DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

DIVISION OF POULTRY HUSBANDRY

PROGRESS REPORT

OF THE DOMINION POULTRY HUSBANDMAN

F. C. ELFORD

FOR THE YEARS 1934 TO 1936, INCLUSIVE

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PERSONNEL

POULTRY DIVISION

CENTRAL EXPERIMENTAL FARM

GEORGE ROBERTSON	Senior Agricultural Scientist.
A. G. TAYLOR	Poultry Husbandman.
H. S. GUTTERIDGE	Senior Assistant Agricultural Scientist.
S. S. MUNRO	Assistant Agricultural Scientist.
S. BIRD	Junior Agricultural Scientist.
J. L. ROY	Senior Agricultural Assistant.

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F. C. ELFORD

INTRODUCTION

The activities of the Poultry Division of the Central Experimental Farm during the years 1934, 1935 and 1936 are briefly reviewed in this report. Since a large part of the work carried out is of a technical nature much of the work reported in this publication has been published elsewhere in scientific journals. For the benefit of those who may be interested in the detail of such research projects, reprints of these papers are available from this division on request.

In addition to reports of research projects, the routine work of the division is reviewed. There is also included a report of the activities of the poultry pathological laboratory of the Health of Animals Branch located at this division.

The officers responsible for the different activities of the division reported herein are as follows:—George Robertson, Dr. A. Deakin and S. S. Munro for breeding and genetics; H. S. Gutteridge and S. Bird for nutritional and marketing work; A. G. Taylor for Egg Laying Contests and Registration and J. L. Roy for services to French speaking poultrymen. The work of the pathological laboratory is carried out by C. H. Weaver, A. B. Wickware and Dr. E. W. Bond.

BREEDS AND BREEDING

The poultry breeding work on the experimental farms may be divided into two broad phases: first, research and investigation, and second, the practice of breeding for improved productivity and type. The former may be subdivided into purely genetic studies designed to investigate the mode of transmission of economically important characteristics such as egg and meat production; into physiological genetics, which encompasses studies of a purely physiological nature on the processes of reproduction; and into developmental physiology or the manner in which the gene produces its end result, the character. The last mentioned involves the practice under field conditions of those methods which investigation has indicated as most likely to gain the desired end. The branch farms located in each province of the Dominion form a valuable network for the testing of methods under a variety of climatic conditions.

Incubation

Records of fertility and hatchability are kept for all farms and the accompanying table shows the results for the years 1934-36 inclusive.

TABLE I.—HATCHING SUMMARY OF EXPERIMENTAL FARMS 1934-36

—	Total eggs set	Per cent fertile	Per cent total eggs hatched	Per cent fertile eggs hatched
1934	79,213	82·5	49·5	60·0
1935	72,494	83·5	50·9	61·0
1936	82,030	82·6	53·1	64·3

It is clearly indicated by the above table that the quality of hatching results was well maintained. Since the numbers of eggs and of flocks is large, a fairly constant average of performance is registered from year to year.

Rearing

During the three years 1934, 1935 and 1936, 2,333, 2,444 and 4,215 chicks respectively were sent to the Poultry Division range or a total of 8,992. During the entire rearing period an average of six pounds of feed was required to produce one pound of gain. The mortality on range was low being 2·0 per cent, 2·2 per cent and 2·3 per cent for the three years respectively, up to three weeks of age. There occurred in mortality an aditional 5·8 per cent, 8·4 per cent and 6·5 per eent for the three years respectively, between three weeks of age and maturity making a total range mortality of 7·8 per cent, 10·6 per cent and 7·1 per cent respectively. Considering the large number of chicks involved and the numerous difficulties attendant upon such a rearing practice, this mortality rate reflects well upon the range rotation system used to combat disease.

PROJECTS IN BREEDING AND GENETICS

During the period covered by this report several studies have been carried out dealing with inheritance of various characteristics and in some instances papers have been published in scientific journals setting forth these findings. These will be reviewed briefly with particular reference to the practical applications of the findings.

Inheritance of Egg Production

The factors affecting egg production are still incompletely known and inadequately understood. Little knowledge or agreement exists even on such a fundamentally important point as the comparative effects of environment and heredity. This problem is one of the most important from a practical as well as a purely scientific standpoint and with the aid of newly acquired technical assistance in the form of personnel and equipment, a comprehensive study of the whole problem was begun. In attacking the problem the existing knowledge as to the manner in which complex characters such as egg production are inherited was thoroughly analysed; the results of the analysis indicating not only that inheritance played a smaller part than environment in the determination of individual and familial variability but that the increases which have occurred in mean yearly egg production during the past two decades must largely be due to improvements in feeds and management.

The conclusions thus drawn from the application of known principles of inheritance to the actual problem were further supplemented by a detailed analysis of pedigree records from experimental farm flocks and egg laying contests which completely verified the conclusions previously reached. It was shown that in the great majority of cases no difference could be demonstrated between the transmitting ability of different dams; the variability in production between full sisters being as great as between half sisters out of the same sire. The very slight difference which occasionally was found between the progeny of different dams was not sufficiently great to be of practical use in selective breeding.

The question of variability between sires was then investigated and it was found that the situation here was similar to that previously found in dams. However, the fact that a sire produces a relatively large daughter group out of several dams in a single season makes the possibility of measuring his transmitting ability much more practical than in the case of the dam. From the data collected, the average variability between different locations or farms as well as

between and within families was calculated and from this an appropriate formula devised to determine the variability. In practice, adjustments are made in the case of each individual male for the actual number of daughters he has produced and the number of dams from which they come.

The applications of the statistical constants thus derived to the data accumulated from experimental farm flocks throughout Canada during the last three years has shown that sires which can be rated as definitely superior are extremely rare. Less than five per cent can be rated as superior to the average on the usual statistical odds basis of 19:1, while less than one per cent are outstanding.

This study has amply demonstrated the enormous difficulty of improving production through selective breeding. It must be concluded that nothing short of the most rigorous selection of proved sires will give definite progress. The fact that not more than 1 in 100 proves to be an outstanding sire makes an organized breeding policy designed to locate such sires and to properly utilize them for the purpose of establishing a permanently superior strain, not only desirable but necessary. It is clear that this fact must be recognized and that breeding policies in the future must be organized accordingly.

The conclusions drawn concerning the relative effects of environment and heredity apply only to numbers of eggs and not to egg size. A study of factors affecting size of egg, organized and carried out on lines similar to that described above for egg numbers, showed clearly that egg size is controlled very largely by inheritance and that improvement in this trait can be readily accomplished by individual selection.

The results of this study may be summarized as follows:—

1. Differences between individuals and families in their egg producing abilities i.e., numbers of eggs, are mostly due to environmental rather than hereditable factors.

2. Increases which have occurred in production during the present century are largely the result of improvements in feed and management.

3. The production of a dam is such a poor indication of her transmitting ability that selection of individuals on the basis of their production and/or pedigree will result in little or no increase in the egg laying ability of future generations.

4. Although there appears to be no greater difference between sires than between dams in their ability to transmit production, the fact that the former produce a large daughter group from several dams in one season makes it possible to identify the superior ones with a reasonable degree of accuracy.

5. Tables showing the level of production which must be attained by the daughters of any given sire before he can be adjudged superior have been set up and in actual practice it is found that only five per cent are better than average in their transmitting ability and only one per cent or less are really outstanding.

6. It seems clearly indicated that a co-operative breeding project embracing a large number of flocks and consequently a large number of males, and organized and directed so that (1) the few really outstanding sires can be located and (2) they can be efficiently and effectively used at a central breeding station for the establishment of a foundation flock of permanent superior quality, must be the only practical way of making improvement in egg production through breeding. Eventually stock from this central station can replace that at the contributing and supporting farms. Any less rigorous method of selection does not seem likely to result in appreciable progress.

7. Egg size is largely influenced by inheritance and standard size or better can be attained and maintained by the more commonly practised and uninvolved methods of breeding.

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Published Papers

INHERITANCE OF EGG PRODUCTION IN THE DOMESTIC FOWL

I. General Considerations. Scientific Agric. 16:11 July 1936.
II. Increases in Production, Their Extent and Characteristics with a Discussion of Causal Factors. Scientific Agric. 17:6 Feb. 1937.
III. Differences in Transmitting Ability of Dams and Degree of Dam-daughter Correlation. Scientific Agric. 17:6 Feb. 1937.
IV. Reliability of Progeny Tests of Sires. Scientific Agric. 17:6 Feb. 1937.

Body Weights and Egg Weights

For experimental purposes, monthly body weights of the pullet flock during the pullet laying year as well as egg weights were kept. The body weights of pullets gradually increased from the commencement of laying, reaching their peak during the spring months, mostly in March or April (for April hatched chicks), then declining somewhat until after the moult. In compiling the data obtained from Barred Rock pullets it was found that the average peak weight was 6·7 pounds while the average annual monthly weight was 5·95 pounds or ¾ pound lighter. The average January weight was 6·22 pounds, approximately ¼ pound heavier than the average annual monthly weight of the pullet laying year and ½ pound lighter than the average peak body weight of pullets. Correlation coefficients between the various body weights are given in table II. As might be expected the correlation is very high between peak and mean body weights.

TABLE II.—CORRELATION COEFFICIENTS OF BODY WEIGHT AND EGG WEIGHT

—	No. birds	Correlation*
Mean and peak body weights	147	+·913±·009
Mean and January body weights	147	+·772±·022
Peak body weight and egg weight	147	+·453±·044
Mean body weight and egg weight	147	+·561±·038
January body weight and egg weight	147	+·391±·047
November body weight and egg weight	147	+·367±·048
Peak body weight and egg weight	791	+·434±·036

*Perfect correlation=1·00.

For the commercial breeder who wishes to weigh his pullets only once, January would be a good month, remembering that the weights obtained would be on an average ¼ pound heavier than the average for the pullet laying year.

It is generally recognized that the heaviest birds tend to lay the largest eggs. This general rule only holds for birds within a breed and not between breeds. For example, Leghorns lay eggs as large or larger than some breeds that have twice their body weight. The correlation between mean body weight and egg weight is significant, though not high, as can be seen in table II.

In table III a more detailed tabulation of the data on body and egg weights is given for 791 Barred Rocks using peak body weights and average egg weights from February to September of the pullet year. It can be noted by general inspection of the table that there is a tendency for egg weights to increase on an average with an increase in body weight. There is a good deal of variation, however, some light birds laying large eggs and vice versa, which indicates that a larger egg and comparatively light body weight strain could be selected by careful breeding. The extreme body weights given are from 4·9 pounds to 8·8 pounds, or approximately 4 pounds difference while the egg weight ranges from 48 to 72 grams, or 6/7 of an ounce difference, thus giving approximately 1/6 of an ounce increase in egg weight to every one pound increase in body weight. It can be noted that the 7·0 pound body weight class contains some birds of every

egg weight class with one exception. The optimum peak body weight in this group from the standpoint of standard egg size is 6·7 pounds. These birds average slightly over standard sized eggs (2 ounce eggs = 56·7 gms.).

TABLE III.—SCATTERGRAM OF 791 BARRED PLYMOUTH ROCK PEAK BODY WEIGHT AND EGG WEIGHT RECORDS

Egg Weight—grams														
72	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....
69	.....	.....	.....	.....	.....	.....	.....	2	1	4	1	.....	.....	.....
66	.....	.....	1	2	1	3	8	7	5	3	6	6	2	.....
63	.....	1	3	4	3	6	10	11	12	12	6	8	5	3
60	1	4	4	7	16	13	22	19	17	20	13	5	1	2
57	2	5	11	13	32	22	36	34	18	13	6	5	3	.....
54	5	5	9	24	39	24	33	21	11	17	2	1	.....	.....
51	3	5	10	18	20	13	8	4	2	2	.....	.....	.....	.....
48	.....	4	5	4	11	5	2	3	.....	.....	.....	.....	.....	.....
Body weight —pounds	4·9	5·2	5·5	5·8	6·1	6·4	6·7	7·0	7·3	7·6	7·9	8·2	8·5	8·8

There is a relationship, of course, between the size and number of eggs. Generally speaking the comparatively early maturing pullets lay the most eggs but the best layers tend to lay the smallest eggs and are usually a little smaller in size. In selecting breeders, body weight and egg weight as well as egg numbers should be given consideration.

Comparative Efficiency of Pure and Cross-bred Lines

It is generally recognized that cross-bred pullets because of hybrid vigour are on the average better layers than are those of pure-bred parent strains. An experiment was conducted at the Experimental Farm, Ottawa, to see by how much the cross-breds were superior to pure-breds in egg production, egg size and mortality. Consequently two pens of pure Rocks and two pens of Leghorns were made up. One pen each of Rocks and Leghorns were pure-bred for the first half of the season and for the second half the males were exchanged thus getting both pure-breds and cross-breds from the same hens. The other two pens were cross-bred the first half of the season and pure-bred the last half by similarly exchanging males. In the fall the same number of cross-bred and pure-bred pullets from each hen were selected. Thus all the pure-bred pullets, both Rocks and Leghorns, had some half sister cross-breeds. Any difference between the two groups in egg production, therefore, would be largely due to crossing and not to the superiority of the parents of any one group.

TABLE IV.—EGG PRODUCTION OF ROCK, LEGHORN AND CROSS-BRED PULLETS ARRANGED ACCORDING TO SIRE

Sire No.	Breeding	No. Birds	Average date hatch	Days to first egg	Egg No. to Oct. 17	Egg weight oz. per dozen
Rock 700	Pure	17	April 24	214	151·8	24·7
Rock 700	Cross	10	May 11	221	154·3	25·2
Leghorn 602	Pure	6	April 21	185	154·0	25·0
Leghorn 602	Cross	15	May 15	194	192·3	26·2
Rock 701	Pure	3	May 16	198	158·0	23·8
Rock 701	Cross	18	April 24	193	185·4	25·2
Leghorn 601	Pure	6	May 14	226	138·4	24·6
Leghorn 601	Cross	15	May 3	203	195·2	23·9

TABLE V.—AVERAGE CALCULATED YEARLY PRODUCTION OF ROCK, LEGHORN AND CROSS-BRED PULLETS STANDARDIZED TO 200 DAYS TO MATURITY AND 2 OUNCE EGG WEIGHT

Sire	Breeding	No. birds	No. omitted	No. of 2 oz. eggs	Days from hatch to Oct. 17—200	Yearly rate	Average peak body weight lb.
Rock	Pure	20	2	156·4	338	169	6·7
Rock	Cross	28	0	183·1	335	200	5·7
Leghorn	Pure	20	7	147·1	328	164	4·4
Leghorn	Cross	24	1	204·1	324	230	5·5

The pullets were kept until October 17 of the pullet year and had laid for an average of about 11 months. The average records are given in table IV and arranged according to sire. The Rock male No. 700 was exchanged with the Leghorn male No. 602 and the 701 Rock male exchanged with the No. 601 Leghorn male. The males gave different fertility, thus the Rock male No. 701 had only three pure-bred daughters, due to sickness during the breeding season. On the other hand this male has 18 cross-breds. It can be noted in table IV that the egg weight is slightly heavier for the cross-bred in three of the groups and slightly lighter in the other. Since the cross-breds and pure-breds have different dates of hatch, the difference in egg production cannot be compared in this table. Hence in table V the two Rock groups, the two Leghorn groups and the two cross-bred groups have been averaged and the egg production standardized to a two-ounce egg weight and a yearly average. In arriving at the yearly average it was decided to also standardize the days to maturity. Thus the number of days from hatching to October 17 was obtained and 200 days subtracted to allow for days to maturity, and the remainder of days used to calculate the yearly average.

From the data in table V it can be noted that the number of birds in each group is small, ranging from 20 to 28. The few omitted were birds that laid under 60 eggs. The percentage of mortality was rather high but comparatively uniform for each group.

The yearly egg rate shows considerable difference. The two pure-bred groups are nearly the same, namely, 169 for the Rocks and 164 for the Leghorns. The cross-breds, resulting from a Rock male and Leghorn females have a yearly rate of 200 eggs, while the reverse cross, Leghorn male and Rock female have a yearly rate of 230 eggs. There is thus a difference of 66 eggs between the pure Leghorns and cross-breds. The average body weight of the cross-breds is seen to be just about intermediate between that of their parents. The crosses from the Rock male are slightly heavier than from the Leghorn male.

In considering the greater production of the cross-breds, presumably due to the hybrid vigour, it should be pointed out that such differences in production will not always be expected. Many strains of Leghorns or Barred Rocks, for example, when crossed do not exhibit as great a degree of hybrid vigour as herein reported and this should be clearly understood in considering such crosses.

Yellow-head Characteristics

In 1932 two Barred Rock pullets were noticed in the farm flock that had pronounced yellow coloured head furnishings, including the face, comb and wattles. Since that time several other birds possessing this trait have appeared in the farm flock. Subsequent breeding tests from these pullets showed the characteristic to be an inherited trait, and inherited as a simple autosomal recessive. Linkage tests revealed that this characteristic is not linked with either dominant white plumage or the yellow skin factors.

The yellow-head characteristic, however, is dependent for its expression upon the yellow skin factors, the yellow-head factor thus being a recessive extension factor of the yellow-skin pigment. The yellow-head factors were found also to affect the vascularization of head furnishings, causing pale coloured heads. Further details will be found by consulting the following references:—

(1) The inheritance of yellow-pigmented heads in domestic fowl. American Naturalist, Vol. 59, p. 378-380.
(2) Linkage tests with the yellow-head and dominant-white plumage and white skin characteristics in domestic fowl. Scientific Agriculture, Vol. 17, p. 451-452.

Studies in Fertility

The factors causing variability between the fertilizing power of individual males and laboratory methods of detecting such differences prior to the breeding season are being studied. This research has been of a fundamental and highly technical nature, the methods used and results obtained to date being given in detail in the publications listed below. Only short statements on the various phases of this work will be made here.

LABORATORY METHODS OF DETERMINING THE FERTILIZING POWER OF INDIVIDUAL MALES

Recent discoveries concerning the innervation of the organs of reproduction in the fowl have made possible and relatively simple the collection of samples of semen for laboratory studies. Microscopical examination of samples from a large number of males shows that approximately one male in twenty can be distinguished as sterile or highly infertile. Of the remainder, which appear in laboratory studies to possess equivalent fertilizing potentialities, considerable variability in actual fertility exists. The studies are being continued and efforts made to develop finer laboratory methods of distinguishing between good and poor males.

BIOLOGY OF SPERMATOZOA IN THE REPRODUCTIVE TRACT OF THE MALE

Tests involving artificial insemination have shown that spermatozoa immediately after formation, i.e., morphological maturity, within the testes of the males, are incapable of accomplishing fertility. Fertility power is attained during their passage outward through the epididymis and vas deferens. By the time they reach the distal end of the excurrent ducts, they have acquired their functional potentialities. The nature of this physiological maturity is not clear. Two possibilities exist, (1) aging of the protoplasm within the sperm head may, in itself, bring about certain physico-chemical alterations which are correlated with the attainment of fertilizing power or (2) secretions from the walls of the excurrent passages may coat the sperm with a protective colloidal covering which armours it against debilitating conditions or agencies encountered within the female tract.

It has been found, further, that the maximum life of sperm when held within the male tract is between 30 and 35 days, but this is not dependent, as in the case of mammals, upon the presence of the testis hormone.

BIOLOGY OF SPERM WITHIN THE REPRODUCTIVE TRACT OF THE FEMALE

It is a well known fact that fertility in the female fowl will persist for as long as one month after the male has been removed from the pen. Experiments have shown that this is due to the ability of the sperm to survive for that period of time in the oviduct rather than to preovulatory fertilization. This is unusual since, in the great majority of vertebrate forms, the sperm has a relatively short life in the female tract, usually a few hours or a day or two at the most. Research

into the nature of the conditions encountered by the sperm within the uterus and oviduct of the female has resulted in the discovery of an elaborate natural mechanism designed, in certain parts of the tract to stimulate sperm motility and in others to immobilize the sperms and conserve their vitality. The nature of the immobilizing mechanism is not clearly understood but depends on a complicated interaction between temperature and the nature and relative acidity of the female secretions.

ARTIFICIAL INSEMINATION

For some years an officer of this division has utilized artificial insemination as a technique for the investigation of certain problems connected with the study of reproduction and in particular sperm physiology. While the work has not been directed towards a probing of the practical possibilities of artificial fertilization, the results secured have, nevertheless, resulted in first hand information in this connection. It can now be confidently stated that artificial insemination can be practiced with results equal to those which may be secured naturally. However, due to the very small volume of semen which can be obtained from a male bird in a given time limit, the number of females which can be kept continuously fertile by this method is not much greater than that which follows natural pen mating. However, in special circumstances such as hatching from females in laying batteries or the securing of fertility in an individual female which refuses to mate, the method is very useful.

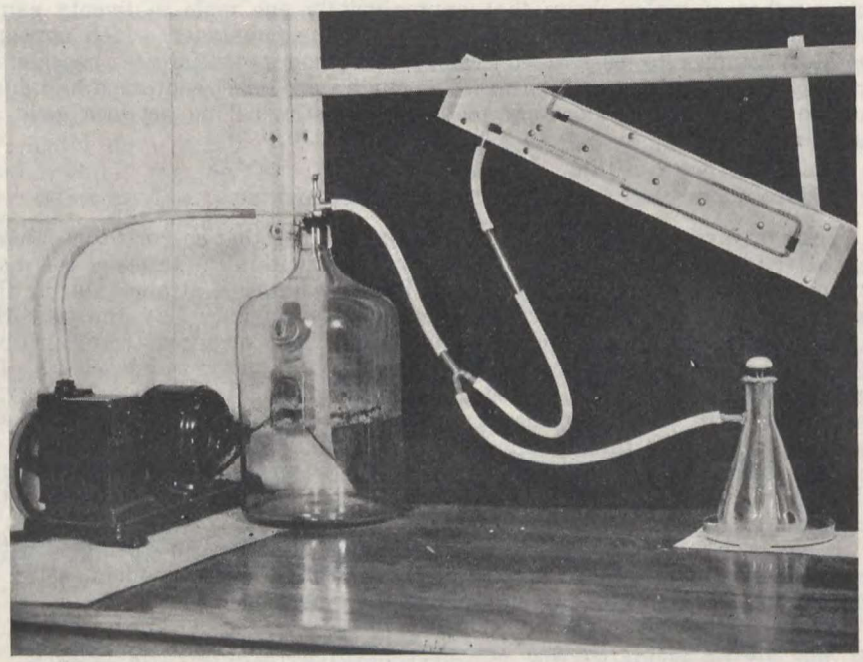

FIG. 1.—Apparatus used to determine the breaking strength of yolk membrane in egg quality studies. The partial vacuum created in the large bottle by the electric pump produces equal suction power upon the mercury column in the "U" tube and upon the yolk through the aperture of the cork in the florence flask. The pressure required to break the membrane is read from the scale in the mercury tube at the instant of rupture of the yolk.

Publications

The effect of testis hormone on the preservation of sperm life in the vas deferens of the fowl. Journal Experimental Biology. Vol. 15, 186-196, 1938.

Fowl sperm immobilization by a temperature-media interaction and its biological significance. Quarterly Journal Experimental Physiology. Vol. 27, 281-291, 1938.

Functional changes in fowl sperm during their passage through the excurrent ducts of the male. Journal Experimental Zoology. Vol. 79, 71-92, 1938.

The Influence of Heredity on Egg Quality

Beginning in 1934, a project designed to measure the effect of heredity on egg quality was carried out. The original phase of this study was completed and a technical communication published as designated below. Very briefly it may be said that of the seven egg-quality charteristics investigated viz., per cent thick white, upstanding quality of white, yolk size, yolk colour, breaking strength of yolk membrane, per cent ash of shell, and per cent ash of total egg, only the last two showed definite family trends. While very slight indications of the effect of heredity were observed in one or two other traits, this was not sufficiently pronounced to indicate that selective breeding as a means for improving egg quality would be practicable.

The effect of heredity on the shell, however, was so pronounced that it seems certain that efficiency of calcium utilization depends to a considerable extent on heredity. A more comprehensive experiment designed to determine the stage in calcium metabolism at which the genes come into play is under consideration.

Publication

The effect of heredity on interior egg quality and shell composition. Poultry Science, XVII, 1,17, 1938.

The Relation of Production to Mortality

It has been considered in many quarters that the strain of heavy egg production makes birds more susceptible to various diseases and physiological upsets, thus bringing about a higher mortality. For example, it had been shown previously that a greater number of deaths occur during the period of high production in the spring thus strengthening the belief that the rate of production brought about an increase in mortality. It is obvious, however, that the factors which affect seasonal production might also affect mortality, without production and mortality themselves being causally related. If, therefore, mortality were shown to be greater in birds which produce at a faster rate than average, it might be concluded that the rate of production was indeed the cause of the high mortality, whereas if the heavier laying birds die less often than their lower producing pen mates, then it must be concluded that high production is itself a sign of health and stamina.

In order to determine this point, the information already published upon this subject was critically reviewed and supplemented with extensive analysis of egg laying contest data from records of the division. This analysis brought out the following facts:—

(1) The majority of deaths occurred in the lower producing pens and within the individual pen the mortality among birds laying at a high rate was less than that occurring among the lower producing birds. It is apparent therefore that the factors such as feeding, breeding, housing, etc. which bring about high production are more apt to lower the mortality rate than otherwise.

(2) Although there is a tendency for the rate of production to parallel the rate of mortality from season to season within the year, the two rates are, in reality independent and therefore the high mortality which occurs during the season of high production is not caused by that production.

(3) No evidence has been secured through this study to indicate that " the strain of heavy production" shortens the life of the pullet, the contrary seeming to be the case and it therefore appears that the practices which contribute toward increased production, in the aggregate at least, contribute also toward health and lowered mortality.

Publication

The relation of production to mortality in the domestic fowl. Journal Agricultural Science, 26:101-113, 1936.

The Effect of Tilting Eggs on Hatchability

An experiment was planned during the hatching season of 1935 to determine the effect of the position or tilting of eggs in the incubator on hatchability. Eggs are usually stood on their narrow end when being packed into the incubator in order to conserve space. This position is also beneficial from the standpoint of hatchability as found by experiment. The experiment was designed so that the eggs from one half of the breeding pens were tilted or stood on the narrow ends and the other half were laid on their side or natural resting position. To eliminate the chance of pens with naturally poor hatchability affecting the results, eggs that were tilted for one hatch were laid on their side for the next, and vice versa. The total number of eggs set was 4,282, about half of which were tilted. The result was five per cent better hatch for eggs tilted or stood on their ends compared with those laid in their natural resting position.

The Effect of X-rays on Male Birds

A study of the possibility of caponizing by use of X-rays, begun in 1933, was completed during the period of this report. In a previous report it was indicated that, as anticipated, caponizing by this means proved to be entirely impracticable. Even when partial or complete sterility was attained, secondary sex characters including stagginess of flesh remained unaffected.

PHYSIOLOGY AND NUTRITION DURING BROODING PERIOD

Toxic Properties of Some Cod Liver Oils

For some years past cod liver oil has been fed as a source of vitamins for poultry. As is the case with all feeds, a great variation in the quality of the oil sold for this purpose exists both with regard to vitamin content, and chemical and physical constitution. In so far as vitamin content is concerned a biological test carried out with chickens will definitely assay the vitamin potency of any oil. As to chemical constitution, the differences existing between oils are slight with the exception of free fatty acids which commonly vary from almost nil to 30 per cent or more. Physical characteristics of concern to users of oils are mainly matters of colour, odour and amount of suspended material usually originating from the livers from which the oil is made. Since from the standpoint of physical characteristics some oils are extremely objectionable, so much so, in fact, that many inquiries are received as to whether they are fit for feeding or otherwise, it was considered to be worth while to investigate the possibility of injurious effects from oils of apparently objectionable qualities. A review of work by previous investigators brought to light the fact that certain oils, mainly prepared by the sun-rendering process and high in fatty acids had shown definitely toxic qualities when fed to chicks and rats. In one instance with chicks very high mortality and irregularity of development was brought about by the feeding of such oils. It was also found that certain products, resulting from protein decomposition were found in some cod liver oils which when injected into sparrows in minute amounts were very pois-

onous. These products being readily formed during the decomposition of liver, it was concluded that they might be expected to be present in the sun-rendered oils during the manufacture of which the livers are allowed to decompose. It was also determined that oils made by such a process are almost invariably high in free fatty acids although all oils high in free fatty acids are not necessarily sun-rendered oils. Previous published research by other investigators had indicated certain high free fatty acid oils to be definitely toxic to chicks. A series of oils was therefore analyzed for the presence of presumed toxic products of decomposition and for free fatty acids. This analysis bore out the suggestion that high free fatty acidity and content of toxic products were likely to be found in the same oil. It was concluded therefore that the toxic effect of high free fatty acid oils upon chicks might well be due to these products rather than to their high free fatty acidity to which it had previously been ascribed.

The effect of these decomposition products on growth, uniformity, egg production and mortality of chickens was therefore determined by feeding a high free fatty acid sun-rendered oil to two groups of 280 chicks from which at nine weeks of age two groups of 90 pullets were selected and carried to maturity and through one year of production. Each of the two groups was given identical feeding and treatment except that the fraction of the oil containing the presumably toxic products was removed from the oil of one group by a chemical process which was shown by a vitamin test not to decrease the vitamin value of the oil. The oil comprised one per cent of the total ration in each instance. From this experiment the following results were obtained:—

All oils used were found to contain measurable quantities of the toxic products and certain sun-rendered oils were relatively high in these impurities. Although it is not necessarily always the case, in most instances oils high in free fatty acids were also high in toxic products. A high free fatty acid oil is therefore undesirable.

The removal of these toxic products from oils increased the growth, uniformity and egg production, of chickens to which the oils were fed. While in these experiments the detrimental effect was not great, it was very definite and particularly so with cockerels. There are in the literature cases cited where oils of this nature were much more detrimental (seriously so) to chickens than was the case in this instance although the free fatty acidity of such oils was considered to be the detrimental factor rather than the products of decomposition under consideration.

It is obvious therefore that sun-rendered oils or oils produced under unhygienic conditions such as from stale livers should not be used for poultry feeding. Since high free fatty acidity in oils is indicative of unhygienic conditions of manufacture and is very often accompanied by the presence of poisonous materals, oils high in free fatty acids should not be used. Oils very low in free fatty acids (less than one per cent) are readily procurable at reasonable prices.

Publication

The effect of feeding deaminized vs. untreated cod liver oil, on growth, egg production and mortality of poultry. Pub. 475. Technical Bulletin No. 1, Department of Agriculture, Ottawa.

The Effect of Different Light Rays Upon the Incidence of Slip Tendon

Slip tendon is a nutritional disorder of chicks raised in confinement in which one or both of the hock joints are affected to such an extent that the lower leg turns out at almost right angles to the thigh with accompanying swelling of the joints. Since light rays of different qualities have been shown to affect body processes very greatly through the regulation of hormone secre-

tion, it was though that the greater or lesser lack of light under most conditions of confinement brooding might be responsible for the physiological upset of which slip tendon might be a sympton. In view of the increasing importance of confinement brooding, particularly where disease is apt to be present in the growing stock, it was felt that this possibility should be investigated.

A carefully controlled experiment carried out with young chicks, in which light rays of different lengths were used, indicated that the different rays apparently exerted no effect upon the influence of this condition. It is of interest to state that investigators in the United States have recently shown this condition to be caused largely by a lack of the mineral manganese in the ration. Substances which contain manganese in reasonable quantities and which prevent slip tendon are rice bran and wheat shorts. Manganese sulphate at the rate of one-tenth pound per ton of feed also prevents the condition.

Methods and Rations for Finishing Poultry for Market

Apart from certain diseases, the depredations of which are ruinous to the production of quality market stock, the factor of most importance in production of quality is feeding. In feeding, the period of greatest improvement is that period just before marketing when proper fattening treatment can produce a carcass of extremely high finish and which will be graded well up in the market grades, thus bringing a higher price per pound. In view of the importance of this finishing period a series of projects was inaugurated to determine the most satisfactory feeds and treatments for fattening purposes.

The procedure in all tests was to select semi-mature cockerels, discarding all which might be low in vigour, and to confine them to fattening crates. The birds were starved for 24 hours with water to drink. Epsom salts were mixed with the mash of the first feeding at the end of that time at the rate of one pound per 100 birds. Granite grit was also supplied at that time. Two feedings were given daily in troughs using sour skim-milk as the mixing material. All unused feed was removed at the end of one-half hour.

The first experiment was carried out on White Leghorn capons, 28 to each group, the following treatments being given:—

Group A.—Dry mash and skim-milk before the birds at all times.

Group B.—Wet mash composed of two parts of skim-milk to one part of mash—pen fed.

Group C.—Ground raw potatoes in wet mash, equal parts of potatoes and mash by weight, mixed with one part of skim-milk to one part of the mash potato mixture.

Group D.—Restricted feeding—wet mash composed of two parts of skim-milk to one part of mash.

Group E.—Control—wet mash composed of two parts of skim-milk to one part of mash.

The following table indicates the results obtained.

TABLE VI.—ACTUAL WEIGHT GAIN, ADJUSTED WEIGHT GAIN AND CONSUMPT ION OF DRY MATTER FOR ALL GROUPS

Group	Actual Gain	Adjusted Gain	Consumption dry matter
	gms.	gms.	gms.
A.—Dry mash + milk	315·2	335·5	2872·9
B.—Pen fed, wet mash	300·4	.....	2699·1
C.—Raw potatoes + mash	391·5	403·5	2903·6
D.—Restricted feeding	445·7	439·8	2976·1
E.—Wet mash (Control)	452·6	428·9	3070·1

It should be pointed out that the adjusted gains represent the gain made on the basis of birds having the same body weight and consuming the same amount of feed.

The results obtained, as indicated by the above table may be summarized as follows:—

The data presented indicate that the feeding of a wet mash of two parts of ground oats to one part ground barley, mixed with skim-milk at the rate of two parts of milk to one of mash, for one-half hour periods, twice daily, to Leghorn capons in fattening crates gave definitely superior weight gains to those obtained by the following treatments:—

1. The feeding of the same mash dry with milk to drink, both being continuously before the birds (24·4 per cent difference).

2. The feeding of the same mash mixed with two parts of skim-milk to one part of mash to capons in pens (40·4 per cent difference).

3. The feeding of a wet mash composed of equal parts of the same mash and chopped raw potatoes mixed with one part of milk to one part of mash (6·1 per cent difference).

A second series of tests was carried out using Barred Rock cockerels, 28 birds to the pen. These birds were accorded the general treatment previously mentioned for the White Leghorn capons. In addition they received the following experimental feeds or treatments:—

Group A.—Ground yellow corn mixed with skim-milk.
Group B.—Control—two parts of ground oats to one part of ground barley mixed with skim-milk.
Group C.—Cooked potatoes—one part of ground oats, ground barley mash as for pen B to one part of mashed potatoes mixed with skim-milk.
Group D.—Ground wheat mixed with skim-milk.
Group E.—Meat meal—ground oats, ground barley mixture as for pen B, plus 10 per cent of meat meal, mixed with skim-milk.

In addition to the differences in feeding practice one-half of each group was allowed only 15 minutes to consume their feed while the other half was allowed 30 minutes.

Where ground grains are indicated, the whole grain finely ground was used. In the case of the cooked potatoes, as little water as possible was added during cooking and they were steam cooked in a double boiler. Hence all added water was evaporated and nothing was drained off from the potatoes and discarded.

Table VII indicates the results obtained.

TABLE VII.—ACTUAL WEIGHT GAIN, ADJUSTED WEIGHT GAIN AND CONSUMPTION OF DRY MATTER FOR ALL GROUPS

Group	Actual gain	Adjusted gain	Consumption dry matter
	gms.	gms.	gms.
A.—Corn	311·4	378·8	2408·0
B.—Control—2 oats : 1 barley	266·6	246·8	2535·2
C.—Cooked potatoes	248·3	196·3	2575·0
D.—Wheat	321·1	319·0	2638·9
E.—2 oats : 1 barley + 10 per cent meat meal	289·4	296·7	2521·9
15 minutes feeding	281·1	293·1	2484·4
30 minutes feeding	293·2	282·4	2584·5

The results obtained as indicated by the above table may be summarized as follows:—

1. While corn and wheat gave similar increases in weight (actual gain) in fattening, judged upon the basis of the efficiency with which these grains were used (adjusted gains) corn was decidedly superior (difference 17·1 per cent) to wheat as well as to all other feeds used in this test.

2. The use of a wet mash of two parts of ground oats to one part of ground barley mixed with skim-milk gave less satisfactory results than those obtained with the same ration supplemented with 10 per cent of meat meal (difference 18 per cent).

3. A mixture of equal parts of the above mash (2 oats : 1 barley) and cooked potatoes, the whole mixed with skim-milk, gave inferior results (difference 22·8 per cent).

4. A feeding period during fattening of 15 minutes duration was equally as efficient as one of 30 minutes (difference 3·7 per cent).

In addition to the routine fattening tests just reported, analyses of fattened birds were made to obtain information with regard to the manner of deposition of fat in the body. It was found that the degree of fatness at the completion of the fattening period was a poor indication of the fat gained, due apparently to the difference in amount of fat in different birds at the commencement of the fattening period. It was also found that the gain in body weight during fattening was a poor indication of the degree of fatness of any individual since many individuals gained heavily but possessed very little fat at the end of the test and vice versa. It was further determined that different cereals had no effect upon the distribution of the fat in the carcass, the ratio of fat in breast tissues to fat in skin and subcutaneous tissues to fat in abdominal tissues being practically constant upon the different cereals. In this connection it is interesting to note that while fat was deposited in large amounts in the skin and subcutaneous tissues and in the abdominal tissues, very little, if any, was deposited in the breast tissue itself. It would appear, therefore, that the fattening process consists largely of a laying down of fat abdominally, in and under the skin and between the muscles, and that the fat content of the breast tissue itself is not likely to be appreciably increased. It would seem also that since fat is laid down at relatively the same rate in the different areas, in order to have the desirable large amount of fat in and under the skin which is so essential for high quality, the fat in the abdomen must also be at a relatively high level.

A third experiment was then carried out with the Barred Rock cockerels, the general treatment being as before noted. The experimental feeds and treatments were as follows:—

Group A.—Ground yellow corn mixed with skim-milk plus 5 per cent of feeding molasses.

Group B.—Ground yellow corn mixed with skim-milk plus 5 per cent of ground oyster shell.

Group C.—Ground yellow corn mixed with skim-milk plus 5 per cent of mutton fat.

Group D.—(Control) Ground yellow corn mixed with skim-milk.

Molasses was used as a highly available source of sugar which might readily be transformed into fat and deposited in the body, ground oyster shell was added in the hope that it might stimulate feed consumption, and fat was used because of the belief that it is readily laid down as fat and because of the great hardness of mutton fat and its possible effect upon the texture of the fat of the chicken.

Table VIII indicates the results obtained.

TABLE VIII.—ACTUAL WEIGHT GAIN, ADJUSTED WEIGHT GAIN AND CONSUMPTION OF DRY MATTER FOR ALL GROUPS

Group	Actual gain	Adjusted gain	Consumption dry matter
Group A.—Ground yellow corn + 5 per cent molasses	439·1	395·3	299·7
Group B.—Ground yellow corn + 5 per cent ground oyster shell	472·3	410·3	314·7
Group C.—Ground yellow corn + 5 per cent mutton fat	516·7	567·7	294·3
Group D.—Ground yellow corn (Control)	425·0	416·5	285·1

It will be noted from the above that mutton fat was outstanding both as to actual gain and as to efficiency of the use of feed for gain (adjusted gain). Also that the ground oyster shell improved the gain over the control group but requiring a greater amount of feed, just equalled the efficiency of the control. Molasses, on the other hand did not significantly increase the gain although having a slightly higher feed consumption. It would seem therefore that the feeding of fat would be justified from the standpoint of gain and efficiency of use of feed, that the addition of ground oyster shell might be justified by the fact that it increases feed consumption and actual gain and that the feeding of molasses was of no value in this instance.

At the completion of the test the birds were graded by an inspector of the Poultry Services of the Live Stock Branch with the following results:—

Grade	Molasses	Ground oyster shell	Mutton fat	Control
	%	%	%	%
A	47·3	55·0	74·3	57·5
B	52·7	45·0	25·7	42·5

It will be seen immediately that mutton fat was responsible for a definite increase in quality of carcass From the economic standpoint a higher price is obtainable for this increase in quality, not only for the pound of weight added in fattening but for the whole seven pounds or whatever it may be, of the bird. Ground oyster shell had no effect upon the quality while molasses appeared to have an adverse effect if any.

In order to determine to what extent there was an actual increase in fat during the fattening period, samples of skin and subcutaneous fat were taken from the same birds before and after the fattening test. By analysis of these samples it was found that an increase of from 15 to 20 per cent of fat had occurred in this area during fattening. The actual percentages of fat adjusted to a basis of the same initial per cent of fat at the beginning of the test were—molasses 56·2 per cent, ground oyster shell 54·8 per cent, mutton fat 63·4 per cent and control 53·6 per cent. Thus a 14·5 per cent greater increase in fat was made with mutton fat than was made by the control pen to which fat had not been added.

Costs of Fattening for Market

In the last analyses, the cost of fattening for market must be lower than the increased price received for the additional weight put on and for the increase in grade (quality). Feed costs in fattening were calculated for the fattening tests just reviewed. The value allowed for the different feeds was:—Skim-milk 20 cents per cwt., corn meal $2 per cwt., molasses 1·4 cents per pound, mutton fat 5 cents per pound and ground oyster shell 80 cents per cwt. On the basis

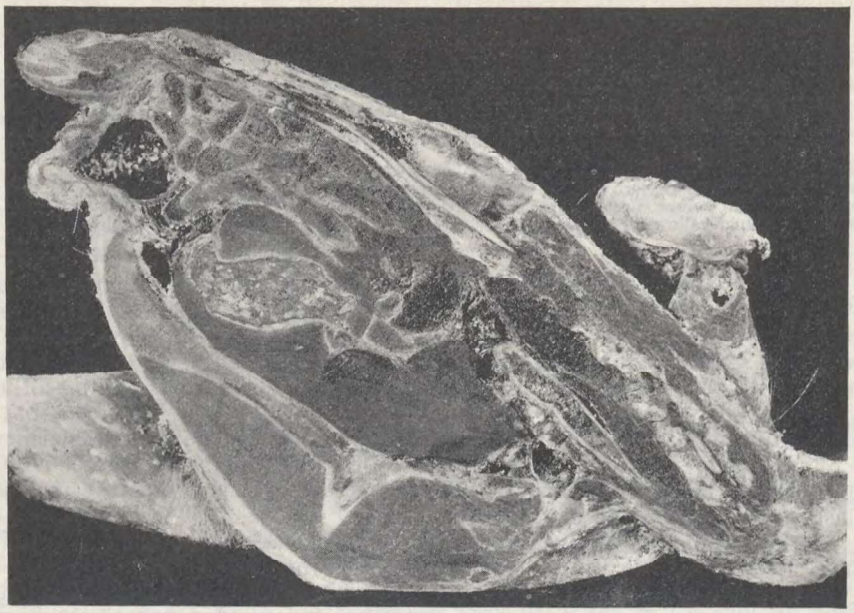

FIG. 2.—An average selected C cockerel showing an almost complete absence of fat.

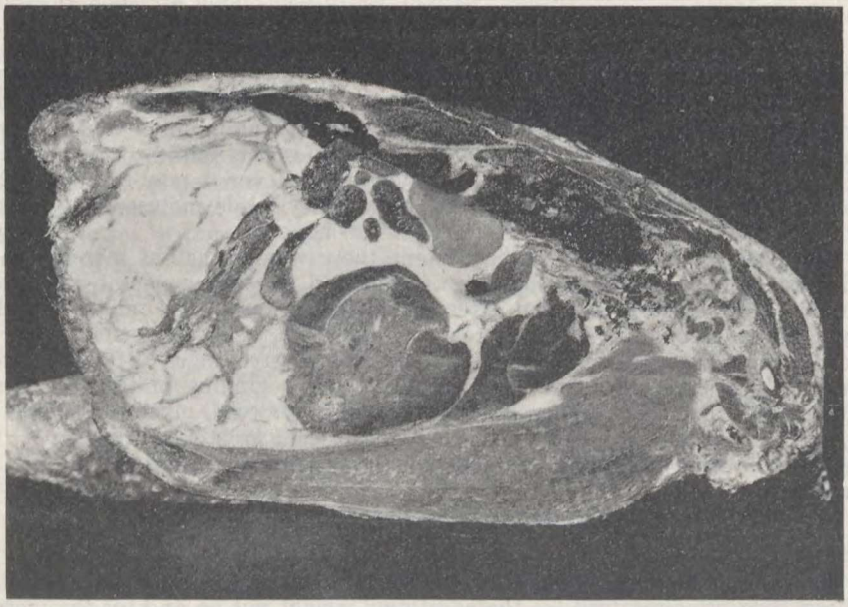

FIG. 3.—A typical "Milk-fed A" cockerel in longitudinal section showing the large deposits of fat (white areas) in the abdominal cavity and around the viscera. This bird was also well fatted in and under the skin making a very attractive appearance. Degrees of fatness intermediate between this bird and the selected C shown above are available in the B grades.

of these costs and of the gain in weight made, it cost per pound of gain during fattening 13·7 cents for the molasses ration, 12·8 cents for the ground oyster shell ration, 12·4 cents for the mutton fat ration and 13·2 cents for the control ration of corn meal and skim-milk alone. Since the fat was the most expensive supplement and the cost per pound gain was the lowest for this ration it is apparent that the amount of gain is the most important factor in determining costs in this instance. The greatest gain was for this group and was 567·7 gms. or 1¼ pounds per bird.

On the basis of the market grades, i.e., the percentage grading A and B, the average value per pound for each group was: molasses 20·0 cents; ground oyster shell 20·1 cents; mutton fat 20·5 cents; and control 20·2 cents. The values quoted are calculated on prevailing prices to producers at the time of the test or 21 cents per pound for Milk-fed A and 19 cents per pound for Milk-fed B. The feeding of fat therefore increased the price received by ⅓ cent per pound because of increased quality, increased the gain by 5½ ounces per bird over that of the control pen and accomplished this at a feed cost lower by ·8 cents for every pound of gain. It should be particularly noted that the fattening of these birds increased returns by 20·5 cents—12·4 cents or 8·1 cents per pound for 1¼ pound gain in fattening plus ⅓ cent per pound for each pound of the bird or approximately 2 cents per pound (7 pound birds) or a total of slightly over ten cents per bird. Information is not available regarding the increased returns through increase in quality over unfattened birds but it may safely be assumed that a large proportion of even unfattened cockerels would be classed as B grade. Hence, in allowing an additional 2 cents per bird or 12 cents all told, the possibility of increased returns over unfattened stock would be largely discounted. Whether 12 cents per bird profit to cover labour, equipment, overhead, etc., is sufficient to justify the fattening process, only the individual operator can decide in the light of his particular operating costs. The advantages such as a ready market or the working up of a special market because of the quality of product should also be considered in arriving at the value to the poultryman of the fattening process.

Publications

Methods and rations for fattening poultry. Scientific Agriculture, Volume 17, Number 6, February, 1937.

Methods and rations for fattening poultry. Scientific Agriculture, Volume 18, Number 4, December, 1937.

PHYSIOLOGY AND NUTRITION DURING PERIOD OF EGG PRODUCTION

Numerous experiments are carried out each year dealing with feeds or treatments which affect the production of eggs. The most outstanding of these will be briefly reviewed.

The Nature of Cannibalism

The term cannibalism as commonly used, refers to the very prevalent practice of pullets attacking each other and usually picking out the vent and in some cases partially consuming the victim. In some cases the losses through cannibalism reach very high proportions and the impression exists that it is usually the best birds which are cannibalized. A very common theory is that during the process of laying eggs upon the floor, the protruding flesh and membranes of the vent and oviduct become the target for watchful birds and that the habit of vent picking thus becomes established. In order to learn more about this condition, the records of the birds cannibalized upon the poultry plant over a period of years were analysed with the following results.

Over a nine-year period, 940 cases of cannibalism appeared out of 3,664 autopsies made or 12 per cent of all deaths in the flock. The first year of the nine had no deaths from cannibalism but increase was gradual until at the ninth year the figure had reached 25 per cent of all fatalities. On analysis of the egg production of the birds it was found that the average production of the birds which lived during the entire year was 44·4 per cent whereas that of the cannibalized birds up to the time of death was 26·4 per cent. It was further found that the production of the cannibalized birds was much lower during every month of the year. Since eggs laid upon the floor rather than in the trap nests could not be credited to the bird which laid them the monthly number of floor eggs laid was correlated to the monthly incidence of cannibalism. It was found that there was no direct relation between floor eggs and cannibalism, hence laying upon the floor must have contributed to cannibalism to a very limited degree, if at all. The possibility that prolapsus or eversion of the oviduct which sometimes occurs with laying, leaving the membrances exposed might be a cause of cannibalism, was found to be unlikely since no birds were cannibalized immediately after laying and only ten birds were cannibalized within a week of last laying. In any event, prolapsus would have to have been very widespread to account for even a portion of the violent deaths occurring.

Another very common belief with regard to cannibalism is that it is merely a vicious habit which presupposes that the attacking fowls were abnormal. As previously indicated however, the birds which were attacked were apparently the abnormal ones, many never having laid an egg, practically all out of production when killed, and those which did lay doing so at a very much lower rate than their pen mates which survived. It would appear therefore, that the abnormal birds and those unable to defend themselves were the ones which were killed in most instances. There is a very definite suggestion therefore, that the weaklings are being eliminated by a process of natural selection which goes on continuously in all species and is generally known as " the survival of the fittest." If this is the case as appears to be a fact from these data, it may be expected that where parasitism and such debilitating diseases are present in the flock, cannibalism may be high, the weaklings not being permitted to waste to death but being killed by their pen mates while in a weakened state. A healthy vigorous flock free from disease might therefore be the best possible insurance against cannabilism.

Laying Batteries—Feeding and Management

The use of laying batteries as a method of carrying birds through their pullet year has made considerable headway during the past few years. The laying battery consists of a battery of individual pens, approximately 12 inches by 16 inches, to which each bird is confined with access to its own feed and completely penned off from its neighbours. The advantages of this arrangement are several. Each bird has access only to its own feed and hence the competitive factor in feed consumption is eliminated. Thus a certain percentage of birds which in the ordinary laying house would be kept away from the troughs and might even be victims of cannibalism, are permitted to live a normal existence and to maintain body weight and produce eggs, which otherwise would not be the case. Also, the evils of feather pulling and cannibalism are non-existent and it is believed that certain diseases such as coccidiosis and worm infestation are made less serious, due to the fact that the birds are upon wire floors and not in contact with their droppings. Considerations of time and expense are also favourable to batteries of this type, since trap-nesting is obviously unnecessary and the eggs need only to be gathered daily. Feeding may be automatic as well as cleaning of the dropping pans, and, therefore, one man can look after many times the number of birds which he could take care of in the ordinary poultry

pen. At least double the number of birds can be carried in a house of the same size where batteries are used, although sufficient insulation and heating of the building are necessary, which factors cut down the saving attained under this head. The original cost of the battery equipment is also fairly high although a long time investment is represented.

Experimental work with laying batteries is being continued and it is hoped that additional data will be available in the near future to more accurately gauge the usefulness of this equipment. At time of writing, the battery caged birds have laid at a much higher rate than the control group of birds upon the floor in an ordinary laying house. This has been due in part to the fact that infectious bronchitis greatly reduced the production of both groups for a period although the caged birds recovered and came back into production much more quickly than did those in the pen. Mortality has been much lower in the batteries to date. The percentage of cracked eggs has been considerably higher in the laying battery. This of course constitutes an economic loss and may possibly be overcome to some extent by improvement in the type of floor of the cages. As previously stated it is hoped that a more comprehensive report upon the merits of laying batteries can be made in the near future.

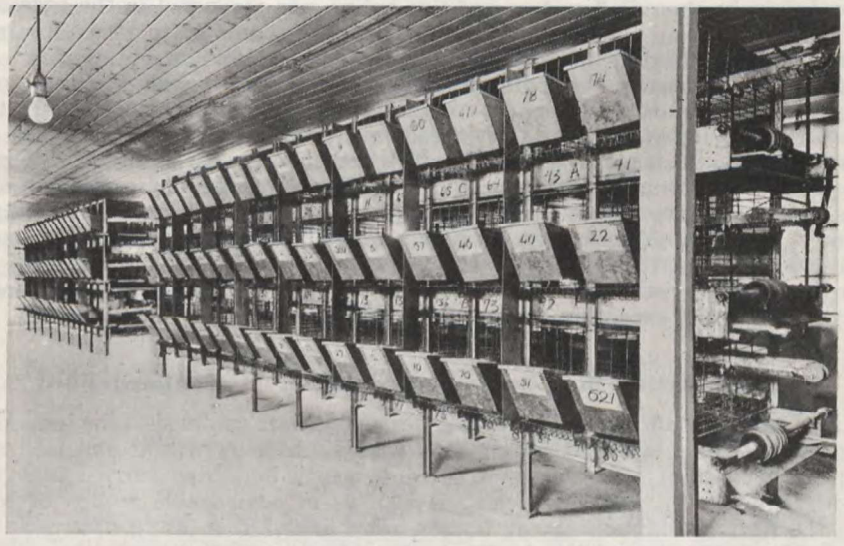

FIG. 4.—Two laying battery sections, each accommodating 96 pullets. The mash hoppers indicated were specially constructed and accommodate mash for one week's feeding thus making possible measurement of feed consumption for each individual bird.

The Value of Supplementary Iodine for Egg Production

The fact that the iodine requirement of humans is relatively high and that the absence of this mineral causes very serious physiological troubles such as goitre in many species of farm animals as well as humans, has created the impression that a supplementary supply of iodine might be essential to sustained egg production and health in poultry. Since this farm is situated in a low iodine area it was thought that a test of the value of this supplement might be in order.

Two groups of 45 and 49 Barred Rock pullets were housed in pens side by side in the same house for this test. The groups were as equally balanced as possible, having full sisters divided between the two pens. Both groups were identical in treatment excepting that one group received supplementary iodine.

The iodine used was a commercial preparation 1·34 gms. of which was placed in an enamelled drinking vessel in sufficient water to last the birds approximately two hours so as to ensure that all the iodine was consumed. After one month of this treatment the iodine was increased to 13 gms. daily which amount they received until the completion of the test three months later. The dosages quoted represent actually 0·001523 gms. and 0·014444 gms. of iodine per bird per day. Since the dosage remained constant the mortality which occurred in the pen slightly increased the consumption per bird each month to a maximum of 0·018571 gms. per day. In order that the response to iodine feeding if any, could be measured, records were kept on the birds for 28 days prior to the commencement of iodine feeding. Analyses of eggs from both pens for iodine content were also made prior to feeding of the supplement and also at the close of the feeding period.

The data obtained indicated that the feeding of iodine at the dosages mentioned had no significant measurable effect upon the number of eggs laid, the egg weight or the body weight of the birds. The analyses of the eggs laid for content of iodine indicated the feeding of iodine to have increased the iodine content of the eggs by approximately 4,000 per cent. This fact has long been recognized as a definite effect of iodine feeding. On the basis of the amount of iodine fed, only about 1·7 per cent of this iodine was recovered in the eggs laid.

It would appear, therefore, that under conditions similar to those obtaining in this test, the feeding of iodine would not be justified excepting from the standpoint of increasing the iodine content of the eggs. It would appear to be likely that the failure to respond to iodine treatment was due to the fact that the average laying ration contains ingredients from a great many sources and grown on soils which may be well supplied with iodine. In addition, fish meal and cod liver oil form a part of most rations for egg production and contain an appreciable quantity of iodine. Under the circumstances therefore, supplementary iodine would represent a surplus which is largely eliminated, a small portion being stored in the egg. In goitrous areas where all or most of the ingredients of the ration are of local origin, the need for iodine may not necessarily be supplied excepting where supplementary iodine is fed.

Egg Production and Reproductive Ability in Confined Fowl

By "closely confined fowl" is meant birds which are confined to the individual compartments of a laying battery. The production, body weight and feed consumption records of several groups of birds which had been carried in laying batteries during the past few years, as well as of comparable groups of birds upon the floor of ordinary laying houses, were analysed so as to determine the comparative efficiency of the laying battery birds and the limitations of the system from a nutritional standpoint particularly. The following information was obtained.

Four groups of caged birds had an average production of 58·0, 47·4, 61·8 and 59·0 per cent. Two groups of comparable birds on the floor of laying houses had an average production of 54·3 and 62·4 per cent. It would appear therefore that from this standpoint there is little to choose between the two methods of handling. However, the variability in production, that is the extent to which individuals varied, on the average, from the average production was 12·4, 26·5, 14·8 and 19·3 per cent for the caged birds as against 26·9 and 20 per cent for those upon the floor. It would appear therefore that under caged conditions, more uniform production from bird to bird may be obtained. Examination of the level of production of the individual birds indicated this to be the case, there being fewer really high producers in the cages and also fewer low producers, the latter no doubt brought about because of the fact that the poorer birds had a feed supply always available to them, thus not having to

compete for their feed, and the former due to some unascertained influence exerted by the caged condition.

With regard to reproductive ability, it was found that when mated to males which also had been caged, fertility and hatchability were low. When the caged females were artificially inseminated, however, that is to say live sperm from non-caged males injected into the oviduct, approximately normal fertility and hatchability was experienced indicating that reproduction may be approximately normal with caged birds. Whether the poor fertility and hatchability in the first instance using caged males was due to the caging of the males rather than of the females, was not ascertained. Several months after removal of the females from the cages at the end of the laying year, normal fertility and hatchability was obtained by actual mating with uncaged males, showing that the breeding ability of the caged females was not permanently impaired by the caging treatment.

On analysis of the oyster shell consumption, it was found that caged birds given free access to oyster shell consumed an entirely inadequate amount of shell to provide for the amount actually laid out of the body as egg shell and that eliminated with the droppings. The additional calcium required was therefore withdrawn from the body storage and it was found that so much calcium had been removed from the bones that when the flesh was cooked from the bones they were very soft and easily crumbled. Since it has been shown that low calcium (oyster shell) consumption usually precedes pauses in egg production, it would appear that this may have been the limiting factor which brought about low production in many of these birds. Although no evidence is available, it does not seem unreasonable to suppose that birds upon the floor in an ordinary laying house also do not consume sufficient oyster shell, in all cases at least, to allow for the drain of production and for that eliminated in the droppings. It was estimated that 11 per cent of the total food consumption should be calcium for a bird laying 10·5 ounces of egg material per week if that bird is to produce eggs of good shell and not draw upon the calcium reserves of the skeleton in any way.

Publication—

Fecundity and Reproductive Ability in Closely Confined Fowl. Scientific Agri. 17:6, February 1937.

MARKETING EXPERIMENTS

Up until very recent years the marketing of poultry products, and especially poultry meat, was largely haphazard in nature. What regulation and improvement in quality of these products was brought about came largely as a result of the efforts of the trade and as a direct result of competition. The producer himself had knowingly very little to do with the improvement in quality largely because of indifference on his part, brought about to some extent by the lack of inducement in the form of increased remuneration for quality products. Government regulation, competition for exacting export markets, and general improvement in husbandry on farms and poultry plants have recently largely changed the aspect of this phase of the industry, and quality is now being duly stressed by all those interested in the marketing of poultry products. In keeping with this trend a larger amount of research upon marketing problems has been undertaken here than at any time previously. The results of some of the projects undertaken are briefly reviewed in the following paragraphs.

Storage of Dressed Poultry

The storage of dressed poultry is of considerable economic importance under present conditions of marketing where poultry is held for long periods before being consumed. It is also of particular importance in export trade where poultry

must be shipped long distances, particularly where non-uniform and not sufficiently low temperatures are available in the refrigerator car or on board ship. A group of experiments was carried out in co-operation with the Divisions of Chemistry and Bacteriology of the Experimental Farms Branch and Poultry Services of the Live Stock Branch, to obtain reliable information as to correct holding temperatures, the length of time during which poultry would remain fresh in chilled storage and the value of preservatives in preventing decomposition.

TEMPERATURE OF STORAGE

Chilled storage refers to the storage of meat without reducing the temperature so low that freezing takes place, i.e., frozen storage. It was decided to compare the very commonly used storage temperature of 32° F. with a lower temperature of 30° F., at which point freezing does not take place or does so to such a limited extent as to be not objectionable. The first signs of spoilage at 32° F. were evident four weeks after commencement of storage whereas at 30° F. spoilage was not evident until five weeks had passed. It was also found that the spoilage at this time was confined to the surface (skin), muscular deterioration not having developed. It was apparent therefore that where constant temperatures of 30° F. could be maintained and where the birds used were quickly chilled before storage, they could be held or shipped for one week longer than was possible at 32° F.

VENTILATION OF SHIPPING BOXES

A preliminary experiment indicated that ventilation of shipping boxes, i.e., slatted sides and half inch holes top and bottom, had no effect upon the length of time before spoilage in storage when the birds were collectively wrapped in wax paper in keeping with commercial practice. Such wrapping may have prevented greater change of air in the ventilated boxes thus not appreciably changing the condition under which the ventilated and non-ventilated birds were being stored.

PRECOOLING TEMPERATURES

An experiment comparing the keeping quality of birds which had been precooled at temperatures of 30° and 31·5°F. immediately after killing, was carried out. The birds were precooled for six to eight days at the temperatures mentioned and shipped over a period of six days. It was found that there was no measurable deterioration for 11 to 13 days after the end of shipment, that is for 23 to 27 days after killing, when precooling was done at 30°F., but that deterioration had definitely set in where the birds were precooled at 31·5°F. Thus precooling to 30°F. was most satisfactory.

RELATIVE RATE OF DECOMPOSITION OF FRESH, FROZEN AND CHILLED POULTRY

Experiments carried out using fresh, frozen and chilled poultry indicated that frozen poultry deteriorates more rapidly after thawing than fresh poultry, with chilled poultry being intermediate in rate of spoilage. Consequently both frozen and chilled poultry, particularly the former, should be used as soon as possible after removal from storage.

THE EFFECT OF PRESERVATIVES ON LENGTH OF STORAGE OF POULTRY

Experiments were carried out to determine whether the spoilage of chicken in storage, which is largely brought about by growth of bacteria, might not be greatly delayed by the application of preservative chemicals or materials which would prevent the development of bacteria.

Two oils, one described as white oil and the other by the trade name "Stanlax," were sprayed upon the carcasses of dressed birds. It was found that the coating of oil very greatly decreased the growth of bacteria but that the oil itself was to some degree objectionable on the skin of the bird.

Continuing this work further, five preservatives, sodium hypochlorite, chloramine T, formalin, hexylresorcinol and saturated brine were tested. Sodium hypochlorite and chloramine T showed no reduction in bacterial count. Formalin in different concentrations was effective in reducing bacteria but after eight days storage objectionable amounts of formalin remained in the skin. A solution of hexylresorcinol 0·1 per cent was quite effective in reducing bacteria while brine was not so effective.

The most successful treatment used was dipping three times in ordinary plucking wax. Five birds thus treated were kept for four weeks at 34°F. followed by two weeks at 59°F. and were found to be in excellent condition at the end of that time with a moderately low bacterial count.

It should be pointed out that objection to the use of preservatives is raised by most countries which import poultry meat. Some materials which are effective in holding back bacterial decomposition cannot be used for this reason.

In these tests, neither storage temperatures nor preservatives provided a means of increasing the storage period of chilled poultry to a sufficient degree to permit of large shipments of chilled poultry with safety to the British market. It was the consensus of opinion that poultry should be shipped in the frozen state, in which condition it is quite acceptable, at least until such time as methods for safe shipment are determined.

Canadian Poultry for the British Market

The opinion had been expressed that breeds in common use in Canada were not entirely suited to the requirements of the British market since there is a definite demand for lighter weight chicken than is commonly available in this country. In order to determine whether the breeds in common use could not be marketed at the weights desired, a test was inaugurated with Barred Plymouth Rocks and Leghorns and, in case the Leghorns might not fully come up to expectations, a flock of Leghorn top-crossed with Cornish.

All experimental birds were graded on the basis of satisfactory type and conformation as well as degree of fatness.

Sixty-two White Leghorn cockerels were killed in lots when the birds weighed 2½, 3, 3½ and 4 pounds. Of these 35·6 per cent graded A, 59·6 per cent graded B, and 4·8 per cent graded C.

Seventy-four Leghorn pullets were killed in lots when they weighed 2, 2½, 3, and 3½ pounds. Of these 73 per cent graded A, 22·9 per cent graded B, and 4·1 per cent graded C.

A further group of Leghorn cockerels were caponized. These birds at 4¼ to 4¾ pounds, properly finished, left little to be desired as table poultry.

The cross-bred group dressed out considerably better, 60 cockerels killed in groups at 2, 2½, 3, and 4 pounds gave 75 per cent A grade, 18·2 per cent B grade; 5 per cent C; 1·7 per cent D. Forty-one pullets in this group gave 95 per cent A, 4·9 per cent B.

With the Plymouth Rocks, only cockerels were used in this test and as it has been demonstrated frequently that they are satisfactory at broiler age, 2 to 2½ pounds, only groups at 3, 3½ and 4 pounds were killed. Forty-nine birds were used and these graded 79·6 per cent A and 20·4 per cent B.

As past experience has shown that grade A is desired and grade B acceptable, these tests have shown conclusively that the breeds in most common use in Canada are suitable to meet the requirements of the British market. While these chickens were in storage a number of the largest and most prominent

poultry dealers in England visited the experimental farm and examined them. They expressed themselves as highly pleased with the quality and stated that they could use large quantities of Canadian poultry of that quality.

One point they stressed and stressed strongly, however, was the necessity for great care in the killing, dressing, grading and packing of the poultry and the fact that birds falling into the grades below B are not wanted, consequently should not be shipped.

It would appear as a result of experience with export shipments of heavier weight birds, that the determining factor is largely one of quality and price rather than size.

CANADIAN NATIONAL EGG LAYING CONTEST

Summary of Contests

During the three years 1933-34, 1934-35 and 1935-36 egg laying contests were conducted in the various provinces of Canada. The Canadian contest was conducted at the Central Experimental Farm while the other contests were provincial in nature and were conducted on experimental farms or stations in the various provinces. A summary of the results by years is given in the following tables.

TABLE IX.—NAME OF CONTEST; NUMBER OF BIRDS; AVERAGE EGG PRODUCTION PER BIRD; LEADING PEN; PRODUCTION AND POINTS OF HIGHEST REGISTERED BIRD IN EACH CONTEST, 1933-34

Contest	No. of birds	Average eggs per bird	Average points per bird	Leading pen number of points	Highest Registered bird	
					Eggs	Points
Canadian	470	166·0	169·5	2424·7	276	304·0
Prince Edward Island	120	194·9	206·8	2434·5	265	302·7
Nova Scotia	210	185·1	190·3	2420·5	279	306·8
Nova Scotia Southern	200	188·0	193·0	2400·8	294	332·7
New Brunswick	290	197·1	208·7	2694·0	290	335·3
Quebec Eastern	200	182·2	188·4	2611·3	280	321·2
Quebec Western	180	179·0	189·6	2214·8	266	310·4
Ontario	740	159·5	163·5	2301·5	297	309·0
Ontario Western	360	171·9	183·1	2353·5	297	331·9
Manitoba	200	200·1	206·3	2618·0	270	319·4
Saskatchewan	140	144·5	144·4	2123·4	237	280·4
Alberta	260	157·0	163·2	2480·9	266	310·5
British Columbia	450	206·7	220·8	2757·1	309	352·3
Vancouver Island	330	203·7	217·5	2780·7	300	356·8
Total	4,150	179·5	187·3			

NOTE.—Ten birds constitute a pen.

TABLE X.—NAME OF CONTEST; NUMBER OF BIRDS; AVERAGE EGG PRODUCTION PER BIRD; LEADING PEN; PRODUCTION AND POINTS OF HIGHEST REGISTERED BIRD IN EACH CONTEST, 1934-35

Contest	No. of birds	Average eggs per bird	Average points per bird	Leading pen number of points	Highest Registered bird	
					Eggs	Points
Canadian	330	184·7	195·6	2461·7	302	350·9
Prince Edward Island	70	185·3	194·7	2345·1	262	301·7
Nova Scotia	180	206·8	213·2	2443·0	264	314·3
Nova Scotia Southern	200	185·2	190·5	2865·6	286	335·6
New Brunswick	260	192·5	199·4	2931·4	303	353·4
Quebec Eastern	110	201·1	213·8	2353·8	296	332·9
Quebec Western	200	163·2	173·5	2181·8	253	294·7
Ontario	620	180·2	187·2	2543·8	306	360·4
Ontario Western	320	170·7	179·0	2554·9	279	321·7
Manitoba	130	196·6	208·5	2620·1	278	323·2
Saskatchewan	150	183·3	193·3	2150·7	260	283·4
Alberta	200	158·7	166·6	2395·3	281	329·2
British Columbia	460	215·3	228·8	2874·3	308	358·6
Vancouver Island	340	209·3	224·7	2707·7	284	340·4
Total	3,570	186·5	198·6	.....	.....	.....

NOTE.—Ten birds constitute a pen.

TABLE XI.—NAME OF CONTEST; NUMBER OF BIRDS; AVERAGE EGG PRODUCTION PER BIRD; LEADING PEN; PRODUCTION AND POINTS OF HIGHEST REGISTERED BIRD IN EACH CONTEST, 1935-36

Contest	No. of birds	Average eggs per bird	Average points per bird	Leading pen number of points	Highest Registered bird	
					Eggs	Points
Canadian	280	184·0	193·0	2569·1	273	310·9
Nova Scotia Southern	160	193·6	199·3	2552·7	274	310·5
New Brunswick	240	197·8	209·5	2651·9	305	312·2
Quebec Eastern	160	200·3	214·2	2711·7	290	324·3
Quebec Western	200	184·8	196·2	2303·4	276	320·1
Ontario	600	169·5	173·6	2265·3	260	292·2
Ontario Western	220	190·4	207·7	2573·3	308	352·3
Manitoba	140	172·0	183·8	2486·8	281	328·9
Saskatchewan	140	160·4	172·1	2294·5	286	309·9
Alberta	90	176·1	179·8	2308·2	294	305·6
British Columbia	430	210·2	224·4	2751·0	278	320·7
Vancouver Island	220	201·8	213·5	2535·1	264	315·6
Total	2,880	187·7	197·6	.....	.....	.....

NOTE.—Ten birds constitute a pen.

The total number of birds entered each year, together with the average egg production for the 17 years the Canadian National Egg Laying Contest has been in operation are given in table XII.

TABLE XII.—BIRDS ENTERED IN CONTEST—BY YEARS

Contest Year	Total number birds	Average production per bird
1919-20	1,610	122·5
1920-21	2,480	137·0
1921-22	2,590	143·3
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
1928-29	4,370	176·5
1929-30	4,320	178·1
1930-31	4,560	176·2
1931-32	4,370	174·5
1932-33	3,401*	204·9
1933-34	4,150	179·5
1934-35	3,570	186·5
1935-36	2,880	187·7

*Number of pens withdrawn.

Table XII shows the increase in number of birds year by year. During the year 1932-33 a number of pens and birds were withdrawn in midsummer which accounts for the decrease in number of birds shown and this also accounts for the increase shown in egg production. Since 1933 there has been a gradual decrease in numbers of birds entered in egg laying contests in Canada. Generally speaking egg production per bird has increased steadily. During the last six years the production has increased steadily and the egg production per bird in 1935-36 is the highest figure ever recorded during the 17 years of laying contests in Canada.

Registration

Female birds are granted registration provided they lay 200 eggs or over in any of the Canadian National Egg Laying Contests or in the Registration Progeny Test, provided the eggs average 24 ounces per dozen. Male birds are registered when bred from second or subsequent generation registered females and from approved or registered males. All birds to qualify for registration must be free from standard disqualifications and typical of the breed. Females laying eggs with shell colour not characteristic of the breed are disqualified and refused registration.

During the year 1933-34, 2,026 birds were registered in Canada. This total was made up of 1,525 females and 501 males.

In the year 1934-35 the total number of birds registered was 1989, made up of 1,366 females and 623 males.

The year 1935-36 shows the total number of birds registered as 1,729 made up of 1,242 females and 487 males.

Reports

A report was sent out at the end of each week from each egg laying contest giving the individual production of each bird for the week. The reports also give the total eggs and points to date. These reports were sent to all contestants and to individuals interested in them, not only in Canada but in other countries as well. The mailing list includes many poultry breeders and laying contest managers in the United States, England, Ireland, Scotland, France, Holland, Australia, New Zealand and South Africa.

When the contest year was completed a production and identification chart was prepared and sent to each breeder, giving him important details 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 number if the bird was the daughter of a registered hen, the flock name and breeder's mark and the tattoo marks if the bird was registered, the body weight of the bird, the number of eggs laid, points secured and average weight of egg laid, also disqualifications, if any were present.

With such complete information at hand the breeder should be prepared to act wisely in the mating 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 egg size and size of bird, both of which are important factors in poultry breeding.

FARM, EGG AND POULTRY ACCOUNT SERVICE

The service to poultrymen and farmers, through the supplying of account forms and the analysis of their poultry enterprise, was continued. The demand for this service was heavy and correspondence relating to the individual difficulties of the poultrymen was greater than usual. The service forms a desirable contact between this division and the poultry farming public.

For purposes of comparison the following table is presented showing the growth of the enterprise concerned during the period 1931-35 and the costs and returns as calculated from the figures presented.

It is particularly noticeable that the average production per bird has remained fairly steady for a period of years and much higher than during the early years of the service. The price of eggs has shown a gradual reduction but the average feed cost per dozen has also lowered so that the average profit per dozen from 1928 to 1935 has been fairly constant. The average profit over feed cost per bird has shown a tendency to increase during 1934 and 1935.

In view of the fact that the flocks which represent the bulk of the correspondents in this service are of mixed breeds and small in size, the financial returns indicated may be considered to be very gratifying.

TABLE XIII.—A SURVEY SUMMARY OF THE ANNUAL FARM EGG AND POULTRY ACCOUNTS

Year	Average number of birds per flock	Average number eggs laid	Average production per bird	Average price per dozen	Average receipts from eggs	Average feed bought	Average total profit over cost of feed	Average cost per dozen	Average profit per dozen	Average receipts per bird	Average cost of feed per bird	Average profit per bird over feed
				c.	$ c.	$ c.	$ c.	c.	c.	$ c.	$ c.	$ c.
1921–22	39·8	4,878·8	122·5	41·7	169 59	112 36	57 23	27·6	14·1	4 26	2 83	1 43
1922–23	41·0	4,733·2	115·4	45·8	180 72	118 24	62 48	29·9	15·8	4 40	2 88	1 52
1923–24	45·5	5,243·6	115·2	54·9	240 14	146 83	93 31	33·6	21·3	5 27	3 22	2 05
1924–25	34·9	4,448·7	127·4	50·4	187 19	115 53	71 66	31·1	19·3	5 36	3 31	2 05
1928–29	68·1	8,442·2	123·9	42·6	299 67	239 45	60 22	34·0	8·6	4 40	3 52	0 88
1929–30	88·3	12,043·0	136·3	34·4	346 09	272 99	73 10	27·2	7·2	3 91	3 09	0 82
1930–31	106·6	17,266·1	161·9	24·7	356 51	254 01	102 50	17·6	7·1	3 34	2 38	0 96
1931–32	123·8	19,655·8	158·7	22·2	364 66	264 47	100 19	16·1	6·1	2 94	2 13	0 81
1932–33	108·9	16,658·9	152·9	20·2	281 28	194 65	86 63	14·0	6·2	2 58	1 79	0 79
1933–34	116·7	17,900·8	153·3	23·9	356 81	234 75	122 06	15·7	8·2	3 05	2 01	1 04
1934–35	130·7	19,638·8	150·6	22·5	370 06	212 83	157 23	12·9	9·6	2 83	1 63	1 20

BREEDS.—Barred Plymouth Rocks; Buff Plymouth Rocks; White Leghorns; White Wyandottes; Rhode Island Reds; Black Minorcas; Chantecler; Jersey Black Giants; White Orpington; Cross Breeds; Mixed Flocks (two or more different breeds on the same farm). The number of flocks for each year was 20, 23, 28, 68, 34, 31, 40, 55, 55, 63 and 59 respectively.

SERVICES TO FRENCH SPEAKING POULTRYMEN

The French correspondence continues to keep up steadily, and letters are received not only from the province of Quebec, but also from many French Canadians living in other provinces. During the past three years a number of letters asking for information regarding Canadian methods of poultry farming and its possibilities have been received from numerous Franco-Americans.

French Monthly Report Form Service

The demand for the Farm Egg and Poultry Account forms is maintained, showing that the work is popular with the poultrymen and farmers who have the time and the inclination to learn more of the possibilities for profits in their poultry flocks.

The French monthly report service supplements survey work, for through it valuable data are obtained, and information is given to farmers or poultrymen who cannot be visited personally. This service helps the farmers to keep an account of their poultry enterprise. This is followed by a personal letter, provided that a study of this report reveals any condition which requires comment.

The circular letter sent out every month has been maintained for the past three years and a yearly summary of all reports is sent to all contributors so that they can compare their results with those obtained elsewhere. As a rule the expenditures and receipts of the poultry flock are small in comparison with some of the operations on the farm, and, being spread over the entire year in small daily items, they lose significance, or may be overlooked and given little consideration.

Where an effort is made to keep accounts of the poultry revenue, results are shown that compare favourably with the profits in any other branch of the farm work. Sometimes, where special effort has been made and more attention given, the poultry flock has proved to be the mainstay of the farm.

If elaborate and accurate accounts are kept of the profit and loss of a small flock, the time involved is out of proportion to the returns. A simple system that will show the progress made at any period and from which a fairly accurate balance sheet can be drawn up annually, may be all that is necessary.

As a rule, where this is practised, the results shown are encouraging. The profits on the small outlay invested in the stock, overhead and labour, frequently prove an incentive to greater effort and lead to expansion. From the simple monthly form provided by the Poultry Division, on request, the yearly balance can be compiled.

In the past it was the practice to prepare a balance sheet from the duplicate monthly accounts sent in by breeders, and to forward it to them, but this had to be discontinued owing to the pressure of other work. When a special request is received from a poultryman, a balance sheet is prepared and sent to him. From this account, a fairly accurate estimate can be made of the return received by the owner for his labour, or the labour can be estimated and charged each month, when the balance shown at the end of the year will represent the return on the capital invested in stock and equipment.

This work is valuable because of the information derived from the accounts sent in from all parts of the country as well as its help to the poultry keeper.

The prices received by the farmer for his products and the prices paid for his feeds are available for the information of any interested person, and the opportunity for successful poultry keeping and the difficulties, if any, that may be present in different localities can also be traced from these reports.

The following table gives a summary by districts, for 43 farms immediately adjacent to the St. Lawrence river in the province of Quebec for the year 1933-34.

TABLE XIV.—SHOWING RESULTS BY DISTRICTS, OF THE POULTRY OPERATIONS ON 43 FARMS IN QUEBEC

District	Number of flocks	Number of birds	Average number per flock	—	Eggs per bird	Average value per doz.	Average cost per bird	Average cost per doz.	Returns per bird
						$ c.	$ c.	$ c.	$ c.
Northwest of St. Lawrence (from Rigaud-Three Rivers)	16	1,653	103·3	Five winter months	69·2	0 34	0 99	0 17	1 19
				Entire year	138·9	0 28	1 81	0 16	2 22
Northeast of St. Lawrence (from Three Rivers-Quebec)	3	346	115·3	Five winter months	78·3	0 38	1 26	0 19	2 10
				Entire year	167·6	0 31	2 53	0 18	2 38
Southwest of St. Lawrence (from Valleyfield-Nicolet)	18	1,793	99·6	Five winter months	54·6	0 32	0 80	0 17	1 11
				Entire year	135·9	0 27	1 68	0 15	2 21
Southeast of St. Lawrence (from Nicolet to Rimouski)	6	421	70·1	Five winter months	59·0	0 31	1 06	0 22	1 13
				Entire year	157·1	0 23	1 61	0 15	1 95
Year Total	43	4,213	98·0	.....	149·9	0 27	1 90	0 16	2 19

REMARKS.—The foregoing table shows that the heaviest production and the greatest profits, both for the winter months and the entire year, were obtained by the farmers living north of the St. Lawrence and east of Three Rivers, and the lowest by those south of the St. Lawrence and west of Nicolet. These figures give a very fair indication of the varying progress made in poultry keeping in these four districts, respectively.

Co-operation with Other Agencies

By special request of the Department of Agriculture, Quebec, an officer of this division delivered several lectures during the winter of 1934, in different parts of that province dealing with the importance of the use of prepotent males in order to develop better lines of breeding.

The results of these lectures undoubtedly had an effect on the flock improvement policy in the province since the number of registered and R.O.P. birds purchased was twice that of the previous year. These males were used on the foundation flocks and the offspring were then used for improvement purposes.

The division also co-operated with the Ontario Department of Agriculture in order to improve poultry conditions particularly in Russell and Prescott counties.

Attendance at these meetings was very satisfactory and this work was greatly appreciated by poultry keepers and farmers. The quantity of poultry shipped to the Montreal market was about the same as in previous years but the quality was very much improved.

A member of the staff helped at the agricultural short courses held at the following places during the past three years—Limoges, Wendover and Clarence Creek, Ontario.

Co-operation with Illustration Stations

A certain amount of assistance is given each year to the operators of illustration stations. This takes the form of a much reduced price on day-old chicks or good breeding eggs for hatching. During the summer of 1934 a further step was made in this co-operation, when an officer of the division visited and lectured on feeding poultry, at all annual gatherings in Western Quebec and Eastern Ontario. All illustration stations in the province of Quebec and Eastern Ontario were again visited during 1936. The latter trip was chiefly for the purpose of testing birds for pullorum disease and at the same time discussing poultry problems whenever necessary with the operators of various illustration stations.

At the annual convention of the Quebec poultry instructors and managers of co-operative hatcheries, held in Quebec City in 1934, an officer of this division delivered a talk on breeding, and during the afternoon gave a demonstration on culling at the experimental station, Cap Rouge, Quebec.

A special poultry field day held at the experimental station, Cap Rouge and various poultry association meetings held in Montreal were also attended during the summer of 1935.

The division has been officially represented by a bilingual officer, at the Montreal poultry show during the past three years. Attractive exhibits were supplied comprising interesting and educational coloured transparencies and models of useful appliances with appropriate legends. In co-operation with the Live Stock Branch, two demonstrations were given every day of the show, on killing, rough plucking and waxing birds.

REPORT OF THE POULTRY PATHOLOGY LABORATORY OF THE HEALTH OF ANIMALS BRANCH FOR THE YEARS 1934, 1935 and 1936

C. H. WEAVER, *Pathologist in charge*

The following is a report of the routine and investigational work of the poultry pathology laboratory for the years 1934, 1935, and 1936. An attempt is made to review, as concisely as possible, this work which is a co-operative undertaking between the Health of Animals Branch and the Poultry Division of the Dominion Experimental Farms.

As in preceding years, activities have been divided between an essential diagnostic service and a research or investigational program. The diagnostic service, embracing as it does a pathological study of the organs and tissues of all dead and living birds coming to autopsy, the application of the agglutination test for the detection of pullorum disease carriers to experimental farm flocks and those operating under federal policies and attention to the hundreds of letters and requests, places a heavy tax upon the time available for all studies.

Nevertheless, many hours have been devoted to a study of parasitic infestations, especially the different forms of coccidiosis and the decimating filterable virus group of diseases, leucosis, infectious bronchitis and infectious laryngotracheitis.

Serious outbreaks of infectious diseases at different points throughout Canada have necessitated, in several instances, personal visits to premises and advice to owners of flocks in epizootical regions.

Memoranda outlining disease control programs and eradication measures have been prepared and submitted to the Federal Poultry Board and already several of these recommendations have been put into practice.

Co-operation has been maintained with federal branches and provincial agencies in formulating a procedure designed to avoid the transmission of infections and infestations from older fowls to succeeding generations, by the practice of flock replacement.

Efforts to standardize the agglutination test for the detection of pullorum disease carriers, have made necessary visits to many private laboratories in Ontario, Quebec and the Maritime Provinces to inspect equipment and make personal contact with the veterinarians in charge or supervising operations. Subsequently, provincial Departments of Agriculture were visited with the object of having methods for pullorum disease control and eradication standardized throughout Canada. To further assist in the work of pullorum eradication, this laboratory, pending the installation of suitable equipment for the manufacture of antigen, has undertaken to supply standardized antigen to several private laboratories and already large quantities have been shipped to different points in the areas mentioned.

An exhibit of pathological specimens illustrating the various diseases affecting fowls, has been maintained and used throughout the summer months in connection with the annual poultry field days at the Central Experimental Farm. In addition to these practical demonstrations, illustrated lectures have been given from time to time to the students of the Kemptville Agricultural School and to the poultrymen attending the special short courses arranged for their benefit by Mr. Fraser, head of the poultry department of that institution. The annual conference of laboratory workers in pullorum disease control which was held at Durham, New Hampshire, and the World's Poultry Congress held in Berlin, Germany, were attended by representatives of the poultry pathology laboratory.

Routine Laboratory Service

(Applied Science)

PATHOLOGICAL DIAGNOSIS

During the year 1934, a total of 1935 pathological specimens were examined and reported upon. The results, as set forth in table I, show the pathological conditions recorded and their calendar distribution.

The year 1935 saw a slight decrease in the number of pathological specimens submitted for examination, records showing a total of 1,624—table II.

During the year 1936, a total of 1,017 pathological specimens were received, and examined—table III. This decrease is accounted for by the fact that the mortality rate from parasitism, cannibalism and infectious laryngotracheitis, was much less than in either of the two preceding years.

The diagnostic work again has occupied a major position among the activities of the laboratory. A total of 4,576 pathological specimens has been dealt with—table IV. Of these, 865 or 18·90 per cent are listed directly to intestinal parasitism, which does not take into consideration those cases where the presence of parasites probably acted as a contributing cause to the later development of diseases of a fatal nature. By themselves, the animal parasitic diseases are evidently very serious disorders, but they are probably most significant as factors leading to the undermining of the health with subsequent serious eventualities such as loss of flesh, lowered production and eventually death from other causes. As an example, the 185 cases listed as range paralysis probably in a large measure are due to a pre-existing parasitism, especially coccidial infection of a certain type. From the standpoint of the poultry industry, parasitic diseases may be expected to become worse with time through their dissemination to areas now free from the more serious disorders caused by pathogenic coccidia. Infectious laryngotracheitis and infectious bronchitis—filterable virus diseases—taken collectively, occupy second place with 393 cases.

Pullorum disease is still a very important and serious ailment, though its control is in sight and in fact many flocks have been freed of this serious infection.

Apart from the specific infections, tremendous losses occur from conditions which are classified as sporadic diseases. The extent of such non-communicable diseases may be judged by a reference to the losses listed under pericarditis, peritonitis, reproductive, avitaminosis, digestive and liver troubles. In addition, cannibalism and feather pulling which in all probability are outward manifestations of metabolic or other disturbances, rather than simply vicious habits, annually add to the heavy toll occasioned by diseases in general.

TABLE I.—AUTOPSY REPORT FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1934

Item No.	Disease	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
1	Parasitism (intestinal)	16	5	11	6	6	53	45	53	25	37	19	14	290	14·99
2	Chicken Pox														
3	Roup (pasteurellosis)	1	6	10	2	3	5	2	3	1	12	2	1	48	2·48
4	Infectious Laryngotracheitis	36	24	71	31	2	2	1	1	9	82	3	1	263	13·59
5	Infectious Bronchitis							1						1	0·05
6	Pullorum		4	2	21	11	22	5						65	3·36
7	Tuberculosis	3	2	2	1	3	1	2	4	1	3	3	1	26	1·34
8	Pericarditis	3	2	2	2	5	5	2	3	3	2	1	1	31	1·60
9	Vent Gleet		2	1	1	1						1		6	0·31
10	Peritonitis	8	5	16	21	23	21	24	13	13	7	7	9	167	8·63
11	Reproductive	4	6	7	12	12	5	5	6	4	7	2	2	72	3·72
12	Avitaminosis	5	2	11	10	7	9	9	6	6	7	3	4	79	4·08
13	Cannibalism	12	10	24	23	22	16	10	11	4	9	10	4	155	8·01
14	Haemorrhage	8	6	7	7	4	9	9	7	3	10	2	4	76	3·93
15	Visceral Gout	2	2	4	2	3	4	4	5	2	3	3	1	35	1·81
16	Digestive and Liver Troubles	9	5	9	22	7	5	7	3	4	1	3	3	78	4·03
17	Tumor	2	4	8	7	4	5	2	1	5	8	4	5	55	2·84
18	Leucosis	12	5	15	9	4	4	6	7	2	8	8	6	86	4·44
19	Paralysis	3	7	6	2	3	7	10	18	16	18	13	3	106	5·48
20	Heat Prostration														
21	Undetermined	15	6	11	8	67	29	51	26	10	11	3	2	239	12·35
22	Miscellaneous	3	6	6	3	3	8	5	7	4	10	1	1	57	2·95
	Total	142	109	223	190	190	210	200	174	112	235	88	62	1,935	
	Per cent	7·34	5·63	11·52	9·82	9·82	10·85	10·34	8·99	5·79	12·14	4·55	3·20		

TABLE II.—AUTOPSY REPORT FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1935

Item No.	Disease	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
1	Parasitism (intestinal)	7	5	2	10	22	53	88	69	51	34	19	12	372	22·91
2	Chicken Pox	1	4	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	0·62
3	Roup (pasteurellosis)	1	.....	.....	1	2	2	1	3	1	.....	.....	2	13	0·80
4	Infectious Laryngotracheitis	1	.....	7	.....	1	2	.....	.....	.....	10	53	7	81	4·99
5	Infectious Brochitis	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	Pullorum	.....	.....	14	40	12	.....	.....	.....	.....	.....	.....	.....	66	4·06
7	Tuberculosis	5	1	1	2	.....	1	2	.....	3	1	2	.....	18	1·11
8	Pericarditis	1	3	2	1	4	1	.....	1	12	1	4	.....	30	1·85
9	Vent Gleet	1	1	.....	.....	3	.....	.....	.....	.....	1	.....	.....	6	0·37
10	Peritonitis	11	10	20	3	12	16	11	11	.....	8	.....	4	106	6·53
11	Reproductive	2	3	8	4	7	16	4	4	5	6	3	2	64	3·94
12	Avitaminosis	1	3	6	3	3	4	2	8	3	1	.....	1	35	2·15
13	Cannibalism	5	5	6	13	13	15	4	5	7	11	29	3	116	7·14
14	Haemorrhage	6	5	1	8	7	4	2	3	4	2	6	6	54	3·32
15	Visceral Gout	3	.....	2	4	1	3	8	6	.....	1	.....	.....	28	1·72
16	Digestive and Liver Troubles	10	10	15	9	7	6	3	5	5	.....	2	2	74	4·56
17	Tumor	7	9	10	6	2	4	6	.....	4	3	6	2	59	3·63
18	Leucosis	9	1	11	3	7	2	3	3	5	5	11	12	72	4·43
19	Paralysis	5	7	4	6	1	5	2	3	8	11	5	5	62	3·82
20	Heat Prostration	.....	.....	.....	.....	.....	.....	1	3	.....	.....	.....	.....	4	0·25
21	Undetermined	5	5	10	21	100	49	43	15	4	7	8	5	272	16·75
22	Miscellaneous	3	.....	2	12	1	11	20	6	3	10	3	11	82	5·05
	Total	84	72	112	120	233	206	200	145	115	112	151	74	1,624	.....
	Per cent	5·17	4·43	6·90	7·39	14·35	12·69	12·31	8·93	7·08	6·90	9·30	4·56	.....	.....

TABLE III.—AUTOPSY REPORT FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1936

Item No.	Disease	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
1	Parasitism (intestinal)	9	5	1	6	21	29	28	29	31	22	14	8	203	19·96
2	Chicken Pox	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	Roup (pasteurellosis)	3	.....	2	1	1	.....	1	2	3	.....	1	1	15	1·47
4	Infectious Laryngotracheitis	1	9	5	.....	.....	.....	.....	1	.....	.....	4	.....	20	1·97
5	Infectious Bronchitis	.....	.....	.....	14	1	4	5	1	1	.....	1	1	28	2·75
6	Pullorum	.....	.....	2	2	1	3	.....	2	.....	.....	.....	.....	10	0·98
7	Tuberculosis	3	1	.....	2	2	.....	1	.....	.....	1	.....	4	14	1·38
8	Pericarditis	2	1	3	1	2	.....	4	1	.....	1	1	.....	16	1·57
9	Vent Gleet	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	2	4	0·39
10	Peritonitis	2	7	6	14	19	14	9	8	6	14	3	4	106	10·42
11	Reproductive	3	1	7	6	4	12	6	7	3	4	3	7	63	6·19
12	Avitaminosis	4	4	3	3	2	3	5	4	1	3	.....	3	35	3·44
13	Cannibalism	3	4	7	14	14	9	6	5	2	2	3	1	70	6·88
14	Haemorrhage	4	7	3	4	6	8	3	4	1	1	2	5	48	4·72
15	Visceral Gout	2	2	2	.....	1	.....	.....	.....	1	1	1	.....	10	0·98
16	Digestive and Liver Troubles	2	5	8	23	13	5	2	1	3	7	1	3	73	7 18
17	Tumor	8	2	3	5	4	3	1	3	4	4	2	2	41	4·03
18	Leucosis	5	6	5	3	1	4	5	1	3	10	12	15	70	6·88
19	Paralysis	4	3	1	2	1	.....	.....	1	3	.....	1	1	17	1·67
20	Heat Prostration	.....	.....	.....	.....	.....	.....	9	.....	.....	.....	.....	.....	9	0·89
21	Undetermined	7	4	15	11	9	3	5	3	5	1	.....	2	65	6·39
22	Miscellaneous	7	5	4	10	13	25	8	5	5	9	3	6	100	9·83
	Total	69	66	77	123	115	122	98	78	72	80	52	65	1,017	.....
	Per cent	6·78	6·49	7·57	12·09	11·31	12·00	9·64	7·67	7·08	7·87	5·11	6·39	.....	.....

TABLE IV.—AUTOPSY REPORT FOR THE YEARS 1934, 1935, AND 1936

Item No.	Disease	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
1	Parasitism (intestinal)	32	15	14	22	49	135	161	151	107	93	52	34	865	18·90
2	Chicken Pox	1	4	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	0·22
3	Roup (pasteurellosis)	5	6	12	4	6	7	4	8	5	12	3	4	76	1·67
4	Infectious Laryngotracheitis	38	33	83	31	3	4	1	2	9	92	60	8	364	7·95
5	Infectious Bronchitis	.....	.....	.....	14	1	4	6	1	1	.....	1	1	29	0·63
6	Pullorum	.....	4	4	37	52	37	5	2	.....	.....	.....	.....	141	3·08
7	Tuberculosis	11	4	3	5	5	2	5	4	4	5	5	5	58	1·26
8	Pericarditis	6	6	7	4	11	6	6	5	15	4	6	1	77	1·68
9	Vent Gleet	1	3	1	3	4	.....	.....	.....	.....	1	1	2	16	0·40
10	Peritonitis	21	22	42	38	54	51	44	32	19	29	10	17	379	8·28
11	Reproductive	9	10	22	22	23	33	15	17	12	17	8	11	199	4·34
12	Avitaminosis	10	9	20	16	12	16	16	18	10	11	3	8	149	3·26
13	Cannibalism	20	19	37	40	49	40	20	21	13	22	42	8	331	7·23
14	Haemorrhage	18	18	11	19	17	21	14	14	8	13	10	15	178	3·89
15	Visceral Gout	7	4	8	6	5	7	12	11	3	5	4	1	73	1·59
16	Digestive and Liver Troubles	21	20	32	54	27	16	12	9	12	8	6	8	225	4·92
17	Tumor	17	15	21	18	10	12	9	4	13	15	12	9	155	3·39
18	Leucosis	26	12	31	25	12	10	14	11	10	23	31	33	238	5·20
19	Paralysis	12	17	11	10	5	12	12	22	27	29	19	9	185	4·04
20	Heat Prostration	.....	.....	.....	.....	.....	.....	10	3	.....	.....	.....	.....	13	0·28
21	Undetermined	27	15	36	40	176	81	99	44	19	19	11	9	576	12·56
22	Miscellaneous	13	11	12	25	17	44	33	18	12	29	7	18	239	5·22
	Total	295	247	412	433	538	538	498	397	299	427	291	201	4,576	.....
	Per cent	6·45	5·40	9·00	9·46	11·76	11·76	10·88	8·68	6·53	9·33	6·36	4·39	.....	.....

SEROLOGICAL DIAGNOSIS

This work is confined to the examination of fowls' blood for the detection of pullorum disease. The standard tube method is employed in single tube dilution of approximately one of serum to fifty of antigen.

With the flocks of the Experimental Farms System where the laboratory encourages disease eradication, supplementary tests are made on all samples showing any deviation from normal. In these instances the fowls' sera are set up in series dilutions of one in twenty-five to one in two hundred, doubling the dilution in each instance. Many of these flocks are now pullorum free or have approximated that desirable state. In such cases it is highly desirable to definitely determine the exact status of each fowl where the results of the tests are not entirely negative. These individuals are then generally submitted to further study, by supplementary pathological examination. This plan has proved highly satisfactory as a diagnostic means for the eradication of infection.

In 1934 blood samples numbering 15,419 were submitted to the agglutination test for the detection of pullorum infection, the standard tube method being employed. .The origin of this material is given in table V.

In 1935 serological diagnoses numbered 16,315, an increase of 896 over the preceding year—table VI.

In 1936 blood samples numbering 18,917 were tested for evidence of pullorum infection—table VII.

During the past three years, 50,651 samples of blood were tested—table VIII. These samples coming as they do from the flocks of the experimental farms and illustration stations, represent but a small part of the work being undertaken under the supervision of the Health of Animals Branch throughout Canada. The work of this laboratory towards standardization of the test is briefly outlined in a preceding paragraph.

Departments now rendering a service in pullorum control would be well advised to consider a policy based on eradication of the disease in a representative number of flocks from which known pullorum-free chicks on a certified basis could be obtained, for the stocking of new plants or where flock replacement practice is desired for disease eradication in general.

TABLE V.—AGGLUTINATION TESTS FOR THE DETECTION OF CARRIERS OF B. PULLORUM INFECTION, 1934

Source	Jan.	Feb.	Mar.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
Experimental Farm Flocks	320	.....	31	1,964	3,307	1,000	1,002	7,624	49·44
Egg Laying Contests	.....	.....	.....	68	2,544	625	.....	3,237	20·99
Other Sources	597	200	1,337	130	1,801	493	.....	4,558	29·56
Total	917	200	1,368	2,162	7,652	2,118	1,002	15,419	.....
Per cent	5·95	1·30	8·87	14·02	49·63	13·74	6·50	.....	.....

TABLE VI.—AGGLUTINATION TESTS FOR THE DETECTION OF CARRIERS OF B. PULLORUM INFECTION, 1935

Source	Jan.	Feb.	Mar.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
Experimental Farm Flocks	.....	348	.....	2,301	3,881	2,567	116	9,213	56·47
Egg Laying Contests	.....	.....	.....	.....	1,255	239	.....	1,494	9·09
Other Sources	984	568	100	386	2,112	237	1,231	5,618	34·43
Total	984	916	100	2,687	7,248	3,033	1,347	16,315	.....
Per cent	6·03	5·61	0·61	16·47	44·42	18·59	8·26	.....	.....

TABLE VII.—AGGLUTINATION TESTS FOR THE DETECTION OF CARRIERS OF B. PULLORUM INFECTION, 1936

Source	Jan.	Feb.	Mar.	April	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
Illustration Stations	.....	.....	.....	.....	60	2,112	2,154	50	58	4,434	23·44
Experimental Farm Flocks	1,011	21	237	.....	.....	810	4,213	1,689	1,201	9,182	48·54
Egg Laying Contests	.....	.....	.....	.....	.....	.....	1,365	171	138	1,674	5·15
Private Flocks	.....	.....	.....	.....	.....	321	557	96	nil	974	4·88
Miscellaneous	976	718	.....	745	.....	.....	.....	214	nil	2,653	14·02
Total	1,987	739	237	745	60	3,243	8,289	2,220	1,397	18,917	.....
Per cent	10·50	3·91	1·25	3·94	0·32	17·14	43·82	11·73	7·38	.....	.....

TABLE VIII.—AGGLUTINATION TESTS FOR THE DETECTION OF CARRIERS OF B. PULLORUM INFECTION FOR THE YEARS 1934, 1935 AND 1936

Source	Jan.	Feb.	Mar.	April	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Per cent
Experimental Farm Flocks	1,331	369	268	.....	.....	5,075	11,401	5,256	2,319	26,019	51·37
Egg Laying Contests	.....	.....	.....	.....	.....	68	5,164	1,025	138	6,395	12·62
Illustration Stations	.....	.....	.....	.....	60	2,112	2,154	50	58	4,434	8·75
Other Sources	2,557	1,486	1,437	745	.....	837	4,470	1,040	1,231	13,803	27·25
Total	3,888	1,855	1,705	745	60	8,092	23,189	7,371	3,746	50,651	.....
Per cent	7·68	3·66	3·37	1·47	0·12	15·97	45·78	14·55	7·40	.....	.....

Research

The staff and facilities of this laboratory are sufficiently preoccupied attending to the pressing disease relief needs of poultrymen and in co-operating with the official agencies as to leave but little opportunity for systematic investigational studies. Notwithstanding the pressing needs of this exacting routine service, many hours have been devoted to investigational work. The losses caused by infectious diseases, infectious laryngotracheitis and infectious bronchitis, are still too large and the present knowledge regarding the causative viruses, symptomatology, pathological lesions, and modes of transmission, leaves much to be desired. A rapid laboratory method to replace the time-consuming biologic test for their differential diagnosis would be of inestimable value in a study of these two specific infections.

Blood Studies

The systematic examination of the blood of fowls was undertaken as a basic study of the causes of the high and increasing incidence of sporadic diseases. The increase in the mortality rate due to leucosis alone makes it imperative that investigations in this direction be extended. Occurring as it does in two forms, one seemingly benign and the other infectious, unattended by any premonitory symptoms and diagnostically dependent upon leucocytic and differential blood counts, this disease has seemingly defied elucidation. Fundamental blood studies of presumably normal fowls and those living birds coming to autopsy are being continued in an endeavour to throw some light on this obscure malady. A paper under preparation dealing with these blood studies, shows that before means for both leucocytic and erthrocytic counts can be established which would be diagnostically significant, much work remains to be done to reduce to a minimum errors of technique resulting in wide variations between counts even when dealing with the same bird.

Immunity Experiments

Attempts to measure the degree of immunity capable of being induced in test birds by the intra-abdominal injection of embryonated eggs of the intestinal round worm, *Ascaridia galli* as well as cross immunity experiments with the embryonated eggs and protein derivatives of different species of nematodes infesting fowls have been among the studies undertaken at this laboratory.

Studies on the life history of capillarid worms from the intestine of fowl have been made. Experience in the embryonation and hatching of eggs both free and in utero, using tap water and potassium dichromate as media has been rather disappointing in some respects. While normal development within the shell goes on uninterruptedly until the coiled embryo stage is reached, the young worms shortly afterwards seem to enter a stage of lethargy and subsequent attempts to infest parasite-free chicks have been repeatedly unsuccessful. Capillarid worms are less prevalent in fowls than either Ascarids or Heterakids but as they are seriously pathogenic to chickens, it is the intention to continue studies with worms of this genus as opportunity permits.

Considerable time has been devoted to a study of coccidiosis in the hope of finding a practicable method of immunizing birds that may subsequently be exposed to such infection. The influence of various chemicals in sporulation of oocysts and their subsequent behaviour in the tissues has been given attention.

Two interesting cases of pasteurella infection have been investigated, one occurring in wild ducks reared on one of the western experimental farms while the other occurred in a production poultry flock in Ontario. Cross infection experiments with pure cultures of bacterial organisms (*Pasteurella avicida*) isolated from these cases showed an almost complete reciprocal relationship in regard to pathogenicity, wild mallards and chickens succumbing in approximately 24 hours after injection with either strain. This reciprocal relationship may explain the sporadic occurrence of septicaemia in different varieties of waterfowl otherwise not explainable, since it is well known that chickens act as carrier-hosts of *Pasteurella avicida* and are frequently infected with this species of organism.

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