the young stock. With the hope of controlling this excessive mortality, and make rearing operations reasonably successful, testing was started. This was the first testing from this laboratory and was of a purely experimental nature. As the flock is several hundred miles from the laboratory considerable difficulties have intervened which could only be corrected by experience and have been a hindrance rather than a help to the control work.

There has been a persistance of flock infection since the first testing with recurrence of increased reactors which can be explained in part only. Also the chick losses continue higher than they should, part of which seems likely to be due to the cause of infection. The losses before and after testing are not absolutely comparable due to recording on a given date i.e. July 1 for the four

years 1919 to 1922 and at three weeks of age for the remaining years. It seems unlikely however, that this should materially alter the figures. One significant point remains that previous to testing the viability was lower, tending to decrease with successive years, whereas the general viability has been greater with increasing improvement with subsequent years of testing, resulting in a decided improvement in the stock on hand.

The following tabulation covers this flock:—

TABLE P. 3—FLOCK F.E.F.

Year	Number chicks hatched	Number chicks alive	Per cent chicks alive	Per cent reactors
1919	1,086	474 July 1	43·6 July 1	No test
1920	809	448 July 1	62·2 July 1	"
1921	1,050	360 July 1	34·2 July 1	"
1922	1,089	652 July 1	59·7 July 1	"
1923	1,194	301 wing-banded	25·2 wing-banded	34·4
1924	1,461	735 "	50·3 "	3·93
1925	1,079	706 "	65·4 "	9·8
1926	1,686	1,028 "	60·9 "	20·41
1927	1,638	1,223 "	74·66 "	7·37
1928	2,072	1,726 "	83·30 "	1·05

In each of these examples an increase in the numbers of reactors is recorded on a single occasion and was due to improved technique picking out mildly positive reactors which formerly were being omitted.

A total of 9,027 blood specimens were submitted to the test during the year.

MORTALITY STUDY

A COMPARISON BETWEEN SINGLE COMB WHITE LEGHORNS AND BARRED PLYMOUTH ROCKS, AND BETWEEN EGG PRODUCTION AND LOSSES, IN WHICH IS INDICATED A HIGHER INCIDENCE FOR THE LEGHORNS ALSO A DIRECT CORRELATION BETWEEN PRODUCTION AND MORTALITY.

A particularly favourable opportunity of studying the relative mortality between the two popular breeds, Single Comb White Leghorn and Barred Plymouth Rock is afforded this laboratory, receiving as it does all the fowl cadavers from the two Laying Contests conducted at Ottawa.

The excellence of the material for such a study is due to the fact that, the birds having originated from many flocks, one of the difficulties usually encountered in such studies, that of breed strain, is eliminated They are not of one but of many strains. The rearing conditions of the birds, while probably generally similar and in keeping with popular customs, nevertheless, would be more varied than would prevail where rearing had been by one individual or institution, thus more nearly simulating general conditions throughout the industry, and tending to eliminate producers' individuality effects. Another controlled variable factor which might adversely affect one breed to a greater degree than the other may be termed environmental disease. Reference is here made to local nutritional defects in the young due to an inadequate supply of certain essential nutritional factors due to peculiarities of a given district. Finally must be considered a communicable disease factor in the young and its effects on adult life. This is infinitely greater as a variable, subject to breed influence and conversely influenced by breed, to a greater extent in subjects from a common source than in those of a divided origin.

Fortunately two contests are operated under one management giving similar conditions to each, but each contest is handled by separate individuals. This makes possible the separation of some local conditions which would otherwise miss detection as such.

The material was from pens picked from flocks of select breeding representative of the best to be obtained in what is popularly referred to as production bred stock. With generations of breeding and selection for high production the stock might be looked upon as suitable to withstand the stress and strain incident to heavy, intensive productivity over a prolonged period, as must prevail in contest work.

Food materials supplied, methods of feeding and the general care given the stock from which these cadavers arose were considered in keeping with present day methods.

Mortality listing in each instance was based on the pathological condition existing, and did not consider the actual or exciting cause for same, which should be taken into consideration in reading this report. Thus it will be noticed that paratyphoid infection is unrecorded and intestinal parasitism appears relatively unimportant while in reality probably both have been important indirect factors in bringing about the cause of death, as listed at autopsy.

The fowl population consisted of 1,020 Leghorns and 396 Rocks. These gave 233 deaths for the former and 78 for the latter or 22·8 and 19·6 per cent respectively.

Table P. 5 gives a listing of the mortality according to disease, and by breed on a monthly calculation, with totals and percentages. This table is supplemented by tables P. 6 and P. 7, which separate the autopsies according to contest for the purpose of comparison one to the other and of locating local conditions. The course and grouping as shown by these two tables (P. 6 and P. 7) is very similar as may be graphically seen in fig. VI "Per cent mortality by month—breeds combined—contests separately calculated." The rise and fall of the two lines as shown are fairly uniform, although the broken line maintains an almost constant lower level of the two though not greater than might be expected as a variable. The seasonal disease incidence and the relative disease incidence of the two groups may be considered as one in a general way, exceptions to be noted later. The close relationship existing between the two groups shows that given or common factors were in effect, but the opposite might be concluded had there been a decided dissimilarity.

Figures are submitted which show a higher death rate for the Leghorns than for the Rocks, being the considerable difference of 3·2 per cent. These figures are for but one year and may be greatly altered over a longer period and with greater numbers of birds. The course of mortality (monthly calculation) is graphically indicated in fig. V.

Examination of the figures in table P. 5 shows this increase in the Leghorns chiefly under items 3, 10, 11 and 12. Checking tables P. 6 and P. 7 against these figures in table P. 5 shows a similarity in all except item 3. In this one the deaths were, with but one exception, confined entirely to table P. 6 and should be considered as a local condition, with perhaps a suggestion of increased susceptability on the part of that breed.

Barred Rocks show a reversal of considerable magnitude in one item, No. 13. In this a comparison between tables shows losses in this instance to be almost completely within table P. 7, consequently of local character, but not completely exhonerating the breed.

For further consideration, grouping has been made of items 9-15 inclusive representing a series of disease conditions more or less intimately associated with production, digestion and nutrition. It is true that reasons for such a classification are indefinite but reasons do exist in the main if not the whole.

Leghorns in this group have a mortality of 68·2 per cent of the total deaths, the Rocks have 62·8 per cent. The difference shown here more than covers the mortality variation between the two breeds, and accounts for the better showing of the Rocks, in so far as this tabulation is concerned.

Turning then to the monthly per cent totals in table P. 5 the figures show a steady and constant rise from November to April, and, though less steady than the rise, a decline following to the end of the year. The reason for a spring-time peak in mortality is not explained by these figures, but it did suggest a comparative study between production and mortality. This shows an apparent direct correlation between the two. This parallelism is marked in the Leghorns during the rise of production, but less uniformity exists during the decline. Somewhat more deviation exists for the Rocks.

A comparison appears in graphic form as figs. VII and VIII. The production is of the usual per cent calculation and the mortality is the per cent figures for the respective breeds as shown in table P. 4. A difference of ratio is expressed in the lines representing the production and the mortality curves, in order to impose one curve upon the other. The purpose of the graphs is to show the relationship between course and fluctuations rather than to denote percentages, which are as follows:—

TABLE P. 4—PRODUCTION AND MORTALITY PERCENTAGES

Month	Single Comb White Leghorns		Barred Plymouth Rocks	
	Production	Mortality	Production	Mortality
	%	%	%	%
November	25·0	3·0	20·7	3·8
December	29·2	5·1	33·1	3·8
January	24·7	4·3	35·0	9·0
February	34·9	6·0	50·2	9·0
March	63·3	7·3	62·7	12·8
April	71·6	17·6	80·0	14·1
May	72·0	15·4	78·0	7·6
June	65·2	7·3	61·9	16·6
July	58·2	14·1	57·7	6·4
August	49·2	6·4	52·8	7·6
September	34·8	6·0	41·9	2·5
October	21·1	7·3	31·4	6·4

The mortality figures are the monthly percentage of the sum total for the year, and as they are computed once only for the monthly period together with the smallness of the number the curve shows excessive fluctuations. In order to offset this and to show more nearly the actual course a mean was struck in plotting the curves.

TABLE P. 5.—MORTALITY STUDY—SINGLE COMB WHITE LEGHORNS—BARRED PLYMOUTH ROCKS

Item No.	Disease	Nov.		Dec.		Jan.		Feb.		Mar.		April		May		June		July		Aug.		Sept.		Oct.		S.C.W.L.		B.P.R.	
																										No.	%	No.	%
1	Intestinal parasitism-pathological	....	1	....	3	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	....	4	1·7	4	5·1
2	Roup and chicken pox	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1	0·4	....	....
3	Roup only	2	....	2	....	3	1	2	1	5	....	3	....	3	3	2	....	2	....	2	....	1	....	....	1	25	10·7	6	7·6
4	Pox only	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1	0·4	....	....
5	Tuberculosis	....	....	....	....	....	....	1	1	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	2	0·8	1	1·2
6	Para-typhoid infections	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
7	Pericarditis	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	2	....	....	....	....	....	....	....	2	0·8	1	1·2
8	Vent gleet	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
9	Peritonitis	3	2	2	....	....	2	3	1	1	....	9	2	5	....	2	1	5	2	2	1	5	....	....	1	37	15·8	12	15·3
10	Diseases incident to egg production	1	....	....	....	....	1	1	1	3	1	5	....	4	....	4	1	7	....	3	1	1	....	1	....	30	12·8	5	6·4
11	Avitaminosis	....	....	2	....	2	....	2	1	2	1	4	1	2	1	....	1	1	1	2	....	2	1	5	....	24	10·3	6	7·6
12	Cannibalism	1	....	1	....	....	....	....	....	3	1	15	....	13	....	1	2	2	....	1	....	1	....	....	....	38	12·0	3	3·8
13	Hæmorrhage	....	....	2	....	....	....	....	....	....	3	3	3	2	....	2	3	2	....	1	....	....	1	....	....	12	5·1	11	14·1
14	Visceral gout	....	....	....	....	1	....	....	1	1	....	....	2	....	....	1	1	1	....	....	1	....	....	1	....	5	2·1	5	6·4
15	Digestive and liver trouble	....	....	1	....	2	2	....	....	....	1	....	1	1	....	1	1	5	....	....	1	1	....	2	1	13	5·5	7	8·9
16	Tumor	....	....	1	....	....	....	2	....	1	....	....	2	3	1	....	....	1	....	....	....	....	....	3	....	11	4·7	3	3·8
17	Leukemia	....	....	....	....	1	....	....	1	....	1	1	....	1	1	1	1	1	2	....	....	....	1	2	1	9	3·8	5	6·4
18	Paralysis	....	....	....	....	....	1	....	....	1	1	....	....	....	....	1	....	....	....	1	1	....	....	....	....	3	1·2	3	3·8
19	Heat prostration	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	1	1·2
20	Undetermined and decomposed specimens	....	....	1	....	....	....	2	....	....	....	....	....	....	....	2	2	4	1	4	1	1	....	2	1	16	6·8	5	6·4
21	Miscellaneous	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Per cent by breed	3·0	3·8	5·1	3·8	4·3	9·0	6·0	9·0	7·3	12·8	17·6	14·1	15·4	7·6	7·3	16·6	14·1	6·4	6·4	7·6	6·0	2·5	7·3	6·4	....	....	....	....
	Totals by breed	7	3	12	3	10	7	14	7	17	10	41	11	36	6	17	13	33	5	15	6	14	2	17	5	233	.....	78	.....
	Total	10		15		17		21		27		52		42		30		38		21		16		22			311		
	Per cent totals	3·2		4·8		5·4		6·7		8·6		16·7		13·5		9·6		12·2		6·7		5·1		7·0					

TABLE P. 6.—MORTALITY STUDY—CANADIAN CONTEST

Item No.	Disease	Nov.		Dec.		Jan.		Feb.		Mar.		April		May		June		July		Aug.		Sept.		Oct.		Breeds		Totals
																										W.L.	B.R.	
1	Intestinal parasitism-pathological		1		2	1		1																1		3	3	6
2	Roup and chicken pox											1														1		1
3	Roup only	2		2		3	1	2		5		3		3	1	1		1		1		1			1	24	3	27
4	Pox only													1												1		1
5	Tuberculosis							1	1					1												2	1	3
6	Para-typhoid infection																											
7	Pericarditis																	1								1		1
8	Vent gleet																											
9	Peritonitis	1		2			2	2	1	1		9	1	3		1	1	4	2	2	1	4				29	8	37
10	Diseases incident to egg production						1	1	1	1	1	3		2		2	1	3		3				1		16	4	20
11	Avitaminosis			1				2	1			2		2			1		1	1		1		2		11	3	14
12	Cannibalism			1						1		10		9		1	2	1		1						24	2	26
13	Hemorrhage			2								3		1	1	1		2		1						10	1	11
14	Visceral gout					1							1			1		1						1		4	1	5
15	Digestive and liver trouble					1	1				1					1	1	3				1			1	5	5	10
16	Tumor			1				1		1			2	2				1						2		8	2	10
17	Leukemia										1			1	1	1	1	2				1		2	1	7	4	11
18	Paralysis						1			1	1					1					1					2	3	5
19	Heat prostration																		1									1
20	Undetermined and decompsoed specimens			1												1	2	3	1	1	1	1		1		8	4	12
21	Miscellaneous																											
	Total by breeds	3	1	10	2	6	6	10	4	10	4	31	4	25	3	11	9	22	5	10	4	8	0	10	3	156	45	
	Total	4		12		12		14		14		35		28		20		27		14		8		13			201	

TABLE P. 7.—MORTALITY STUDY—ONTARIO CONTEST

Item No.	Disease	Nov.		Dec.		Jan.		Feb.		Mar.		April		May		June		July		Aug.		Sept.		Oct.		Breeds		Total
																										S. C. W. L.	B. R.	
1	Intestinal parasitism-pathological				1																	1				1	1	2
2	Roup and chicken pox																											
3	Roup only								1						2	1										1	3	4
4	Pox only																											
5	Tuberculosis																											
6	Para-typhoid infections																											
7	Pericarditis										1							1								1	1	2
8	Vent gleet																											
9	Peritonitis	2	2					1				1	2		1		1					1			1	8	4	12
10	Diseases incident to egg production	1								2		2	2		2		4			1		1				14	1	15
11	Avitaminosis			1		2				2	1	2	1				1		1			1	1	3		13	3	16
12	Cannibalism	1								2	1	5	4				1					1				14	1	15
13	Hemorrhage										3	3	1		1	3							1			2	10	12
14	Visceral gout								1	1		1				1					1					1	4	5
15	Digestive and liver trouble			1		1	1					1	1				2					1		2		8	2	10
16	Tumor							1					1	1										1		3	1	4
17	Leukemia					1			1			1														2	1	3
18	Paralysis																			1						1		1
19	Heat prostration																											
20	Undetermined and decomposed specimens							2								1		1		3				1	1	8	1	9
21	Miscellaneous																											
	Total by breeds	4	2	2	1	4	1	4	3	7	6	10	7	11	3	6	4	11	0	5	2	6	2	7	2	77	33	
	Total	6		3		5		7		13		17		14		10		11		7		8		9			110	

MORTALITY STUDY.

DARK LINES – S.C.W. LEGHORNS.
LIGHT " – B.P. ROCKS.

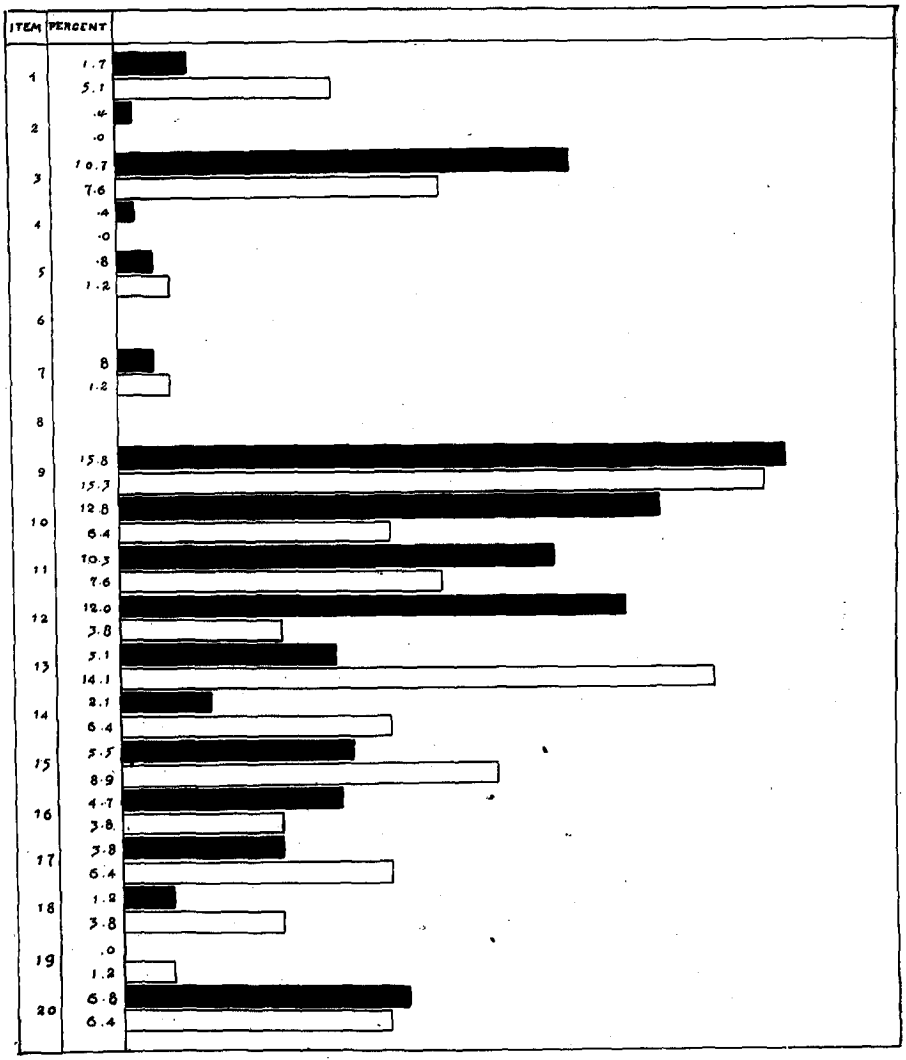


Fig No. IV. Item numbers represent diseases – see table P.1.

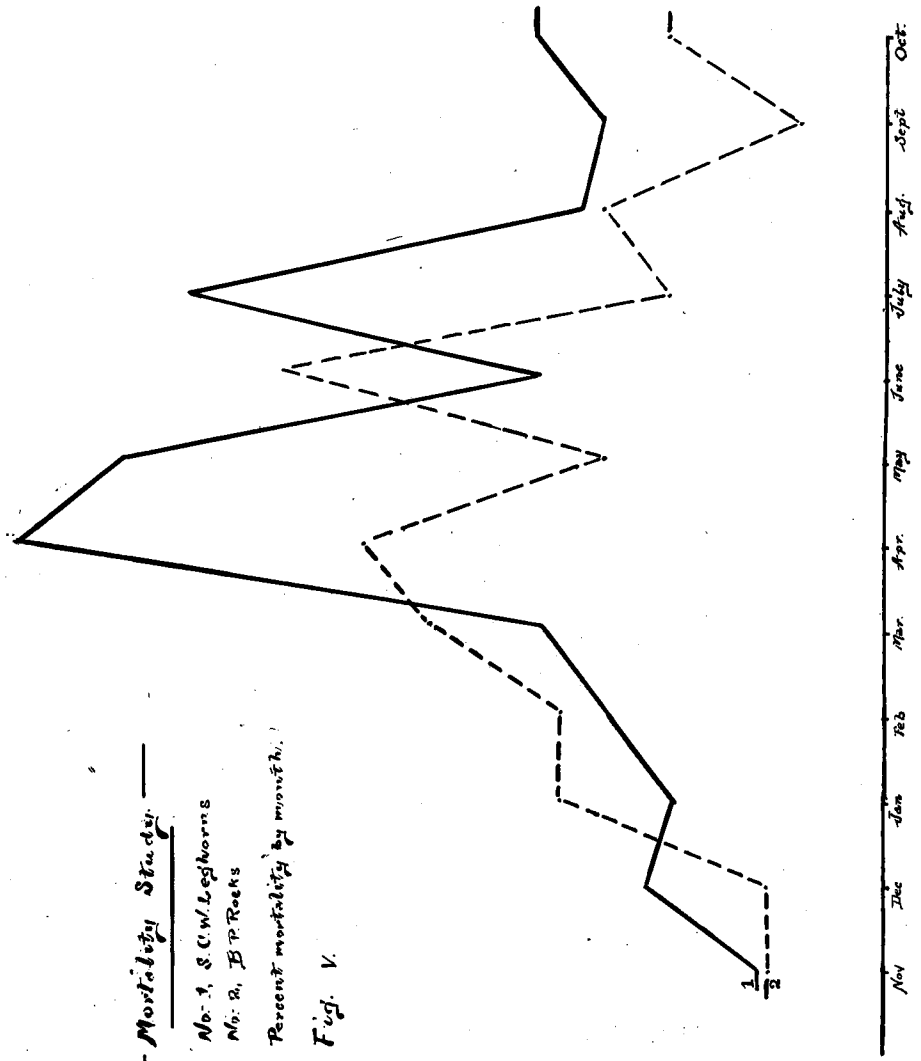
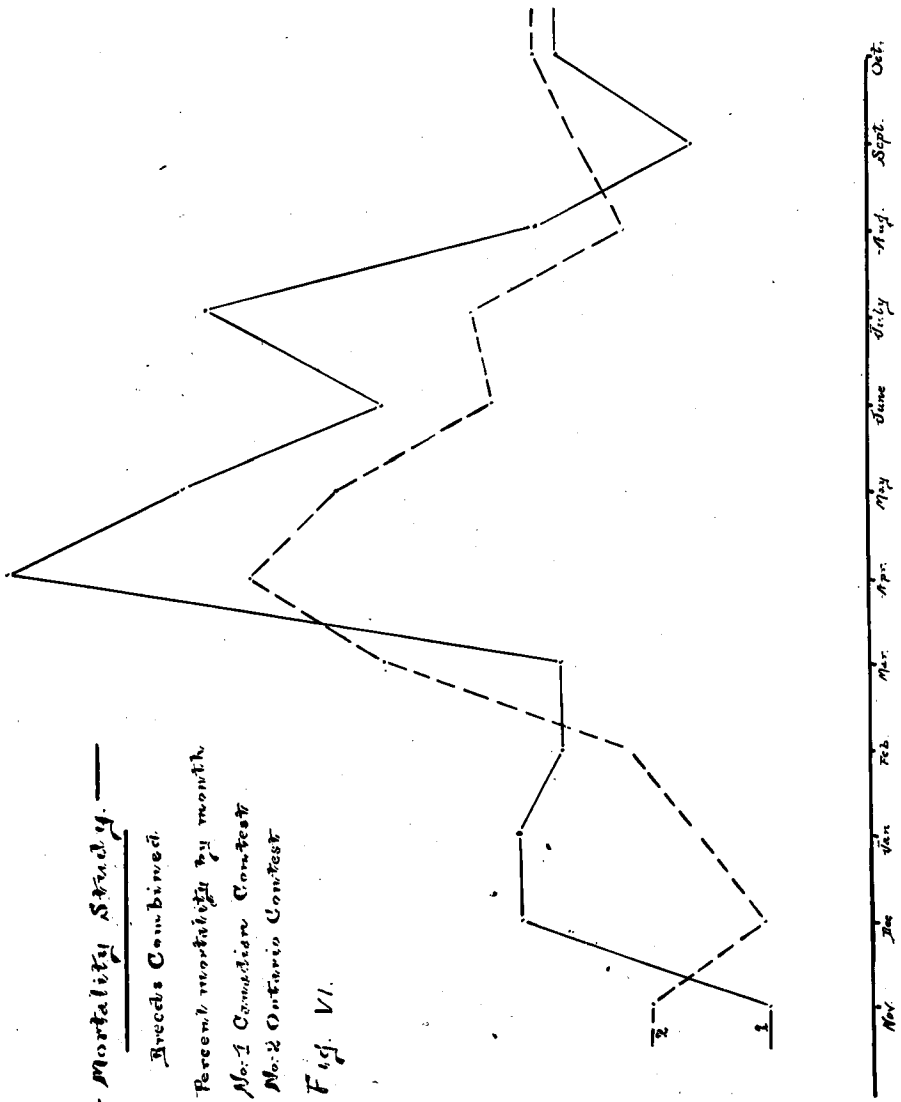
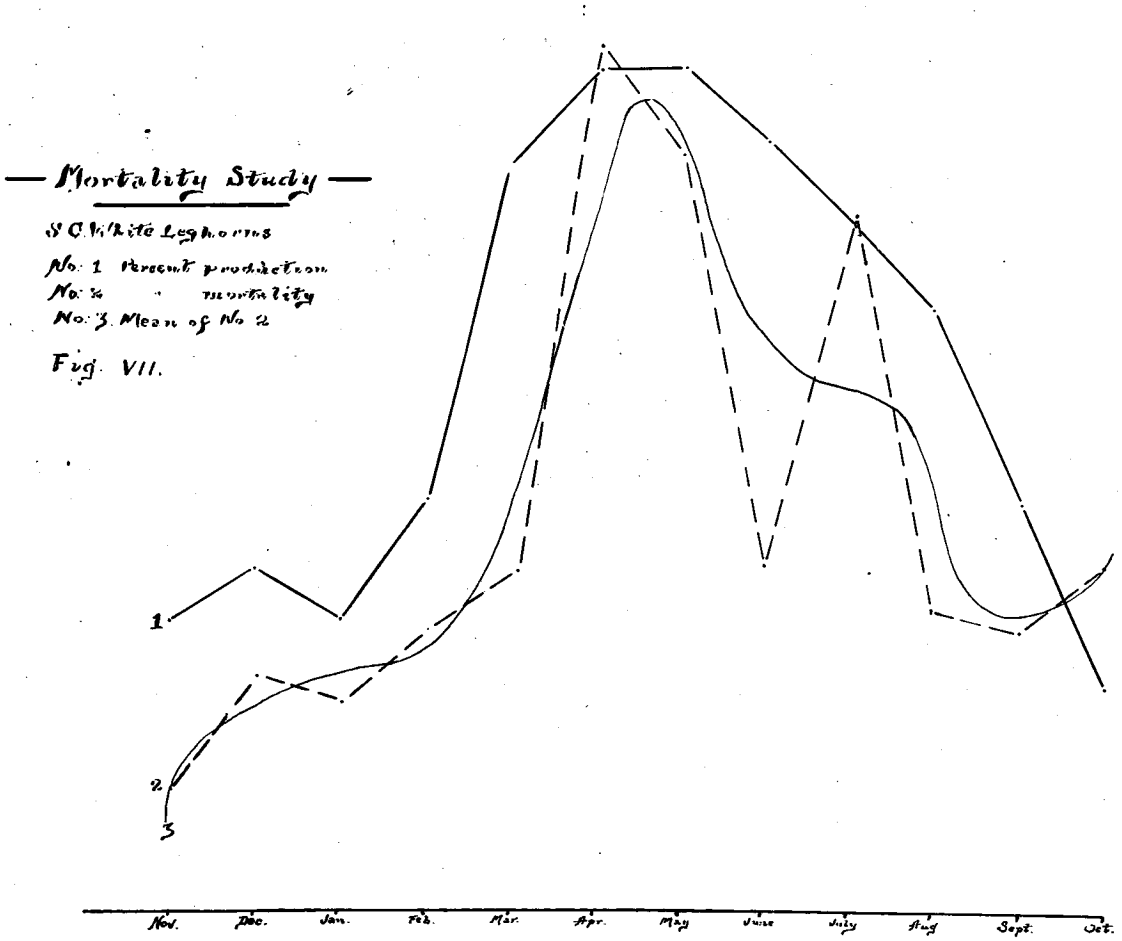
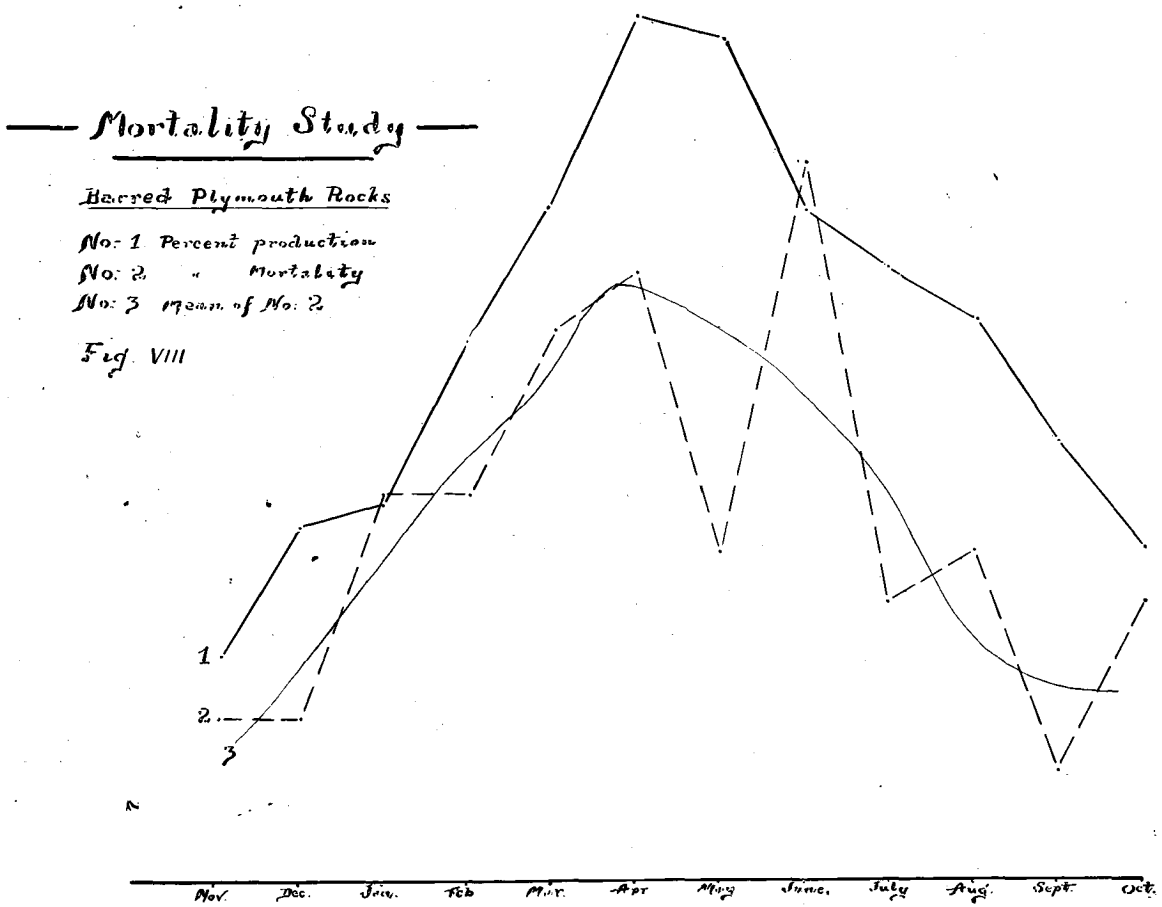

Mortality Study.
No. 1, S.C.W. Leghorns
No. 2, B.P. Rocks
Percent mortality by month.
1/2
Nov
Dec
Jan
Feb
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.

Fig. V.


— Mortality Study. —
Breeds Combined.
Percent mortality by month.
No. 1 Canadian Contest
No. 2 Ontario Contest
Fig. VI.
2
1
Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct.


— Mortality Study —
S C White Leghorns
No. 1 Percent production
No. 2 " mortality
No. 3 Mean of No. 2
Fig. VII.
1
2
3
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.


Mortality Study
Barred Plymouth Rocks
No: 1 Percent production
No: 2 " Mortality
No: 3 Mean of No: 2
Fig. VIII
1
2
3
Nov.
Dec.
Jan.
Feb
Mar.
Apr
May
June.
July
Aug.
Sept.
Oct.

WATERFOWL

Owing to the fact that a full time attendant was not available at the Duck Plant during the past season, no controlled experimental work was carried on with waterfowl. Breeding work, however, was carried on as usual with both ducks and geese.

The stock was further augmented by the addition of fifteen Greater and two Lesser Snow geese. The birds were sent here through the Parks Branch from the Game Reserve north of Quebec. At this Game Reserve they have been attempting to breed the birds in captivity for the last four or five years, but have failed in their endeavours. As nothing is known of the breeding habits of the Snow geese, it was thought that possibly they might breed at our waterfowl sanctuary on the Experimental Farm, and we are making an effort in the spring of 1929 to see what can be done along this line. The birds have wintered well and are extremely tame, and we are in hopes that some good may result. At the present time the Snow geese winter in the south, around North Carolina and go north each spring. The breeding ground is not known but is believed to be in the far north, probably the north coast of Greenland. We are informed by the Parks Branch that there is one possible exception to the birds having been bred in captivity and that is by R. M. Barns, Illinois, but we have no confirmation of this report. To the best of our knowledge, no one in Canada has ever bred Snow geese in captivity, and as their breeding ground is so far north, little is known of the habits of the birds. It is reported that Peary on his northern expedition saw a half grown Snow goose on the south coast of Greenland, but to our knowledge, no one else has ever seen anything but geese which were old enough to migrate.

The flocks consist of between eight to ten thousand and these are of the Greater Snow variety. The Lesser Snow geese have a wider range so far as breeding ground is concerned and are more numerous, and it is believed that they cross the flight line of the Greater Snow geese, which may account for the two Lesser Snows being trapped with the flock of Greater Snows, north of Quebec.

We hope to have some information to report in the next annual report as to our success in the breeding of these distinctly wild geese.

FARM, EGG AND POULTRY ACCOUNTS

There is an ever-increasing demand for the Farm, Egg and Poultry Account forms supplied by the Poultry Division, especially noticeable from amateurs starting into the poultry work and from boys' and girls' poultry clubs. It is also interesting to note that some of the first persons to submit these forms several years ago are still mailing the monthly reports regularly. This indicates that these poultrymen endeavour to keep closely in touch with their farm enterprise and consequently to carry on on a business basis.

The monthly circular letters formerly sent out have been discontinued but correspondence with the readers of reports is kept up and many questions answered.

That the correspondence and the simple monthly forms supplied by the Poultry Division are often instrumental in stopping serious leakages and in greatly increasing the efficiency of poultry farm management is shown by the increased profits of the correspondents from year to year. The Farm, Egg and Poultry Account service serves as a systematic record of expenses, production and income showing up ways in which saving may be made. It is also advisable for the beginner, more especially the intending commercial poultry farmer, to take an inventory at the beginning of the poultry year, preferably November first. A balance sheet should also be made out at the close of the year.

This monthly report form service is available to poultrymen and farmers in all parts of Canada. The French monthly report form service also increases with a considerable amount of correpondence resulting.

General French correspondence on poultry matters is increasing and is a healthy indication of the growing status of poultry work in the province of Quebec.

DEMONSTRATIONS AND EXHIBITS

Attractive exhibits consisting of explanatory panels, models of poultry appliances, feeds, live birds, transparencies and appropriate legends, prepared by the Division of Extension and Publicity, were erected at various shows, the Central Canada Exhibition, Ottawa, Canadian National Exhibition, Toronto, Royal Winter Fair, Toronto, Amherst, N.S., Winter Fair, and fairs at Quebec, Montreal, Sherbrooke and many other places throughout Canada. These exhibits are proving as interesting and instructive as ever, judging by the number of visitors attending the shows and numerous requests for literature. Demonstrations of caponizing, killing and plucking were also put on at various winter poultry shows.

A very attractive exhibit entirely devoted to turkeys was sent to all leading fairs and exhibitions on the prairies since turkey raising is becoming an industry of importance in that part of Canada. It was well received and was an excellent medium for supplying information to many prairie farmers.

CO-OPERATION WITH OTHER AGENCIES

HEALTH OF ANIMALS BRANCH

The poultry disease work that is being conducted in co-operation with the Health of Animals Branch is producing good results. Dr. C. H. Weaver, who is in charge of the work in this Division, is producing valuable material of great assistance to the poultrymen of Canada. It is hoped that in the near future additional pathologists will be available. This will no doubt make it possible to conduct needed investigations that up to the present have not been possible owing to the lack of pathologists and laboratory room.

CHEMICAL DIVISION

Considerable co-operative work has been conducted with the Chemistry Division in the analysis of feeds, tests of digestibility of feeds, etc. The Chemistry Division is always willing to co-operate in experiments that are of interest to the poultry work.

ILLUSTRATION STATIONS

As has been the case for several years, the poultry work at the Illustration Stations is assisted by this Division. Hatching eggs and breeding stock are supplied under certain conditions. The Poultry Inspectors from time to time visit the operators of the Illustration Stations in company with the Supervisors and meetings are arranged at many of the Stations.

PROVINCIAL DEPARTMENTS

The fullest co-operation with the poultry department of the provincial governments and the colleges is maintained. Assistance is secured from these, and this Division is always willing to assist them. The friendly attitude of all provincial authorities toward this Division is much appreciated and fully reciprocated.

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