

[Bulletins 235 to 245 constitute the Report for 1915. In binding, pages i-xvi at the end of this bulletin should be detached and placed before Bulletin 235 which begins with page 1]

Maine Agricultural Experiment Station

BULLETIN 245

DECEMBER, 1915

ABSTRACTS OF PAPERS NOT INCLUDED IN BULLETINS, FINANCES, METEOR- OLOGY, INDEX

CONTENTS.

	PAGE
Abstracts of papers published by the Station in 1915 but not included in the Bulletins	289
Meteorological Observations	309
Report of Treasurer	311
Index for 1915	315
Index for 1911 to 1915	325

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BULLETIN 245.

ABSTRACTS OF PAPERS PUBLISHED BY THE STATION IN 1915 BUT NOT INCLUDED IN THE BULLETINS.

A complete list of all the publications issued by and from the Station in 1915 are given on pages xii to xiv of the introduction to this Report. The following pages contain abstracts of the papers issued during the year that are not included in the Bulletins or Official Inspections for the year.

RELATION OF SIMULTANEOUS OVULATION TO THE PRODUCTION OF DOUBLE-YOLKED EGGS*.

(1) Double-yolked eggs with normal separate yolks may have all the egg envelopes common to the two yolks, or they may have some separate and some common envelopes.

(2) They may be classified with reasonable accuracy into three groups:

Type I.—Double-yolked eggs having the entire set of egg envelopes common to the two yolks.

Type II.—Double-yolked eggs having separate chalaziferous layers but all or part of the thick albumen common to the two yolks.

Type III.—Double-yolked eggs in which the yolks have entirely separate thick albumen envelopes but a common egg membrane and shell.

(3) Of the eggs studied 16.03 per cent belonged to type I, 70.99 per cent to type II, and 12.98 per cent to type III.

(4) A large series of double-yolked eggs show all gradations within and between these groups.

*This is an abstract of a paper by Maynie R. Curtis, having the same title and published in *Journal of Agricultural Research*, Vol. III, pp. 375-386. Pl. XLVI-LII. 1915.

(5) The most probable interpretation of this phenomenon is that the two components unite at any level of the oviduct from the funnel mouth to the isthmus ring.

(6) The conclusion that the union of the component eggs occurs *indiscriminately* at all levels of the oviduct is strongly supported by the fact that the percentage of eggs of each type closely proportional to the percentage of the portion of the duct in which the union of two eggs would give double-yolked eggs of that type.

(7) In 36.44 per cent of the double-yolked eggs the ovulations which furnished the two yolks must have been separated by an abnormally short interval, since a normal egg had been laid on the preceding day.

(8) An examination of the egg structure, however, shows that the two yolks have passed the entire length of the duct together in only 16.28 per cent of the cases in which the ovulations are known to have been usually rapid.

(9) While a heightened rate of fecundity may result in the production of an egg of any of the three types, 68.75 per cent of the eggs of type III are single eggs. It seems probable that many of them have resulted from the delay of the first egg in the oviduct.

(10) The ovary of each pullet which had just laid a double-yolked egg as her first egg contained two normal separate follicles which had separate blood supplies. In these cases, however, the doubling of the egg had occurred near the end of the albumen-secreting region.

(11) In a case in which there was evidence from the structure of the egg that the two yolks had passed the entire length of the oviduct together the two follicles were also quite distinct, with separate blood supplies.

(12) This, together with the fact that in only a small percentage of double-yolked eggs is there any evidence of simultaneous ovulation, indicates that the fusion of follicles and a resulting common blood supply is by no means the usual cause for the production of a double-yolked egg.

(13) A simple normal follicle furnished the yolk with two germ disks; hence, the fusion of the oöcytes (if this was the origin of the two germ disks) must have occurred before the formation of the follicle.

STUDIES ON THE PHYSIOLOGY OF REPRODUCTION
IN THE DOMESTIC FOWL. XII.ON AN ABNORMALITY OF THE OVIDUCT AND ITS EFFECT UPON
REPRODUCTION.*

This paper describes a case of congenital obstruction of the oviduct, of unusual character.

The bird was a year and a half old Rhode Island Red hen which had been killed for meat. She was well grown and in good flesh. When the body cavity was opened it was found full of membrane covered eggs. They represented every possible stage of absorption from a normal membrane shelled egg to collapsed empty egg membranes. Some of the eggs and empty membranes were free in the body cavity. Others were walled off in pockets either singly or in aggregates. There was one large mass (twice the size of a hen's egg) of empty tightly packed egg membranes. At the time of examination 15 absorbing eggs and a very large number of empty membranes were found. Eleven of the 15 eggs had evidently been normal eggs although many of them contained a homogeneous mixture of yolk and albumen at the time examined. Four were double eggs. That is, one egg enclosed within another. One of the four was made up of a series of four concentric eggs. The inner egg being a small "witch" or "cock" egg.

The ovary of this bird was in the same condition as the ovary of any laying bird. It had a normal series of enlarging yolks and resorbing follicles. The oviduct as far as the posterior end of the isthmus or egg membrane secreting portion was also in the normal laying condition. At the posterior end of the isthmus the duct ended blindly, although the ligament which suspends the duct from the body wall continued normally to the end of the body cavity. There was no shell gland or vagina. The only opening to the duct was the funnel mouth.

It was evident that this bird was in the midst of a normal period of reproduction and was producing eggs in a normal manner as far as her oviduct allowed. The membrane shelled eggs then backed into the body cavity from whence they were

*This is an abstract of a paper by Maynie R. Curtis, having the same title and published in *Biological Bulletin*, Vol. XXVIII, pp. 154-163. Pl. I. & II. 1915.

being absorbed at a rapid rate. The occurrence of double eggs shows that one egg did not always get out of the duct in time to make way for the succeeding egg. The occurrence of the egg composed of four concentric eggs suggests that the direction of the movements of the egg must have been considerably disturbed so that this egg passed up and down the duct several times before it was discharged into the body cavity. The condition of the internal organs of the bird indicates that the physiological processes of digestion, absorption and secretion were not seriously disturbed.

The forward end of the oviduct or egg tube arises very early in the development of the chick embryo. The tube then grows backward until it reaches the region of the vent. The most probable explanation for the occurrence of the oviduct found in the case described is that in early embryonic development (probably on the sixth or seventh day of incubation) the backward growth of the oviduct stopped permanently while the differentiation of the part already formed continued in the normal manner.

As in other cases where the passage of the egg is prevented the sex organs passed through their normal reproductive cycles; the oviduct functioned as far as the point where the passage was interrupted; the eggs were then returned to the body cavity and resorbed. The number of eggs and empty egg membranes found in this fowl which was apparently in a perfectly normal physical condition show that a bird may possess very great power of resorption of its own eggs.

ON THE REFRACTIVE INDEX OF THE SERUM IN A GUINEA-CHICKEN HYBRID.*

This is a record of certain results regarding the refractive index of the blood serum of a genus-hybrid produced from the mating Cornish Indian Game ♂ × Guinea Fowl ♀.

Our results show that (1) there is a definite, characteristic, and permanent difference between the refractive index of the serum of the fowl and that of the guinea; and (2) that in the hybrid the guinea parent is dominant in respect of the physico-

*This is an abstract of a paper by Raymond Pearl and John W. Gowen, having the same title and published in Proceedings of the Society for Exper. Biology and Medicine. Vol. XII, p. 48, 1915.

chemical constitution of the blood as measured by the refractive index. Some figures on the point follow :

Source of Blood.	<i>n</i> D
Fowl (<i>Gallus</i> sp.).....	1.34537
(Mean of data from 10 birds of different hereditary constitutions)	
Guinea (<i>Numida meleagris</i>)	1.34184
(Mean from 6 birds)	
Hybrid (<i>Gallus</i> ♂ × <i>Numida</i> ♀).....	1.34179

FITTING LOGARITHMIC CURVES BY THE METHOD OF MOMENTS.*

The use of logarithmic curves in the analysis of various kinds of biological and agricultural data is rapidly becoming widespread and general. It was first shown by Lewenz and Pearson¹ that the growth of children followed a logarithmic curve. Pearl demonstrated that the phenomena of growth and differentiation in *Ceratophyllum* also followed a logarithmic curve. Donaldson and Hatai in a series of papers dealing with the growth and quantitative relations of the whole organism and its various parts in the white rat and the frog have shown that the same law holds for growth in those forms.

Other biological phenomena than growth follow a logarithmic law. Pearl, in a case of regulation of the shape of abnormal eggs, and later Curtis for normal eggs, have shown that the changes in size and shape of successively laid eggs are graduated with a logarithmic curve. Work now in progress in the Biological Laboratory, Maine Experiment Station, of which only a preliminary notice has yet been published, shows that generally the change in milk flow with age in dairy cattle is logarithmic. Several years ago Holtsmark pointed out that the relation between the number of food units required and the milk yields of different animals was logarithmic.

From this incomplete review of the literature recording the use of logarithmic curves in biological and agricultural investigations it is clear that the workers in these fields will, as time

*This is an abstract of a paper by John Rice Miner, having the same title and published in the *Journal of Agricultural Research*, Vol. III, pp. 411-423. 1915.

goes on, have increasing need to be able to handle these curves easily and critically.

Up to the present time the only available method of fitting logarithmic curves was that of least squares. Several years ago Pearl and McPheters published a set of tables intended to lighten materially the labor of fitting such curves by the least-squares method. For a long time, however, the writer has felt that it would be highly desirable to bring this class of curves into the general system of curve fitting worked out by Pearson and known as the "method of moments." The theory of the method is extremely simple, involving as it does only the assumption that if we equate the area and moments of a theoretical curve to the area and moments of a series of observations we shall get a reasonable fit of the curve to the observations. Experience with the method in the hands of different workers in England and America has abundantly demonstrated that this assumption is entirely justified in the fact.

In the papers cited, and in others also, Pearson has given the equations for the calculation of the constants from the moments in the case of (a) skew frequency curves in general, (b) sine curves, (c) parabolas of all orders, (d) the point binomial, (e) hypergeometrical series, etc. There has been lacking, however, the determination of the equations connecting moments and constants for the general family of logarithmic curves of the type.

$$y=a+bx+cx^2+d\log(x+q)$$

and its modifications. The necessary equations are given in the paper here abstracted.

INTERPOLATION AS A MEANS OF APPROXIMATION TO THE GAMMA FUNCTION FOR HIGH VALUES OF n *

This paper is purely mathematical in subject matter and interest. The question discussed is whether a degree of approximation, sufficient for statistical purposes, to the value of log gamma n can be had by interpolating in a table of log factorial n .

*This is an abstract of a paper by Raymond Pearl, having the same title and published in Science N. S. Vol. XLI, pp 506-507.

It is shown that the interpolation method, when third differences are used, gives values slightly better than those by Forsyth's method when $n = 25$. For $n = 75$ or more the interpolation method using only second differences gives an approximation sufficiently close for all practical statistical purposes. As to the labor involved, there is no great amount of choice between Forsyth's and the interpolation method, but on the whole there appears to be a distinct, if small, advantage in favor of the interpolation.

MENDELIAN INHERITANCE OF FECUNDITY IN THE DOMESTIC FOWL, AND AVERAGE FLOCK PRODUCTION.*

In this paper it is shown that:

i. There is a marked difference in average egg production per bird of Barred Plymouth Rock pullets of the Maine Station strain at the present time as compared with what obtained during the period of simple mass-selection for this character. This is seen in Table I.

TABLE I.

MONTHLY DISTRIBUTION OF MEAN EGG PRODUCTION PER BIRD UNDER DIFFERENT BREEDING SYSTEMS

Month	Weighted Mean Under Mass Selection	Best Comparable Year to 1913-14 of Similar-sized Flocks Under Mass Selection (1905-06 100-bird Pens)	Best Month in Any Year of Mass Selection, Any Size Flock	Year 1913-14
November...	4.63	5.38	6.45 (1904-05, 100-bird flock)	10.76
December...	8.91	9.91	12.02 (1901-02, only 48 birds in small flocks)	14.19
January...	11.71	13.27	15.21 (1901-02, only 48 birds in small flocks)	18.88
February...	10.87	13.39	14.46 (1905-06, 50-bird flocks)	18.37
March.....	16.11	17.33	18.29 (1905-06, 50-bird flocks)	19.22
April.....	15.85	16.48	18.50 (1901-02, only 48 birds in small flocks)	18.44
May.....	13.92		17.02 (1902-03, 147 birds in small flocks)	16.88
June.....	12.46	13.47	16.88 (1901-02, only 48 birds in small flocks)	14.56
July.....	10.87	10.49	14.90 (1901-02, only 48 birds in small flocks)	14.52

*This is an abstract of a paper by Raymond Pearl, having the same title and published in American Naturalist, Vol. XLIX, pp. 306-317, 1915.

2. This difference is in the direction of a substantially higher mean production at the present time, when tested on flocks of large size.

3. The increase in flock average productivity is most pronounced in respect to winter production, which is the laying cycle to which especial attention has been given in the breeding.

4. The cause of this increase in flock productivity appears, with a degree of probability which is very high and amounts nearly to certainty, to be that the method of breeding the stock now followed is more closely in accord with the mode of inheritance of fecundity than was the simple mass-selection practised in the earlier period.

5. The result announced in earlier papers that high fecundity is a sex-linked character, for which the female is heterozygous, has been confirmed by practical poultrymen in their breeding operations.

STUDIES ON THE PHYSIOLOGY OF REPRODUCTION IN THE DOMESTIC FOWL.

XIII. ON THE FAILURE OF EXTRACT OF PITUITARY BODY (ANTERIOR LOBE) TO ACTIVATE THE RESTING OVARY.

From the evidence presented in this paper it appears to be clearly established that the substance of the anterior lobe of the pituitary body of the cow, when injected into the abdominal cavity of hens in which the ovary is in a completely resting condition, does not cause an activation of the ovary, in the sense of inducing ovulation at an earlier date than that at which it would normally occur.

*This is an abstract of a paper by Raymond Pearl and Frank M. Surface, having the same title and published in *Journal of Biological Chemistry*, Vol. XX1, pp. 95-101. 1915.

FREQUENCY OF OCCURRENCE OF TUMORS IN THE DOMESTIC FOWL.*

The purpose of the present paper is to record the data on the frequency of occurrence of tumors in the domestic fowl which have been collected during eight years' routine autopsy work at the Maine Agricultural Experiment Station.

The chief points brought out by an analysis of these data are as follows:

(1) Of the 880 birds autopsied 79, or 8.96 per cent, had tumors. That is, there were 90 cases of tumors per 1,000 birds.

(2) There was no significant difference in frequency of occurrence of tumors between birds which died from natural causes and apparently normal birds which were killed.

(3) There is a significant positive correlation between age and the occurrence of tumors. Only 7.37 per cent of the birds under 2 1-4 years had tumors, while neoplasms were present in 19.17 per cent of those that were over that age.

(4) In birds with tumors which died from natural causes, the tumors were directly or indirectly the probable cause of death in from one-third to one-half the cases.

(5) There was a decided tendency for the association of hypertrophied (apparently due to cell infiltration) liver, spleen, or kidney with the presence of tumors in other organs.

(6) Death often resulted from internal hemorrhage from the tumor, the underlying tissue, or the hypertrophied liver or spleen.

(7) The tumors can be classified into cystic and tissue tumors; 22.78 per cent of the tumors were of cystic and 74.68 per cent of solid-tissue structure. There were two cases of tissue tumors to which cysts were attached.

(8) In the females¹ the organs most frequently affected were the genital organs; 37.76 per cent of all the tumors being in the ovary and 18.36 per cent in the oviduct and oviduct ligament.

(9) In most cases the tumors were confined to one organ. In 15 cases, however, the tumor had evidently undergone metastasis, since tumors of similar nature occurred in from two to four organs.

*This is an abstract of a paper by Maynie R. Curtis, having the same title and published in *Journal of Agricultural Research*, Vol. V, pp. 397-404. 1915.

¹Autopsies were made on too few males to yield reliable data.

SEVENTEEN YEARS SELECTION OF A CHARACTER SHOWING SEX-LINKED MENDELIAN INHERITANCE.*

In 1898 there was begun at the Maine Agricultural Experiment Station an experiment in breeding Barred Plymouth Rock fowls, having for its purpose the improvement by selection of the character winter egg production. This investigation has continued to the present time.

The experiment has fallen into three divisions or periods: viz., (1) the period from 1898 to 1907, (2) the period from 1908 to 1912, and finally (3) the period from 1912 to date. Detailed reports on the methods of breeding in operation have been published elsewhere.† For purposes of clear orientation in the present discussion it will be well here briefly to review the facts as to the methods of breeding used in each of the periods. With these facts definitely in mind we may then proceed to an examination of the results.

1. *The Period from 1898 to 1907.*—During this period the breeding followed the plan outlined at the beginning by Woods and Gowell. Essentially it consisted of the following elements.

1. Trap-nest record of the performance of each individual female.
2. Selection as breeders of all females which laid more than a definite number of eggs (150) in the first laying year.
3. Selection as breeders of males whose dams had laid more than another definite number of eggs (200).
4. The indiscriminate mass breeding, *without* individual pedigrees, of all individuals selected as described under 2 and 3, and, in consequence,

*This is an abstract of a paper by Raymond Pearl, having the same title and published in *American Naturalist*, Vol. XLIX, pp. 595-608, 1915.

†Cf. particularly Woods, C. D., and Gowell, G. M., U. S. Dept. Agr. Bur. Anim. Ind. Bulletin 90, 1906, pp. 42; Pearl, R., and Surface, F. M., *Ibid.* Bulletin 110, Part I, 1909, pp. 80; Pearl, Me. Agr. Expt. Stat. Ann. Rept., 1911, pp. 113-176; and Pearl, *Jour. Exp. Zool.*, Vol. 13, 1912, pp. 153-268.

5. *No test of the progeny* of particular matings with respect to their laying ability.

This may be designated as the *period of mass selection*.

2. *The Period from 1908 to 1912*.—For reasons which have been fully set forth elsewhere³ it was decided not to continue the breeding along the same plan after 1907. The new plan, put into operation first in the breeding season of 1908, was calculated primarily to furnish definite information regarding the mode of inheritance of the character winter egg production. It involved essentially the following items:

1. Trap-nest record of the performance of each individual female.
2. The selection of both males and females was made on a *double* basis, including in addition to the individual's own performance as in the earlier plan, also the idea of progeny performance. In practice this worked out *for hens* in the following way; Plans were made to see whether there could be formed by selection and propagated three distinct strains of winter egg producers, namely, high, mediocre and low. This involved, *on the individual performance side*, the separate selection in the first years of *three* classes of females as breeders: (*a*) good winter producers, with records before March 1 of above 30 eggs; (*b*) mediocre winter producers, with records below 30 eggs; and (*c*) poor winter producers, which laid no eggs before March 1. The division at 30 eggs was, after the first year, merely a nominal one in the selection of *high* producers. Actually only birds were used in the *a* class whose records materially exceeded 30 eggs, running up to over 100 eggs in some cases.

The *progeny performance* idea was carried out in two ways in the breeding. In the first place, no female was selected for the *high* winter production breeding pens, for example, unless, in addition to her own high winter record, all her sisters and her dam were high producers. In the second place, of all females fulfilling the above qualification only those were bred a

³Pearl and Surface, *loc. cit.*

second time whose progeny from the first year's mating had proven to be all high producers. Similar types of selection were followed by the mediocre and low lines, except that segregating families were put in the mediocre class.

3. The selection of males was along essentially the same lines, with only such difference as is involved in the fact that the male makes no performance record himself. Males were put into the breeding pen the first time on the basis of the records of their dams, on the one hand, and of their sisters, on the other hand. Those whose progeny proved that they were transmitting the character to which selection was being made were used a second or even third time as breeders.
4. Complete individual pedigrees, whereby each offspring individual's parentage, both male and female, was known.
5. The records of production of the progeny of each mating separately recorded and studied as a unit.

It will be noted that there are but two essential differences between the plan in this period and that followed in the earlier one. These are: first and most important, that in this second period the principle of *progeny testing* was introduced into the scheme of breeding. The second difference was that selection was carried on for low production as well as for high, which had not been previously done. A third difference is apparently found in the fact that in this second period of selection the winter record rather than the yearly record is made the basis of selection. This is in no way an essential difference.

As a result of the studies made in this period on the plan of breeding outlined the mode of inheritance of the character winter production was definitely determined, and has been confirmed by subsequent work.* The character was shown to be Mendelian in its genetic behavior, depending upon two factors, one of which is sex-linked.

3. *The Period from 1912 to Date.*—The only difference in the mode of breeding the stock of Barred Plymouth Rocks in

*Pearl, 1912, *loc. cit.*, also AMER. NAT., Vol. XLIX, 1915, pp. 306-317, and Curtis and Pearl, *Jour. Exp. Zoology*, Vol. 10, 1915, pp. 45-50.

this period, as compared with the preceding one, is found in the fact that during this last period *all selections for low and mediocre production have been dropped*. The breeding for high production alone continues, with only such differences in the details of manipulation of the breeding stock as would naturally follow a definite knowledge of the mode of inheritance of the character, and of the gametic constitution of particular individuals with reference to that character. As a matter of fact, all low-producing lines were dropped at the end of the laying year 1911-12. Certain of the mediocre lines were continued a year longer. In the laying flock of 1913-14 there were no birds which had been bred for anything other than high production, so far as the breeder's deliberate intention went.

The results of this seventeen year selection period are set forth in Table I.

TABLE I

MEAN WINTER PRODUCTION PER BIRD OF THE BARRED PLYMOUTH ROCK FLOCKS FROM 1899 TO 1915

Laying Year	Mean Winter Production of All Birds	No. of Birds Making Winter Records	Mean Winter Production of All Birds Selected for <i>High</i> Production	Mean Winter Production of All Birds Selected for <i>Low</i> Production
1899-1900	41.03 eggs	70	-	-
1900-1901	37.88 "	85	-	-
1901-1902	45.23 "	48	-	-
1902-1903	26.01 "	147	-	-
1903-1904	26.55 "	254	-	-
1904-1905	35.04 "	515	-	-
1905-1906	40.65 "	635	-	-
1906-1907	22.44 "	635	-	-
1907-1908	19.93 "	780	-	-
1908-1909	26.69 "	359	54.16	22.06
1909-1910	31.76 "	247	47.57	25.05
1910-1911	30.49 "	264	50.58	17.00
1911-1912	35.93 "	232	57.42	16.43
1912-1913	43.01 "	182	52.61	-
1913-1914	52.20 "	192	52.20	-
1914-1915	45.89 "	179	45.89	-
Totals and means	35.05 "	4,842	51.49	20.14

The data of this table are shown graphically in Fig. 63.

From the table and diagrams the following results appear:

1. The number of individuals involved in this experiment, on each one of which exact trap-nest records have been kept, is large, amounting nearly to five thousand. This number is large enough to lead to conclusions which are trustworthy.

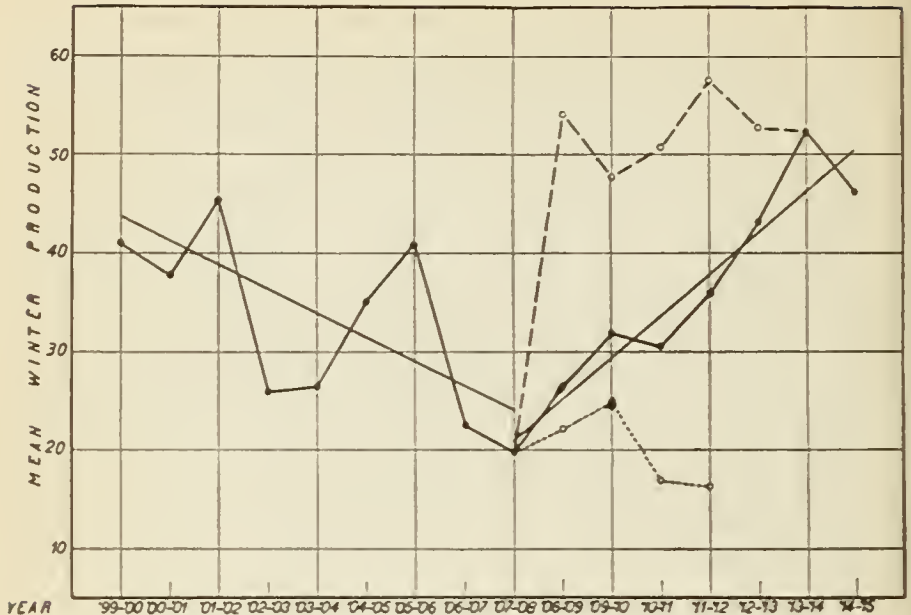


FIG. 1. Graph showing the course of mean winter egg production between the years 1899 and 1915. The solid lines and circles give the total flock means. The two straight lines, fitted by the method of least squares to the observed flock means, have the equations $y=43.655-2.181x$, $y=17.070+4.148x$. The open circles and broken (dash) line give the means of the lines selected for high winter production between the years 1908 and 1915. The dotted line and open circles give the mean winter production of the lines selected for low production between the years 1908 and 1912.

2. From the beginning of the experiment through the laying year 1907-08 the general trend of mean production was downward, with minor fluctuations from year to year. In other words during the period in which the system of breeding was mass selection for high production without progeny test there was no change of the mean in the direction of the selection. The fluctuations in mean production during this period were, in the main, due probably to two sets of causes: (a) environmental differences in different years acting at one point or another in the life history of the birds; (b) random fluctuations in the genetic constitution of the male birds used as breeders in successive years, brought about because of the ignorance of the breeder, in the absence of any individual progeny testing plan, of the ability of any particular male to transmit high fecundity to his daughters.

3. Since the laying year 1907-08 there has been a steady increase in mean winter production for the whole flock, except for the years 1910-11 and 1914-15. In the former year the decline in the mean is slight, and is probably due to unfavorable environmental influences. In 1914-15 the decline is certainly due to such causes.

4. That selection on a progeny test basis was effective is demonstrated not only by the general flock averages, but also by the fact that it was possible to propagate separately high and low producing strains. The high producing strains differed widely from the low producing in mean winter production. Taking the average for seven years in the case of the high, and four years in the case of the low, it appears that the mean winter production of the high producing strains was approximately two and a half times that of the low producing strains. At the end of the laying year 1911-12 the low producing lines were dropped. In the next year (breeding season of 1913) no birds were bred which were known to belong to segregating lines. Of course some were included which proved afterwards to have been segregating, but this fact could not, in any such case, have been told in advance from the records in hand.

A SYSTEM OF RECORDING TYPES OF MATING IN EXPERIMENTAL BREEDING OPERATIONS.*

This paper is of interest only to the experimentalist. It describes a uniform and comprehensive method of describing numerically the different forms of pedigrees which arise in Mendelian work.

MEASUREMENT OF THE WINTER CYCLE IN THE EGG PRODUCTION OF DOMESTIC FOWL.* †

In this paper quantitative evidence is presented which shows, with flocks of poultry having average hatching dates falling somewhere within the month of April, that—

*This is an abstract of a paper by Raymond Pearl, having the same title and published in *Science N. S.* Vol. XLII, pp. 383-386, 1915.

*†This is an abstract of a paper by Raymond Pearl, having the same title and published in *Journal of Agricultural Research*, Vol. V, pp. 429-437. 1915.

(1) The correlation between the egg production to March 1 of the pullet year as one variable and the egg production up to the time when the individual is 300 days of age as the second variable is extremely high.

(2) The mean production to March 1 is, in general, higher than the mean production to 300 days of age.

(3) The production to March 1 is a relatively less variable measure (as indicated by the coefficient of variation) than the production to 300 days of age.

(4) The conclusion that the 300-day production would be a better measure of the winter cycle of fecundity than the production to March 1 is not warranted by the facts. Whatever superiority there is of one of these measures over the other is entirely in favor of the production to March 1. We may therefore conclude that the use, in the writer's investigations on fecundity, of the record of egg production to March 1 of the pullet year as a measure of the winter cycle of production is fully justified by a critical examination of the facts. The justification for the employment of the winter cycle of production as an index of innate fecundity capacity or ability is a distinct and separate problem which has been discussed at length in earlier papers.

TWO CLOVER APHIDS.*

Aphis brevis Sanderson (Long-beaked clover aphid).

In the vicinity of Orono, Me., the leaves of the hawthorn (*Crataegus* spp.) in June are commonly twisted into dark-purple swollen curls and are inhabited by an aphid the fall migrants of which were described by Prof. Sanderson as *Aphis brevis*. This insect takes flight from hawthorn during June and early July and returns late in the season before producing the sexual generation. I have taken the fall migrants on cultivated plum (*Prunus* spp.), but yet have made no spring collections from that host. In June and July, 1906, I collected apparently the same species from the twigs and terminal leaf curls of the Japan quince (*Cydonia japonica*).

*This is an abstract of a paper with the same title, by Edith M. Patch, published in the Journal of Agricultural Research, Dept. of Agriculture, Washington, D. C., Vol. III, No. 5, Feb. 15, 1915, pp. 431-433, with 3 figures.

I undertook some transfer tests during the summer of 1912, and found that *Aphis brevis* accepted both alsike and other clover (*Trifolium* spp.). Migrants placed on alsike and white clover produced nymphs that fed with apparent satisfaction on the test plants. The potted white clover was, however, more easily managed in the laboratory, so it was selected for the main rearings. The transfer was made on June 14. The migrants fed on the clover, and their abdomens became distended. At this time the head, thorax, and cornicles were black, and abdomens olive green, with distinct black lateral dots. By June 21 their abundant progeny were established on both stem and runner. The nymphs at first were pale and pellucid, with rosy head and prothorax. By June 24 this generation had matured, but did not begin to reproduce for a day or two.

Aphis bakeri Cowen (Short-beaked clover aphid).

About the middle of August, 1914, large numbers of an aphid from *Trifolium pratense* were taken by Mr. George Newman at Orono, Maine. This species is distinct from the one just discussed, and yet they resemble each other enough so that both species have sometimes been listed under the same name. The fact that both species are found on hawthorn in the spring and migrate to clover in the summer may be partly responsible for this confusion.

The habitat of the short-beaked clover aphid on clover seemed to be the ventral side of the leaf and the stem near the ground. The colonies were frequently covered by "ant sheds," as well as sometimes extending for a short distance underground.

This species is smaller, more slender and graceful than the long-beaked clover aphid. Joint V of the antenna is noticeably shorter than IV and is without sensoria, except the usual distal one, in the summer winged viviparous female. The stigma is rather narrow and the distal end acute. The beak hardly reaches the second coxa and frequently falls considerably short of it. The prothoracic and abdominal lateral tubercles are prominent, but very slender. Both species have the cornicles and cauda very short.

THE POND-LILY APHID AS A PLUM PEST.*

One of our best-known aphids common upon various water plants is *Rhopalosiphum nymphacae* (Linn.). This has received considerable attention as a "semi-aquatic" species which on account of the waxgland areas of its body appears to be particularly adapted to a life in moist localities and to suffer no inconvenience from contact with water while feeding on aquatic plants.

One of the most troublesome of our plum aphids in Maine is a species inhabiting the shoots and the ventral surface of the leaves, ordinarily without causing curl or similar deformation of the leaf, but exhibiting a dangerous tendency to feed also upon the young fruit itself as well as tapping the fruit stems.

After watching this plum aphid several years and wondering where its summer home might be (for it is a migratory species, leaving the plum in June) it was noticed that there were apparently no structural characters to separate this from the common pond-lily aphid, *R. nymphacae*.

In view of this the "migration test" was made this spring by placing the spring migrants (alate viviparous forms) from plum upon water plantain, *Alisma Plantago-aquatica*; arrow-head, *Sagittaria latifolia*; and cat-tail flag, *Typha latifolia*; which had been potted and kept under laboratory control. These three plants are on the approved dietary of *R. nymphacae* and the plum migrants accepted them all readily, and the progeny of the plum migrants are perfectly content with the habitat given them.

Thus the life cycle of the ancient aphid is found to include a residence upon the plum, migrating thence to water plants for the summer and returning to the plum in the fall for the deposition of the over-wintering egg which provides for its spring generations upon that tree.

Biosteres rhagoletis Richmond, sp. n., A Parasite
of *Rhagoletis pomonella* Walsh.†

During the summer of 1913 the writer was engaged in studying blueberry insects in Washington County, Maine. A maggot

*This is an abstract of a paper with the same title, by Edith M. Patch, published in Science, N. S., Vol. XLII, No. 1074, page 164, July 30, 1915.

†This is an abstract of a paper with the same title, by William C. Woods, published in The Canadian Entomologist, Vol. XLVII, pp. 293-295, with 3 figures.

was found infesting the berries, which when bred proved to be *Rhagoletis pomonella* Walsh, the apple maggot or railroad worm (Journal of Economic Entomology, 1914, Vol. VII, pp. 398-399). There were also obtained from larvae of this species collected at Cherryfield, Maine, in August and September, 1913, twenty-one specimens of a parasite, which emerged from puparia kept under laboratory conditions, at various dates between February 25 and April 21, 1914.

No parasite has been recorded from *Rhagoletis pomonella* Walsh, previous to this time.

The species belongs to the family *Braconidae* and to the subfamily *Opiinae*. In this same group are placed many of the parasites, including one of this genus, which are recorded by Silvestri as bred from various fruit-flies (Bulletin 3, Hawaii Board of Agriculture and Forestry, 1914.)

Specimens of this species were swept on the blueberry barrens of Washington County last summer, where apparently they had considerably reduced the number of the maggots as compared with the preceding season. Specimens of the Cherryfield parasites were submitted to Mr. E. A. Richmond, of Cornell University, who determined it as a new species.

EFFECT OF TEMPERATURE ON GERMINATION AND GROWTH OF THE COMMON POTATO-SCAB ORGANISM.*

The object of this study was to determine as closely as possible the optimum, maximum and minimum temperatures for the growth of the common potato scab organism in artificial cultures, also the effects of variations in temperature upon the germination of the so-called "gonidia" which it produces in the fruiting stage upon such cultures. The organism under consideration is what has been known since 1892 as *Oospora scabies* Thaxter and which Lutman and Cunningham have recently

*This is an abstract of a paper with the same title by Michael Shapovalov published in the Journal of Agricultural Research, Vol. IV, No. 2, pp. 129-134, May 15, 1915.

pronounced as identical with *Actinomyces chromogenus* Gasperini.

In making the germination tests the ordinary agar hanging-block used in studying the growth of bacteria was employed, using beef extract agar without salt. The maximum temperature for germination and growth is apparently slightly below 41° C. Germination is most rapid between 35° and 40.5° with little difference at temperatures between these points. Below this the time for germination gradually increases so that 10° C. it takes 15 or more times as long as at 35°. The largest percentage of germination is usually secured at from 30° to 37° C. Apparently the minimum temperature for germination lies somewhere near 5° C.

Exposure to cold weather, several degrees below zero centigrade, does not always kill the parasite. The organisms in cultures on cooked potato cylinders withstand low temperature better than those in beef broth cultures.

While temperatures from 35° to 40° C. are most favorable for the germination of the gonidia, they are unfavorable for long-continued growth of the organism, although at 35° a stimulating effect was produced at first. Below 20° C. growth is very much retarded and slow. The maximum temperature for growth is about 40.5°, the optimum 25° to 30°, and the minimum about 5° C.

Abnormal growths or involution forms were observed in the cultures but apparently these were produced as the result of variation in the composition of the culture media employed and were not caused by unfavorable temperatures.

METEOROLOGICAL OBSERVATIONS.

For many years the meteorological apparatus was located in the Experiment Station building and the observations were made by members of the Station Staff. June 1, 1911, the meteorological apparatus was removed to Wingate Hall and the observations are in charge of Mr. James S. Stevens, professor of physics in the University of Maine.

In September, 1914, the meteorological apparatus was again moved to Auburt Hall, the present headquarters of the physics department.

The instruments used were at Lat. $44^{\circ} 54' 2''$ N. Lon. $64^{\circ} 40' 5''$ W. Elevation 135 feet.

The instruments used are the same as those used in preceding years, and include: Maximum and minimum thermometers; rain gauge; self-recording anemometer; vane; and barometers. The observations at Orono now form an almost unbroken record of forty-seven years.

METEOROLOGICAL SUMMARY FOR 1915.
Observations Made at the University of Maine.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average.	Total.
Highest temperature	52	64	69	73	77	87	89	89	89	76	62	54		
Lowest temperature.	21	8	6	20	25	31	40	36	30	27	19	4		
Mean temperature	23.9	28.7	30.2	45.4	51.5	62.7	65.7	66.5	62.1	50.8	38.2	28.8	46.21	
Mean temperature in 47 years.	16.4	12.3	30.1	40.1	55.7	69.8	65.8	66.0	60.0	50.9	38.3	24.1	42.73	
Total precipitation in inches	2.49	3.56	0.34	3.28	4.97	2.47	6.67	4.67	1.19	2.62	3.04	3.57		38.87
Mean precipitation in 47 years	3.99	3.51	4.11	29.5	3.56	3.39							42.67	
Number of days with precipitation of .01 or more.	9	10	2	11	11	12	13	13	1	7	11	10		113
Snow fall in inches	9.1	14.0	0.5	13.0										19.1
Mean snow fall in 47 years.	21.69	21.36	15.00	5.62	0.18					0.70	7.03	15.96	87.34	
Number of clear days	14	13	16	13	13	14	14	15	22	19	11	13		177
Number of fair days	8	6	7	3	8	8	9	5	4	4	6	2		67
Number of cloudy days.	9	9	8	14	10	8	8	11	7	8	13	16		121
Total movement of wind in miles	3573	3969	4980	4761	4763	3268	3136	2680	3708	3688	1780	3866		18241

REPORT OF THE TREASURER.

The Station is a department of the University and its accounts are kept in the office of the Treasurer of the University. The books, voucher files, etc., are, however, all distinct from those of the other departments of the University. The classification of accounts is that prescribed by the auditors on the part of the Federal Government, and approved by the State Auditor. All of the accounts are audited by the State Auditor and the Hatch Fund and Adams Fund accounts are also audited by the Office of Experiment Stations acting for the United States Secretary of Agriculture in accordance with Federal Law.

The income of the Station from public sources for the year that ended June 30, 1915, was:

U. S. Government, Hatch Fund appropriation...	\$15,000 00
U. S. Government, Adams Fund appropriation...	15,000 00
State of Maine, Animal Husbandry investigation appropriation	5,000 00
State of Maine, Aroostook Farm investigation ...	5,000 00

The cost of maintaining the laboratories for the inspection analyses is borne by analysis fees and by the State Department of Agriculture. The income from sales at the experiment farms is used to meet the expenses of investigations. The printing which costs about \$4,500 is paid for by an appropriation to the University.

All of the disbursements except for printing and the sheep husbandry experiment are given in the tables that follow on the two succeeding pages. The sheep husbandry expenditures were labor \$182.55, seeds, plants and sundry supplies \$100.22, feeding stuffs \$483.59 and live stock \$750.99, making a total of \$1,517.35.

REPORT OF TREASURER FOR FISCAL YEAR
ENDING JUNE 30, 1915.

DISBURSEMENTS.

RECEIPTS.	Hatch fund.	Adams fund.	Animal husbandry investiga- tions.
Salaries	\$5,537 01	\$11,049 60	\$4,722 74
Labor	3,664 04	33 03	
Publications	113 87		
Postage and stationery	717 20	144 72	56 75
Freight and express	139 05	99 58	2 28
Heat, light and power	158 75	168 00	
Chemical and laboratory supplies	180 29	269 74	21 42
Seeds, plants and sundry supplies	325 06	246 04	35 63
Fertilizers	1,375 36		
Feeding stuffs	1,018 96	1,769 08	
Library	619 07	80 84	2 00
Tools, machinery and appliances	211 36	58 81	
Furniture and fixtures	93 12	34 50	
Scientific apparatus and specimens	16 20	200 09	3 71
Live stock	4 50		
Traveling expenses	353 30	511 49	155 47
Contingent expenses	20 00		
Buildings	452 86	334 48	
Total	\$15,000 00	\$15,000 00	\$5,000 00

REPORT OF TREASURER FOR FISCAL YEAR
ENDING JUNE 30, 1915—Concluded.

DISBURSEMENTS.

RECEIPTS.	Aroostook farm.	General account.	Inspection analysis.
Salaries.....	\$970 00	\$4,135 54	\$10,441 78
Labor.....	3,352 87	2,705 31	.....
Publications.....	.....	10 40	.....
Postage and stationery.....	46 39	91 16	263 18
Freight and express.....	46 99	526 51	157 85
Heat, light and power.....	211 64	256 63	164 67
Chemical and laboratory supplies.....	577 16	402 62	926 79
Seeds, plants and sundry supplies.....	219 53	979 04	.....
Fertilizers.....	1,869 29	24 00	.....
Feeding stuffs.....	585 79	321 97	.....
Library.....	.....	10 70	.....
Tools, implements and machinery.....	966 57	96 48	.....
Furniture and fixtures.....	4 53	2 04	153 60
Scientific apparatus.....	.....	11 85	.....
Live stock.....	70 00	650 00	.....
Traveling expenses.....	276 25	163 50	173 68
Contingent expenses.....	221 70	205 89	7 20
Buildings.....	468 59	129 41	.....
Total.....	\$9,887 30	\$10,723 05	\$12,288 75

INDEX.

	PAGE
Abnormality of oviduct of domestic fowl	291
<i>Accephalus vitellinus</i>	139
<i>Acocephalus albifrons</i>	108
<i>striatus</i>	107
<i>Agallia novella</i>	96
4-punctata	95
<i>sanguinolenta</i>	97
<i>Amblycephalus melsheimeri</i>	119
<i>sayi</i>	117
<i>Athysanella acuticauda</i>	132
<i>Anthrysanus angustatus</i>	130
<i>anthracinus</i>	126
<i>arctostaphyli</i>	129
<i>chlamydatus</i>	136
<i>curtisi</i>	125
<i>elongatus</i>	129
<i>extrusus</i>	127
<i>fenestratus</i>	88
<i>gammaroidea</i>	132
<i>humidus</i>	131
<i>instabilis</i>	128
<i>nigrinasi</i>	89
<i>obsoletus</i>	127
<i>plutonius</i>	126
<i>striatulus</i>	128
<i>striola</i>	132
<i>tergatus</i>	144
<i>vaccinii</i>	139
<i>variabilis</i>	88
Aphid of potato, description	208
distribution	208
economic significance	207
food plants	213
indoor studies	210
life history	206
literature	215
natural controls	216
notes	214
remedial measures	219
pink and green, of potato	205
pond-lily, as a plum pest	306
woolly, of elm and Juneberry	197

	PAGE
Aphids, clover	304
Apple maggot attacking the blueberry	252
spraying, effect on foliage and fruit	182
experiments	177
discussion of results	189
manner of application	181
treatment of plots	178
trees, fertilizer experiments	52
Assumption of male characters by a cow	65
<i>Aulacizes noveboracensis</i>	101
Avuncular matings	230
<i>Balclutha impictus</i>	149
<i>punctata</i>	149
Bean breeding	161
production in Maine	164
Beans, comments of Boston dealers	175
yellow eye, improved	166
old fashioned	170
standard types	151
<i>Biosteres ragoletis</i>	263
Blueberry, associated plants	251
barrens of Washington County	249
cecid	266
damsel-bug	283
insects attacking the fruit	252
of Maine	249
leaf feeders	285
species found on the barrens	251
Breeding oats. See oat breeding.	
operations, system of recording types of mating	303
Bythoscopidae, key to genera	87
<i>Bythoscopus cognatus</i>	89
<i>fenestratus</i>	88
<i>minor</i>	88
<i>pruni</i>	87
4-punctata	95
<i>sanguinolenta</i>	97
<i>sobrius</i>	88
<i>strobi</i>	128
<i>tergatus</i>	144
<i>variabilis</i>	88
• Cecid attacking the blueberry	266
<i>Chlorotettix galbanata</i>	143
<i>lusoria</i>	144
<i>tergatus</i>	144
<i>unicolor</i>	144

	PAGE
<i>Cicada acuminata</i>	104
<i>coccinea</i>	101
<i>lateralis</i>	99
<i>6-notata</i>	147
<i>smaragdula</i>	132
<i>striola</i>	132
<i>virescens</i>	90
<i>Cicadula pallida</i>	146
<i>potoria</i>	147
<i>6-notata</i>	147
<i>slossoni</i>	147
<i>suffusa</i>	146
<i>variata</i>	145
Clover aphids	304
Cousin mating	226
Cow, assumption of male characters	65
cystic degeneration of the ovaries	65
injection of pituitary body substance	69
Currant fruit weevil	270
Cystic degeneration of ovaries of a cow	65
<i>Deltocephalus abdominalis</i>	121
<i>affinis</i>	122
<i>apicatus</i>	120
<i>bilineatus</i>	116
<i>configuratus</i>	122
<i>debilis</i>	121
<i>infumatus</i>	118
<i>inimicus</i>	123
<i>melsheimeri</i>	119
<i>minki</i>	118
<i>misellus</i>	117
<i>nigrifrons</i>	122
<i>obtectus</i>	118
<i>productus</i>	116
<i>sayi</i>	117
<i>sylvestris</i>	119
<i>Dicraneura carneola</i>	151
<i>communis</i>	150
<i>cruentata</i>	150
<i>feberi</i>	151
<i>Diedrocephala angulifera</i>	102
<i>coccinea</i>	101
<i>noveboracensis</i>	101
Domestic fowl, physiology of reproduction	291, 296
<i>Draeculacephala angulifera</i>	102
<i>mollipes</i>	103
<i>noveboracensis</i>	101

	PAGE
<i>Driatura gammaroidea</i>	132
<i>Drosophila ampelophila</i>	270
Dynamite, use in preparing land	62
Egg production, measurement of the winter cycle	303
Eggs, double-yolked, relation to simultaneous ovulation	289
<i>Empoasca atrolabes</i>	152
<i>mali</i>	153
<i>obtusa</i>	153
<i>smaragdula</i>	152
<i>unicolor</i>	152
<i>Epinotia</i> sp. attacking the blueberry	277
distribution	277
habits	281
life history	278
natural enemies	283
technical description	280
<i>Lyrithroneura obliqua</i>	155
<i>vitifex</i>	156
<i>vulnerata</i>	156
<i>ziczac</i>	156
<i>Eucanthus acuminatus</i>	104
<i>orbitalis</i>	104
<i>Eupteryx flavoscuta</i>	155
<i>nigra</i>	155
<i>Eutettix johnsoni</i>	139
<i>strobi</i>	138
<i>subaenea</i>	139
<i>vitellinus</i>	139
Failure of extract of pituitary body to activate resting ovary ...	296
Fertilizer experiments with apple trees	52
potatoes	49
Field experiments in 1914	47
Fowl, domestic, tumors in	297
<i>Galerucella decora</i> attacking blueberry	285
distribution	286
life history	286
means of control	288
natural enemies	288
<i>Gnathodus impictus</i>	149
<i>Gypona cana</i>	106
<i>flavilineata</i>	105
<i>ectolineata</i>	105
<i>quebecensis</i>	106
<i>Helochara communis</i>	103
<i>Idiocerus alternatus</i>	93

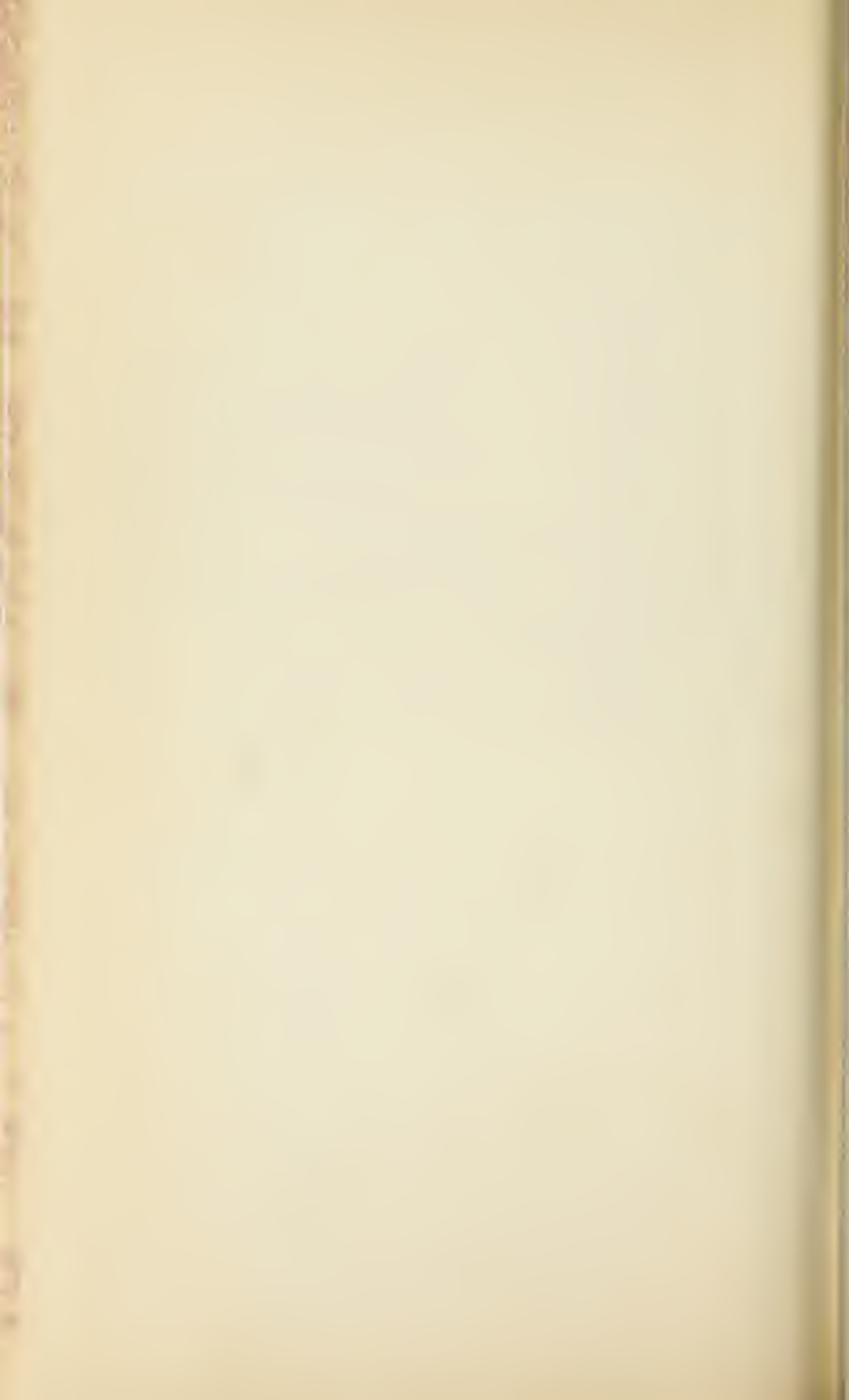
	PAGE
Idiocerus duzei	95
lachrymalis	95
pallidus	93
provancheri	95
situralis	95
Inbreeding, data on measurement	225
and relationship coefficients	233
Inseots attacking the blueberry	249
Interpolation as a means of approximation to the gamma function for high values of n	294
Iron sulphate for spraying potatoes	51
Jassidae, key to Maine genera	106
Jassoidea, key to families	87
Jassus acutus	111
belli	135
clitellarius	134
fulvidorsum	142
inimicus	123
immistus	116
irroratus	139
melanogaster	136
mixtus	108
novellus	96
olitorius	145
productus	116
subbifacciatus	145
Kolla bifida	99
Land prepared with dynamite	62
Lasioptera frutaria, distribution	266
life history	266
technical description	268
Leaf beetle attacking the blueberry	286
Leafhopper, apple	153
destructive	123
grape	156
irrorate	139
rose	158
saddle-backed	134
Leafhoppers of Maine	81
classification	86
methods of control	84
Logarithmic curves, fitting by the method of moments	293
Macrosiphum solanifolii	205
Measurement of inbreeding	225
winter cycle in egg production	303
Mendelian inheritance	298
Meteorological observations	309

	PAGE
<i>Nabis rufusculus</i>	283
distribution	284
life history	284
<i>Neocoelidia tumidifrons</i>	145
Nitrate of soda vs. sulphate of ammonia	47
Nitrogen, source in potato fertilizers	47
Oat breeding, characters other than yield	32
discussion of results	35
effect of selection tested	12
successive selections	24
indices of selection	25
successive selections	31
materials and methods	5
progeny records	3
Oat breeding, results for four years	10
selection for yield of grain	9
significance of deviations	20
summary	37
Oats at Highmoor Farm, commercial varieties	41
tests of new varieties originated at Highmoor Farm	44
yield	43
in Aroostook County, rate of seeding	45
<i>Oncometopia lateralis</i>	61
<i>Oncopsis cognatus</i>	75
<i>fenestratus</i>	88
<i>minor</i>	83
<i>nigrinasi</i>	89
<i>pruni</i>	87
<i>sobrius</i>	88
<i>variabilis</i>	88
Ovary affected by extract of pituitary body	296
Oviduct of domestic fowl, effect of abnormality	291
Ovulation, simultaneous, relation to double-yolked eggs	285
<i>Parabolocratas major</i>	110
<i>Pediopsis basilis</i>	90
<i>bicolor</i>	90
<i>bifasciata</i>	93
<i>canadensis</i>	93
<i>ferruginoides</i>	92
<i>insignis</i>	91
<i>sordida</i>	91
<i>suturalis</i>	92
<i>trimaculata</i>	91
<i>virescens</i>	90
<i>viridis</i>	85

	PAGE
<i>Penthimia americana</i>	100
<i>Phlepsius apertus</i>	140
<i>collitus</i>	142
<i>decorus</i>	141
<i>franconiana</i>	143
<i>fulvidorsum</i>	142
<i>humidus</i>	143
<i>incisus</i>	143
<i>irroratus</i>	139
<i>maculellus</i>	141
<i>strobi</i>	138
Physiology of reproduction in the domestic fowl	291, 296
Pink and green aphid of potato	205
Pituitary body, failure of extract to activate resting ovary	296
<i>Platymetopius acutus</i>	111
<i>angustatus</i>	114
<i>cuprascens</i>	112
<i>frontalis</i>	113
<i>magdalensis</i>	113
<i>obscurus</i>	113
Pomace fly attacking the blueberry	270
Pond-lily aphid as a plum pest	306
Potato aphid	205
fertilizers, method of application	49
source of nitrogen	47
scab, effect of temperature on growth	307
Potatoes followed by corn, oats, and grass	63
potatoes	63
in rotation experiments	63
spraying tops with iron sulphate	51
<i>Pseudoanthonomus validus</i> , distribution	270
enemies	276
life history	270
<i>Pseudococcus</i> sp. attacking the blueberry	285
Reproduction in the domestic fowl, physiology of	291, 296
<i>Rhagoletis pomonella</i> attacking blueberry	252
description	257
host plants	260
life history	252
methods of control	265
natural enemies	263
Rotation experiments	63
treatment and yield	64
Scale insect attacking blueberry	285

	PAGE
Scaphoideus auronitens	115
carinatus	115
immistus	116
jucundus	114
lobatus	114
luteolus	116
productus	115
scalaris	114
Schizoneura americana	197
Sex-linked Mendelian inheritance	298
Sheep, are they profitable in Maine?	59
experiment at Highmoor Farm	59
Simultaneous ovulation, relation to double-yolked eggs	289
Spraying experiment with apples	177
potatoes with iron sulphate	51
Sprays	217
System of recording types of mating	390
Sulphate of ammonia vs. nitrate of soda	47
Tettigonia angulifera	102
bifida	97
gothica	100
hieroglyphica	100
mollipes	103
obliqua	155
octolineata	165
similis	100
teliformis	101
vitis	156
Tettigoniella gothica	109
Tettigoniellidae, key to genera	98
Thamnotettix belli	135
chlamydatum	136
ciliata	138
clitellarius	134
cockerelli	134
decipiens	137
eburata	133
fitchi	137
infuscata	136
inornata	137
kennicotti	134
melanogaster	136
morsei	134
placidus	138
punctiscuta	136
rufescens	135
smithi	137
waldana	133

	PAGE
Treasurer's report	311
Tumors, occurrence in domestic fowl	297
Turnips as a stock food	54
black hearted	57
yields and food value	54
Typhlocyba bifasciata	157
carneola	151
comes	156
commissuralis	158
lethierryi	157
obliqua	155
querci	157
rosae	158
tenerrima	158
vulnerata	156
Typhlocybidæ, key to North American genera	150
Vaccinium, species found on the barrens	251
Weather observations	309
Woolly aphid of elm and Juneberry	197
Xestocephalus fulvocapitatus	109
nigrifrons	109
pulicarius	109
Yellow eye beans, standard types	161



INDEX TO REPORTS FOR THE YEARS 1911 TO 1915, AND TO
BULLETINS 235 TO 245 INCLUSIVE.

In each reference the first two figures indicate the year. Thus, '15, 291, indicates page 291 of the report for 1915.

	Page.		Page.
Abnormality of oviduct of domestic fowl.....	'15, 291	Apatela americana.....	'11, 1
Abstracts of papers.....	'14, 281	funerais.....	'12, 455
Accephalus vitellinus.....	15, 139	Aphalara artemisiae angustipennis	'12, 218
Acnemia flaveola.....	'11, 260	communis.....	'12, 218
psylla.....	'11, 259	fascipennis.....	'12, 217
varipennis.....	'11, 259	nebulosa americana.....	'12, 219
Acocephalus albifrons.....	'15, 108	nubifera.....	12, 216
striatus.....	'15, 107	picta.....	'12, 217
Aedes atropalpus.....	'11, 237	polygona.....	'11, 235; '12, 216
trichurus.....	'11, 237	rumicis.....	'12, 217
Agallia novella.....	'15, 96	veaziei.....	'11, 16
4-punctata.....	'15, 95	Aphid control.....	'13, 91; '14, 279
sanguinolenta.....	'15, 97	of potato, description.....	'15, 208
Agriotes marcus.....	'11, 232; '12, 460	distribution.....	'15, 208
Alder borer.....	'11, 7	economic significance.....	'15, 207
flea-beetle.....	'12, 459	food plants.....	'15, 213
Allotriosa arbolensis.....	'12, 231	indoor studies.....	'15, 210
Alsophila pometaria.....	'11, 2	life history.....	'15, 206
Allocotocera parvula.....	'11, 266	literature.....	'15, 215
Allodia actuaria.....	'11, 317	natural controls... ..	'15, 216
beata.....	'11, 319	notes.....	'15, 214
bella.....	'11, 318	remedial measures... ..	'15, 216
bulbosa.....	'11, 316	pests of Maine....	'12, 159; '13, 73
callida.....	'11, 319	pink and green, of potato....	'15, 205
crassicornis.....	'11, 315	pond-lily, as a plum pest....	'15, 306
delita.....	'11, 320	woolly, of elm and Juneberry..	'15, 197
elata.....	'11, 318	of the apple '12, 235; '13, 173	
falcata.....	'11, 317	Aphidae.....	'11, 20; '12, 448
Aluminum digestibility by chickens	'13, 314	food plant catalogue.....	
Amblycephalus melsheimeri.....	'15, 119	'12, 179; '13, 93, 274; '14, 61	
sayi.....	'15, 117	Aphids.....	'11, 81
Amblyteles montanus.....	'11, 242	clover.....	'15, 304
Amelanchier aphid.....	'14, 253	literature cited.....	'14, 272
Amphicoma vulpina.....	'11, 7	or Maine.....	'14, 49
Anatella silvestris.....	'11, 301	of the rose family.....	'14, 253
Anisota rubicunda.....	'11, 1	preventive and remedial measures.....	'13, 185
Announcements.....	'14, vii	Aphis abbreviata.....	'12, 170
Anosia plexippus.....	'11, 238	avenae.....	'14, 256, 266
Anthraxanthus angustatus.....	'15, 130	bakeri.....	'12, 448; '14, 257
anthracinus.....	'15, 126	brevis.....	'14, 257
arctostaphyli.....	'15, 129	cardui.....	'14, 263
chlamydatus.....	'15, 136	cerasifoliae.....	'14, 260
curtisii.....	'15, 125	furcata.....	'14, 259
elongatus.....	'15, 129	gladioli.....	'12, 176
extrusus.....	'15, 127	maidis.....	'12, 173
fenestratus.....	'15, 88	pomi.....	'11, 235; '14, 267
gammaroidea.....	'15, 132	populifoliae.....	'13, 82
humidus.....	'15, 131	prunorum.....	'14, 262
instabilis.....	'15, 128	rubiphila.....	'14, 260
nigrinasi.....	'15, 89	rumicis.....	'12, 177
obsoletus.....	'15, 127	salicicola.....	'13, 81
plutonius.....	'15, 126	sanborni.....	'14, 52
striatulus.....	'15, 128	scdi.....	'11, 22
striola.....	'15, 132	sorbi.....	'14, 267
tergatus.....	'15, 144	spiraeophila.....	'14, 270
vaccinii.....	'15, 130	tuberculata.....	'14, 261
variabilis.....	'15, 88	varians.....	'14, 50
Ant swarms.....	'12, 459		
Apanteles fumiferanae.....	'13, 27		
sp.....	'13, 27		

	Page.		Page.
Apple aphids.....	'14, 266	Boletina abdominalis.....	'11, 269
canker, European, in Maine..	'14, 23	arctica.....	'11, 274
diseases.....	'14, 2	beringensis.....	'11, 273
injury from spraying.....	'14, 2	cineta.....	'11, 270
inoculations.....	'13, 239	delicata.....	'11, 276
maggot attacking the blue-		gracilis.....	'11, 271
berry.....	'15, 252	groenlandica.....	'11, 273
orchards, spraying experi-		Hopkinsii.....	'11, 274
ments.....	'13, 57	imitator.....	'11, 271
use of sprays.....	'14, 6	inops.....	'11, 277
scab, source of infection.....	'14, 20	longicornis.....	'11, 272
spraying, effect on foliage and		melancholica.....	'11, 271
fruit.....	'15, 182	nacta.....	'11, 277
experiments.....	'15, 177	notescens.....	'11, 272
discussion of results.....	'15, 189	obscura.....	'11, 270
manner of applica-		obesula.....	'11, 276
tion.....	'15, 181	parvula.....	'11, 270
treatment of plots.....	'15, 178	seararina.....	'11, 275
Apples, See orchards.		sedula.....	'11, 277
examination for spray poisons	'14, 46	sobria.....	'11, 274
quality affected by spraying..	'11, 45	tricincta.....	'11, 275
varieties grown at Highmeor		Bordeaux injury, literature and	
Farm.....	'12, 35	comment.....	'11, 35
Apple-tree borer.....	'11, 7	mixture for apple orchards..	'14, 6
shot borer.....	'12, 463	Brachycampta.....	'11, 314
fertilizer experiments.....	'15, 52	Brachypeza bisignata.....	'11, 308
Aroostook Farm.....	'14, ix	var. divergens.....	'11, 309
Arsenate of lead as a fungicide		Bracon sp.....	'11, 243
13, 69;.....	'14, 13	Brassica tempestris, control.....	'14, 49
danger from use.....	'14, 46	Breeding guinea pigs and rabbits,	
for spraying orchards.....	'14, 8	pedigree system.....	'13, 306
Arsenicals in combination with		for egg production.....	'12, 283
lime-sulphur.....	'13, 70	oats. See oat breeding.	
Arsenite of zinc as an insecticide.	'13, 71	operations, system of recording	
Asphes brevicollis.....	'11, 232	types of mating.....	'15, 303
Aspidiotus ostreaeformis.....	'12, 432, 447	Brooding instinct in relation to	
perniciosus.....	'11, 237; '12, 434, 447	egg production, data regarding..	'14, 284
Assumption of male characters by		Brooders, construction.....	'11, 182
a cow.....	'15, 65	fresh air.....	'11, 177
Athyanelia acuticauda.....	'15, 132	Brown-tail moth.....	'12, 451
Atomic sulphur for apple orchards	'14, 7	parasite.....	'12, 455
Aulacaspis rosae.....	'12, 436, 447	Bucculatrix, birch leaf	
Aulacizes noveboracensis.....	'15, 101	canadensislla.....	'11, 2, 239
Aulex glechomae.....	'11, 8	ponafoliella.....	'11, 2, 239
Autographa brassicae.....	'11, 239	Buildings and equipment.....	'14, xv
Avuncular matings.....	'15, 239	Bulletins issued in 1911.....	'11, ix
Azana sp.....	'11, 260	Bushel weight determinations..	'14, 69
Balclutha impictus.....	'15, 149	Butterflies and moths.....	'12, 450
punctata.....	'15, 149	Bythoscopidae, key to genera.....	'15, 87
Balsa malana.....	'11, 1	Bythoscopus cognatus.....	'15, 89
Barred Plymouth Rock matings	'12, 313	fenestratus.....	'15, 88
Bean breeding.....	'15, 161	minor.....	'15, 88
production in Maine.....	'15, 164	pruni.....	'15, 87
Beans, comments of Boston dealers	'15, 175	4-punctata.....	'15, 95
yellow eye, improved.....	'15, 166	sanguinolenta.....	'15, 97
old fashioned.....	'15, 170	sobrius.....	'15, 88
standard types.....	'15, 161	strobi.....	'15, 138
Beetles.....	'12, 459	tergatus.....	'15, 144
Biological analysis of the character		variabilis.....	'15, 88
fecundity.....	'12, 285	Cacoecia rosaceana.....	'11, 239
Biology of poultry keeping.....	'13, 101	Callidium antennatum.....	'11, 7
Biosteres rhogetis.....	'15, 263	Calyx injury from spraying.....	'12, 16
Birch leaf bucculatrix.....	'11, 2	Caives, triplets.....	'12, 259
roller.....	'12, 453	breeding record.....	'12, 279
Black horned callidium.....	'11, 7	color inheritance.....	'12, 280
vine weevil.....	'11, 8	Cane borer.....	'12, 463
Blackleg disease of the potato	'11, 201	Carpophilus sp.....	'11, 233
how eliminated from seed.....	'11, 226	carrot rust fly.....	'11, 5
not carried over in the soil.....	'11, 221	Cecid attacking the blueberry.....	'15, 266
Blackstem disease of the potato..	'11, 201	Cephalothecium roseum.....	'13, 205
Blissus leucopterus.....	'11, 9	Ceroplatinae.....	'11, 321
Blueberry, associated plants.....	'15, 251	Chaetophorus delicata.....	'13, 80
barrens of Washington county	'15, 249	populicola.....	'13, 78
cecid.....	'15, 266	viminalis.....	'13, 80
damsel-bug.....	'15, 283	Changes in station staff.....	'14, xv
insects attacking the fruit.....	'15, 252	Charlock, or wild mustard, control	'14, 40
of Maine.....	'15, 249	Chermes cooleyi.....	'11, 23
leaf hoppers.....	'15, 285	Chickens, ability to digest alum-	
Rhogetis pomonella in.....	'14, 293	inum.....	'13, 314
species found on the barrens..	'15, 251	Chinch bug.....	'11, 9

	Page.		Page.
Chionaspis turfura.....	'12, 439, 447	Data on somatic and genetic sterility in the domestic fowl...	'14, 287
linteri.....	'11, 10; '12, 440, 447	regarding the brooding instinct	
Chlorotettix galbanata.....	'15, 143	in relation to egg production	'14, 284
lusoria.....	'15, 144	Datana ministra.....	'11, 239
tergatus.....	'15, 144	Deltocephalus abdominalis.....	'15, 121
unicolor.....	'15, 144	affinis.....	'15, 122
Choke cherry aphid.....	'14, 260	apicatus.....	'15, 120
Chrysomelidae.....	'11, 233	bilincatus.....	'15, 116
Chrysophlyctis endobiotica.....	'14, 98	configuratus.....	'15, 122
Cicada acuminata.....	'15, 104	debilis.....	'15, 121
cocinea.....	'15, 101	infumatus.....	'15, 118
lateralis.....	'15, 99	inimicus.....	'15, 123
6-notata.....	'15, 147	melsheimeri.....	'15, 119
smaragdula.....	'15, 132	minki.....	'15, 118
striola.....	'15, 132	misellus.....	'15, 117
virescens.....	'15, 90	nigrifrons.....	'15, 122
Cicadula pallida.....	'15, 146	obtectus.....	'15, 118
potoria.....	'15, 147	productus.....	'15, 116
6-notata.....	'15, 147	sayi.....	'15, 117
slossoni.....	'15, 147	sylvestris.....	'15, 119
suffusa.....	'15, 146	Diaeris virginica.....	'11, 1
variata.....	'15, 145	Dicraneura carneola.....	'15, 151
Clisiocampa americana.....	'11, 239	communis.....	'15, 150
distria.....	'11, 239	cruentata.....	'15, 150
Clover aphids.....	'14, 257; '15, 304	ficberi.....	'15, 151
Coburn orchard experiments.....	'12, 23	Dicrocephala angulifera.....	'15, 102
Coccidae.....	'12, 432	cocinea.....	'15, 101
Coefficients of inbreeding.....	'13, 191	noveboracensis.....	'15, 101
Coclosia flava.....	'11, 293	Dioryctria abietella.....	'12, 453
flavicauda.....	'11, 294	Diptera.....	'11, 237
gracilis.....	'11, 294	Disease producing species of Fusarium.....	'13, 203
lepida.....	'11, 294	Docosia dichroa.....	'11, 299
modesta.....	'11, 294	nigella.....	'11, 300
pygophora.....	'11, 293	obscura.....	'11, 300
Colophora fletcherella.....	'11, 2, 239	Domestic fowl, physiology of reproduction.....	'15, 291, 296
laricella.....	'11, 239	Draeculacephala augulifera.....	'15, 102
Coleoptera.....	'11, 7, 229; '12, 459	mollipes.....	'15, 103
Conoblasta fumiferanae.....	'13, 27	noveboracensis.....	'15, 101
Conotrachelus menuphar.....	'11, 7	Driatura gammaroidea.....	'15, 132
Constants, estimation of significance.....	'14, 85	Drosophila ampelophila.....	'15, 270
Contents.....	'14, v	Dynamite, use in preparing land.....	'15, 62
Conrnis Indian Game matings.....	'12, 349	Early blight of potatoes.....	'13, 37
Corpus luteum substance upon ovulation in the fowl, effect of.....	'14, 286	Effect of corpus luteum substance upon ovulation in the fowl.....	'14, 286
Corrosive sublimate for seed potato disinfection.....	'14, 104	Egg, constituent parts.....	'12, 395
Corticum vagum, var. solani.....	'14, 193	how the white is made.....	'13, 161
Corybites cylindriciformis.....	'11, 232	production, breeding for.....	'11, 113; '12, 283
Corydala manca.....	'11, 307	data regarding brooding instinct in relation to.....	'14, 284
neglecta.....	'11, 308	improving by breeding.....	'14, 217
recens.....	'11, 307	in winter, observed types.....	'12, 302
scita.....	'11, 307	inheritance in pedigree lines of fecundity.....	'11, 158
volucris.....	'11, 307	inherited character.....	'14, 219
Council, changes in.....	'14, xiv	measurement of the winter cycle.....	'15, 303
Cousin mating.....	'15, 226	Mendelian interpretation... new plan for breeding for... plan for practical breeder... seasonal distribution.....	'14, 224 '11, 144 '14, 225 '11, 193
Cow, assumption of male characters cystic degeneration of the ovaries.....	'15, 65	Eggs, composition.....	'11, 107
injection of pituitary body substance.....	'15, 69	double-yolked, relation to simultaneous ovulation.....	'15, 289
Craesus latitarsus.....	'11, 242	factors which influence size and shape.....	'14, 106
Crataegus aphid.....	'14, 255	inter-individual variation.....	'14, 107
Crematory for dead poultry.....	'13, 148	intra-individual variation.....	'14, 108
Crickets and Roman wormwood.....	'11, 235	interrelation of dimensions.....	'14, 110
Cryptorhynchus lapathi.....	'11, 234	loss of weight in boiling..... prevented.....	'11, 100 '11, 93
Ctenucha virginica.....	'12, 450	of the same fowl, variation of relation of characters to other characters.....	'14, 112 '14, 109
Cucullia convexipennis.....	'11, 1		
Culex pipiens.....	'11, 237		
Curculionidae.....	'11, 234		
Currant aphid in Maine.....	'14, 40		
fruit weevil.....	'15, 270		
Cuterebra sp.....	'11, 237		
Cystic degeneration of ovaries of a cow.....	'15, 65		
Dairy cattle, law regulating milk flow to age in.....	'14, 289		

	Page.		Page.
Eggs, weight to position in clutch...	'14, 125	Fecundity, anatomical basis.....	'12, 295
litter.....	'14, 125	biological analysis of	
separation of parts.....	'11, 100	the character.....	'12, 285
size, shape and physical con-		in domestic fowl, in-	
stitution.....	'14, 106	heritance of.....	'11, 151
variation with the age of the		inheritance of in the	
fowl.....	'14, 113	domestic fowl.....	'12, 283
season of the year.....	'14, 120	literature.....	'12, 392
state of health.....	'14, 122	selection problem.....	'12, 387
weight of parts.....	'11, 93, 103	mechanism of inheri-	
Elachertes johannseni.....	'12, 458	tance of.....	'12, 302
sp.....	'11, 243	of the individual fowl,	
Elateridae.....	'11, 228	measurement of	
Elm bark borer.....	'12, 463	changes in the rate of	'14, 283
louse.....	'11, 10	Feed trough for poultry.....	'13, 151
borer.....	'12, 464	Fertilizer experiments with apple	
Elm-currant aphid.....	'13, 271	trees.....	'15, 52
gall, new, for America.....	'13, 263	with potatoes.....	'15, 49
leaf curl and woolly apple aphid	'12, 235	Field experiments.....	'11, 25; '14, 25; '15, 41
rosette aphid.....	'13, 264	Fir sawfly.....	'11, 8
scale.....	'12, 441	Flea beetle and early blight.....	'13, 37
Emasculating apple blossom buds.	'12, 52	Food plant catalog of the Aphidae	
Emphytus canadensis.....	'11, 8	'12, 179; '13, 93, 274;	'14, 61
Empoasca atrolabes.....	'15, 152	Formaldehyde for seed potato dis-	
mali.....	'15, 153	infection.....	'14, 103
obtusa.....	'15, 153	Fowl, domestic, tumors in.....	'15, 297
smaragdula.....	'15, 152	Fragaria aphid.....	'14, 258
unicolor.....	'15, 152	Free-martins in multiple gestation	'12, 264
Enarmonia youngana.....	'12, 453	Fringed Anthomyian.....	'11, 5
Entomological papers from the		Fungicide experiments with or-	
Maine station.....	'12, 466	chards.....	'13, 57
Ephestria cautella.....	'11, 240	Fungus control through spraying.	'12, 18
Epicnaptera americana.....	'11, 2	gnats, economic relations.	'12, 57
Epinotia piceatoliana.....	'12, 455; '13, 34	index to genera.	'12, 145
sp. attacking the blue-		of North America	
berry.....	'15, 277	'11, 249;	'12, 57
distribution.....	'15, 277	type locality.....	'12, 142
habits.....	'15, 281	types & paratypes.....	'12, 140
life history.....	'15, 278	Fusarium, culture studies.....	'13, 225
natural enemies.....	'15, 283	disease producing species.....	'13, 203
technical description.	'15, 280	germination of spores.....	'13, 226
Epitrix cucumeris.....	'13, 37	growth and temperature.....	'13, 238
Epiurus innominatus.....	'13, 27	growth in fermentation tubes.	'13, 237
Erythroneura obliqua.....	'15, 155	host index.....	'13, 257
vitifex.....	'15, 155	list of species, determined.....	'13, 254
vulnerata.....	'15, 156	oxysporum.....	'13, 220
ziczac.....	'15, 156	putrefaciens.....	'13, 205
Essigella californicus.....	'12, 169	relation of alkali and acids.....	'13, 237
Establishment of the station.....	'14, vii	tests of pathogenicity.....	'13, 239
Eucallipterus tiliac.....	'11, 22	Galerucella decora attacking blue-	
Eucanthus acuminatus.....	'15, 104	berry.....	'15, 286
ortitalis.....	'15, 104	distribution.....	'15, 286
Eulceanium canadense.....	'11, 10	life history.....	'15, 286
cerasifex.....	'11, 237	luteola.....	'11, 234; '12, 463
corni.....	'12, 445, 448	means of control.....	'15, 288
Eulia quadrifasciana.....	'12, 454	natural enemies.....	'15, 288
Euproctis chrysoorrhoea.....	'11, 1, 240; '12, 451	Galleria mellonella.....	'11, 240
Eupteryx flavoscuta.....	'15, 155	Garden flea.....	'11, 24
nigra.....	'15, 155	Glaphyoptera.....	'11, 278
European apple canker in Maine.	'14, 23	Gnathodus impictus.....	'15, 149
fruit lecanium.....	'12, 445	Gnats, fungus, index to genera..	'12, 145
scale.....	'12, 432	of North America.....	'11, 249; '12, 57
Eurosta solidaginis.....	'11, 5	Gnoriste apicalis.....	'11, 258
Eurycera.....	'11, 266	greenlandica.....	'11, 257
Eurycyttarus confederata.....	'11, 2	macra.....	'11, 257
Eurystoma gigantea.....	'11, 9	megarrhina.....	'11, 257
Eutettix johnsoni.....	'15, 139	Gooseberry aphid in Maine.....	'14, 49
strobi.....	'15, 138	Gossyparia spuria.....	'11, 10; '12, 441, 448
subaenea.....	'15, 139	Grain, test of varieties.....	'14, 76
vitellinus.....	'15, 139	plots, size and shape.....	'14, 76
Euvanessa antiopa.....	'11, 240; '12, 450	tester standard, use of.....	'14, 69
Exorista vulgaris.....	'13, 25	Grass lands, top dressing.....	'14, 25
Failure of extract of pituitary body		Green aphid of the gooseberry.....	'14, 52
to activate resting ovary.....	'15, 296	apple aphid.....	'14, 267
Falcaria bilineata.....	'11, 240	Growth and variation in maize..	'14, 290
Fat content of mixed milk.....	'13, 299	Guinea pigs and rabbits, methods	
		of marking.....	'13, 307
		pedigree records.....	'13, 310

	Page.		Page.
<i>Gypona cana</i>	'15, 106	<i>Jessus clitellarius</i>	'15, 134
<i>ectolineata</i>	'15, 105	<i>fulvidorsum</i>	'15, 142
<i>flavilineata</i>	'15, 105	<i>inimicus</i>	'15, 123
<i>quebecensis</i>	'15, 106	<i>immistus</i>	'15, 116
<i>Gypsy moth</i>	'12, 452	<i>irroratus</i>	'15, 139
<i>Habrobracon johannseni</i>	'12, 458	<i>melanogaster</i>	'15, 136
<i>Haematobia serrata</i>	'11, 6	<i>mixtus</i>	'15, 108
<i>Haltica bimarginata</i>	'12, 459	<i>novellus</i>	'15, 96
<i>carinata</i>	'11, 233	<i>olitorius</i>	'15, 145
<i>cucumeris</i>	'13, 38	<i>productus</i>	'15, 116
<i>pubescens</i>	'13, 38	<i>subbifaciatus</i>	'15, 145
<i>striolata</i>	'13, 39	Kerosene emulsion for woolly aph- ides.....	'13, 187
<i>Helocnara communis</i>	'15, 103	<i>Keyser orchard experiment</i>	'12, 23
<i>Hemiptera-Heteroptera of Maine</i> , list of.....	'14, 294	<i>Kolla bifida</i>	'15, 99
<i>Hemiteles</i> sp.....	'11, 242	<i>Lachnus curvipes</i>	'12, 161
<i>Hen manure, shed for storage</i>	'13, 144	<i>hyalinus</i>	'12, 165
value, preservation and use.....	'13, 141	<i>laricifex</i>	'12, 164
<i>Hens, experiments in breeding</i>	'12, 283	<i>pini</i>	'12, 168
histology of the oviduct.....	'12, 395	<i>strobi</i>	'12, 167
<i>Heterocampa guttivitta</i>	'11, 2	Land prepared with dynamite.....	'15, 62
<i>Heteroptera</i>	'11, 9	<i>Lasioptera frutaria, distribution</i>	'15, 266
<i>Highmoor Farm</i>	'11, viii; '14, x	life history.....	'15, 266
acquisition by the station.....	'12, 34	technical description.....	'15, 268
experiments.....	'14, 25	Law regulating milk flow to age in dairy cattle.....	'14, 289
orchard experiments.....	'12, 1, 33	<i>Lead arsenate as a fungicide</i>	'12, 6, 18
orchard spraying.....	'11, 53	as an insecticide.....	'11, 64
Historical basis of shank color in tows.....	'14, 237	<i>ror spraying orchards</i> '11, 64;.....	'13, 60
Histology of the oviduct of the hen.....	'12, 395	sprays, effectiveness.....	'11, 69
<i>Homoptera</i>	'11, 10, 235; '12, 432	<i>Leaf beetle attacking the blueberry cluster aphid</i>	'15, 286
<i>Horn fly</i>	'11, 6	<i>Leafhopper, apple</i>	'15, 153
<i>Hyalopterus arundinis</i>	'11, 23; '14, 265	destructive.....	'15, 123
<i>Hylurgops opaculus</i>	'12, 463	<i>grape</i>	'15, 156
<i>Hymenoptera</i>	'11, 8, 242; '12, 455	<i>irrorate</i>	'15, 139
<i>Hyphantria cunea</i>	'11, 1, 241	<i>rose</i>	'15, 158
<i>Hypochnus solani</i>	'14, 97, 193	<i>saddle-backed</i>	'15, 134
<i>Hypoderma lineata</i>	'11, 237	<i>Leafhoppers of Maine</i>	'15, 81
<i>Idiocerus alternatus</i>	'15, 93	classification.....	'15, 86
<i>duzei</i>	'15, 95	methods of control.....	'15, 84
<i>lachrymalis</i>	'15, 95	<i>Leia amatilis</i>	'11, 283
<i>pallidus</i>	'15, 93	<i>bivittata</i>	'11, 290
<i>provancheri</i>	'15, 95	<i>cincta</i>	'11, 288
<i>situralis</i>	'15, 95	<i>concinna</i>	'11, 287
Immature stages of the <i>Tenthredo- noidea</i>	'14, 291	<i>cuneola</i>	'11, 283
Imported elm leaf beetle.....	'12, 463	<i>decora</i>	'11, 288
Inbreeding and relationship coeffi- cients.....	'14, 288; '15, 233	<i>dryas</i>	'11, 287
calculation of coefficients.....	'13, 127, 185	<i>hyalina</i>	'11, 286
coefficient tables.....	'13, 194	<i>lineola</i>	'11, 285
data on measurement.....	'15, 225	<i>melaena</i>	'11, 281
formula, brother and sister mating.....	'14, 288	<i>nigra</i>	'11, 281
in poultry.....	'13, 108	<i>nitens</i>	'11, 282
measurement of degree.....	'13, 125	<i>oblectabilis</i>	'11, 286
intensity.....	'13, 123	<i>opima</i>	'11, 289
Inheritance of fecundity in the do- mestic towl.....	'11, 151; '12, 283	<i>plcbeja</i>	'11, 285
Inoculations of carnation buds.....	'13, 243	<i>punctata</i>	'11, 280
cucumbers.....	'13, 243	<i>striata</i>	'11, 284
pears.....	'13, 242	<i>sublunata</i>	'11, 289
potatoes.....	'13, 242	<i>unicolor</i>	'11, 285
Insect notes for 1910.....	'11, 1	<i>varia</i>	'11, 280
1911.....	'11, 229	<i>ventralis</i>	'11, 282
1912.....	'12, 431	<i>Winthemii</i>	'11, 284
Insects attacking the blueberry.....	'15, 249	<i>Lejomya</i>	'11, 278
recorded on potato.....	'13, 51	<i>Lepidoptera</i>	'11, 238; '12, 450
Insecticide, lead arsenate.....	'11, 64	<i>Lepidosaphes ulmi</i>	'12, 437, 447
Insecticides, choice of.....	'11, 38	<i>Leptomorpha hyalinus</i>	'11, 265
Inspection.....	'11, vii	<i>Walkeri</i>	'11, 265
Interpolation as a means of ap- proximation to the gamma func- tion for high values of n	'15, 294	<i>ypsilon</i>	'11, 265
Iron sulphate, effect on potatoes.. for spraying potatoes.....	'14, 43 '15, 51	<i>Leptura canadensis</i>	'12, 463
<i>Jassidae, key to Maine genera</i>	'15, 106	<i>Lime-sulphur and russeting</i>	'12, 18
<i>Jassoidea, key to families</i>	'15, 87	for apple orchards. '13, 58;.....	'14, 6
<i>Jassus acutus</i>	'15, 111	home made vs. commercial... ..	'11, 72
<i>belli</i>	'15, 135	injury to foliage.....	'11, 52
		solutions, directions for making	'11, 73; '12, 29
		sprays.....	'11, 41
		proper dilution.....	'13, 68
		self-boiled.....	'11, 73
		vs. bordeaux mixture '13, 69;.....	'14, 12

	Page.		Page.
Linneria guignardi.....	'11, 242	Nectria ditissima.....	'14, 23
Lintner's scale.....	'12, 440	Nectarophora destructor.....	'11, 92
List of Hemiptera-Heteropera of Maine.....	'14, 294	pisi.....	'11, 92
Lophyrus abietis.....	'11, 8	solanifolii.....	'11, 92
Logarithmic curves, fitting by the method of moments.....	'15, 293	Nematus Erichsonii.....	'11, 242
Macrosiphum crataegi.....	'11, 236; '14, 255	Neocoelidia tumidifrons.....	'15, 145
destructor.....	'11, 81	Neoglaphyoptera.....	'11, 278
dirhodum.....	'14, 268	Neoprociphilus attenuatus.....	'12, 174
lactucae.....	'14, 57	new genus.....	'12, 174
laevigatae.....	'13, 84	Neotriozella ottawanensis.....	'12, 231
pisi.....	'11, 81, 92	Neuratella coxalis.....	'11, 262
rosae.....	'14, 268	desidiosa.....	'11, 263
rubicola.....	'14, 270	eminens.....	'11, 263
solanifolii.....	'12, 178; '14, 268; '15, 205	nemoralis.....	'11, 263
description.....	'11, 84	scitula.....	'11, 263
host plants.....	'11, 87	silvatica.....	'11, 262
species.....	'14, 60	New England Mineral Fertilizer.....	'13, 2
spiraecola.....	'14, 271	New mineral fertilizer.....	'13, 1
Maize, growth and variation in.....	'14, 290	plot experiments.....	'13, 10
Malacosoma americana.....	'12, 452	Nitidulidae.....	'11, 233
distria.....	'12, 452	Nitrate of soda vs. sulphate of am- monia.....	'15, 47
Maple phenococcus.....	'12, 442	Nitrogen, source in potato fertil- izers.....	'15, 47
Matings of Barred Plymouth Rocks.....	'12, 313	Nitrous ether, spirit of.....	'12, 147
Cornish Indian Games.....	'12, 349	Noctua clandestina.....	'11, 1
Mealy aphid of plum.....	'14, 265	Nth generation of a Mendelian population in which all matings are brother x sister, formula for the constitution of.....	'14, 288
Measurement of changes in the rate of fecundity of the individual owl.....	'14, 283	Oat aphid.....	'14, 256
of inbreeding.....	'15, 225	breeding studies, character of soil.....	'14, 140
winter cycle in egg production.....	'15, 303	characters other than yield.....	'15, 32
Megophthalmidia occidentalis.....	'11, 298	discussion of results.....	'15, 35
Melanotus fissilis.....	'11, 233	effect of selection tested.....	'15, 12
Melanoxanthium antennatum.....	'13, 87	successive selections.....	'15, 24
bicolor.....	'13, 85	harvesting.....	'14, 145
salicis.....	'13, 88	indices of selection.....	'15, 26
salieta.....	'13, 86	successive selections.....	'15, 31
smithiae.....	'13, 86	materials and methods.....	'15, 5
Mendelian inheritance.....	'15, 298	plots.....	'14, 139
Mesochorus diversicolor.....	'13, 27	preparation of the land.....	'14, 142
Meteorological observations.....	'11, 329; '12, 467; '13, 319; '14, 295; '15, 309	progeny records.....	'15, 8
Meteorus trachynotus.....	'13, 27	records.....	'14, 146
Microsiphum destructor, host plants.....	'11, 87	results for four years.....	'15, 10
Milk, variation constants in fat content.....	'13, 299	selection for yield of grain.....	'15, 9
Mindarus abietinus.....	'11, 20	shape of plots.....	'14, 144
Mineral fertilizer.....	'13, 1	significance of deviations.....	'15, 20
Monodontomerus aereus.....	'11, 243; '12, 455	summary.....	'15, 37
Moths and butterflies.....	'12, 450	treatment of seed.....	'14, 144
Multiple gestation, physiological problem.....	'12, 260	varieties tested.....	'14, 148
problems in inheritance.....	'12, 265	variety tests.....	'14, 137
production of free-martins.....	'12, 264	Oats at Highmoor Farm, commer- cial varieties.....	'15, 41
sex determination.....	'12, 261	tests of new varieties origin- ated at Highmoor Farm.....	'15, 44
Musca domestica.....	'11, 6	yield.....	'15, 43
Mustard, spraying for.....	'14, 39	average yield of grain.....	'14, 174
Mycetobiinae.....	'11, 321	early varieties.....	'14, 152
Mycetophilidae.....	'11, 249	in Aroostook County, rate of seeding.....	'15, 45
of North America.....	'12, 57	medium early varieties.....	'14, 152
Mycetophilinae.....	'11, 249; '12, 59	late varieties.....	'14, 153
Myzus cerasi.....	'14, 258	results of variety tests.....	'14, 158
dispar.....	'14, 56	treatment of seed.....	'11, 26
persicae.....	'12, 174; '14, 260, 267	variation in weight of bushel.....	'14, 185
porosus.....	'14, 258	variety tests.....	'11, 25
ribis.....	'14, 55	yield of experiment plots.....	'11, 27
rosarum.....	'14, 269	straw.....	'14, 182
Nabis rufusculus.....	'15, 283	Oberea bimaculata.....	'12, 463
distribution.....	'15, 284	Odontopoda sayii.....	'11, 264
life history.....	'15, 284	Oedemasis concinna.....	'11, 241
Nasonia tortricis.....	'13, 27	Olethreutes albeolana.....	'12, 454
		Oncometopia lateralis.....	'15, 99

	Page.		Page.
<i>Oncopsis cognatus</i>	'15, 89	<i>Pemphigus acerifolii</i>	'11, 244
<i>fenestratus</i>	'15, 88	<i>bursarius</i>	'13, 78
<i>minor</i>	'15, 88	<i>gravicornis</i>	'13, 75
<i>nigrinasi</i>	'15, 89	<i>populicaulis</i>	'13, 77
<i>pruni</i>	'15, 87	<i>populiconduplifolius</i>	'13, 76
<i>sobrius</i>	'15, 88	<i>populimonilis</i>	'13, 73
<i>variabilis</i>	'15, 88	<i>rhois</i>	'11, 22, 236
<i>Opius</i> sp.....	'11, 243	<i>tessellata</i>	'11, 236, 244
Orchard experiments, cooperation.	'12, 21	<i>bibliography</i>	'11, 248
notes.....	'12, 33	<i>life cycle</i>	'11, 247
renovation.....	'12, 38	<i>venafuscus</i>	'11, 236
spraying, at Highmoor Farm		<i>Penthimia americana</i>	'15, 100
effects on foliage.....	'11, 53; '13, 57	<i>Peronia ferrugana</i>	'12, 453
fruit.....	'11, 56	<i>Phenococcus acericola</i>	'12, 442, 448
for fungus.....	'11, 58	<i>dearnessi</i>	'12, 443, 448
injury from.....	'11, 62	sp.....	'11, 10
problems.....	'11, 66	<i>Pheosia dimidiata</i>	'11, 1
yields at Highmoor Farm.....	'11, 33	Philbrook orchard experiments.....	'12, 21
Orchards at Highmoor Farm.....	'12, 40	<i>Phlepsius apertus</i>	'15, 140
effects of fertilizers.....	'12, 34	<i>collitus</i>	'15, 142
experimental work, 1910-11..	'12, 49	<i>decorus</i>	'15, 141
1911.....	'12, 41	<i>francoiana</i>	'15, 143
insect injury.....	'12, 8	<i>fulvidorsum</i>	'15, 142
spraying experiments.....	'12, 14	<i>humidus</i>	'15, 143
winter injury.....	'12, 1	<i>incisus</i>	'15, 143
Organization of station.....	'12, 54	<i>irroratus</i>	'15, 139
Orthoptera.....	'14, ii	<i>maculellus</i>	'15, 141
Otiorthynchus sulcatus.....	'11, 235	<i>strobi</i>	'15, 138
Ovary affected by extract of pituitary body.....	'11, 8	Phobetron pithecium.....	'11, 241
Oviduct of domestic fowl, effect of abnormality.....	'15, 296	Pholus pandorus.....	'11, 241
physiological effects of ligation, section or removal of the hen, albumen secreting region.....	'15, 291	Phorbia cinerella.....	'11, 6
funnel region.....	'14, 285	<i>fusciceps</i>	'11, 5, 238
general structure.....	'12, 409	<i>regina</i>	'11, 6
histology.....	'12, 401	Phorodon humuli.....	'14, 264
isthmus.....	'12, 401	Phosphates for grass lands, cost.....	'14, 27
literature.....	'12, 399	top dressing.....	'14, 25
uterus.....	'12, 395	Phthiria curta.....	'11, 291
vagina.....	'12, 419	<i>fraudulenta</i>	'11, 291
Ovulation in the fowl, effect of corpus luteum substance upon simultaneous, relation to double-yolked eggs.....	'12, 421	<i>tanypus</i>	'11, 282
Ox bot-fly.....	'14, 286	Phytophthora infestans.....	'11, 203
Oyster shell scale.....	'15, 289	Phygadeuon plesius.....	'13, 27
Pachypsylla dubia.....	'11, 237	Physiological effects of ligation, section or removal of the oviduct in the domestic fowl.....	'14, 285
<i>pallida</i>	'12, 437	observations regarding plumage pattern.....	'14, 281
<i>tridentata</i>	'12, 224	Physiology of reproduction in the domestic fowl.....	'15, 291, 296
Paedogenesis in Tanytarsus.....	'12, 225	Pimpla conquisitor.....	'13, 27
Palaeoanaclina.....	'12, 224	<i>inquisitor</i>	'13, 27
Paleacrita vernata.....	'11, 3	Ontario.....	'13, 26
Papers, abstracts of.....	'11, 267	Pink and green aphid of potato.....	'15, 205
Parabolocratus major.....	'11, 1	Pissodes strobi.....	'11, 7
Parthenogenesis in Tanytarsus.....	'14, 281	Pituitary body, failure of extract to activate resting ovary.....	'15, 296
Pedigree system in breeding guinea pigs.....	'15, 110	Plant lice.....	'12, 448
Pediopsis basilis.....	'11, 3	or aphids of Maine.....	'14, 49
<i>bicolor</i>	'13, 306	Platymetopus acutus.....	'15, 111
<i>bifasciata</i>	'15, 90	<i>angustatus</i>	'15, 114
<i>canadensis</i>	'15, 93	<i>cuprascens</i>	'15, 112
<i>ruginoides</i>	'15, 92	<i>frontalis</i>	'15, 113
<i>insignis</i>	'15, 91	<i>magdalensis</i>	'15, 113
<i>sordida</i>	'15, 91	<i>obscurus</i>	'15, 113
<i>suturalis</i>	'15, 92	Plodia interpunctella.....	'11, 2
<i>trimaculata</i>	'15, 91	Plum and hop aphid.....	'14, 264
<i>virescens</i>	'15, 90	aphid.....	'14, 262
<i>viridis</i>	'15, 89	thistle aphid.....	'14, 263
Pegomyia vicina.....	'11, 238	Plumage patterns, physiological observations regarding.....	'14, 281
Pellagra and Simulium.....	'11, 4	Polyxena.....	'11, 306
		Pomological notes.....	'12, 52
		Poplar, aphid pests.....	'13, 73
		Porizon senslat.....	'13, 35
		Porthetria dispar.....	'12, 452
		Pomace fly attacking the blueberry.....	'15, 270

	Page.		Page
Pond-lily aphid as a plum pest...	'15, 306	Pseudococcus sp. attacking the blueberry...	'15, 285
Potato aphid.....	'15, 205	Psila rosae.....	'11, 5
blackleg or blackstem disease.....	'11, 201	Psylla annulata.....	'12, 219
diseases, cooperative experiments.....	'11, 209	breviata.....	'12, 220
preventive measures.....	'11, 219	brevistigmata.....	'12, 222
treatment of seed.....	'11, 207	cerasi.....	'12, 223
elimination of blackleg.....	'11, 226	coryli.....	'12, 223
fertilizers, method of application.....	'15, 49	floccosa.....	'11, 11
source of nitrogen.....	'15, 47	galeiformis.....	'11, 12
flea beetle.....	'13, 37	gilletti.....	'12, 221
bibliography.....	'13, 48	hartigii.....	'12, 222
control.....	'13, 44	negundinis.....	'12, 220
habits and description.....	'13, 40	pyrtaola.....	'11, 11; '12, 221
history and distribution.....	'13, 38	striata.....	'11, 14
host plants.....	'13, 43	Psyllidae.....	'11, 10
parasites.....	'13, 44	notes on.....	'12, 215
remedies.....	'13, 47	Peteromalus egregius.....	'12, 457
test of poisons.....	'13, 45	puparum.....	'12, 458
infection of healthy seed pieces list of insects occurring on.....	'13, 51	Ptinidae.....	'11, 233
plants, effect of seed disinfection.....	'11, 225	Ptinus lur.....	'11, 233
scab, common.....	'14, 95	Publications, lists of.....	'11, ix
effect of temperature on growth.....	'15, 307	Pulvinaria innumerabilis.....	'12, 446
treatment of seed with formaldehyde.....	'11, 224	vitis.....	'12, 446, 448
Potatoes effect of iron sulphate spraying.....	'14, 43	Pyrus aphids.....	'14, 266
followed by corn, oats and grass.....	'15, 63	Raphanus-raphanistrum, control.....	'14, 40
potatoes.....	'15, 63	Recurvaria piceaeella.....	'12, 455; '13, 32
high ridge vs. modified ridge culture.....	'11, 29	Relationship and introbreeding coefficients.....	'14, 288
in rotation experiments.....	'15, 63	Report of treasurer.....	'14, 297
powdery scab.....	'14, 89	Reproduction in domestic fowl, physiology of.....	'15, 291, 296
Rhizoctonia disease.....	'14, 193	Rhagoletis pomonella.....	'11, 238
ridge vs. level culture.....	'14, 28	attacking blueberry.....	'14, 293; '15, 252
seed disinfection.....	'14, 102	description.....	'15, 257
silver scurf.....	'14, 96	host plants.....	'15, 260
spraying tops with iron sulphate.....	'15, 51	life history.....	'15, 252
Poultry, artificial hatching and rearing.....	'11, 124	methods of control.....	'15, 265
breeding, at Maine station, summary.....	'11, 174	natural enemies.....	'15, 263
constitutional vigor.....	'13, 106	Rhizoctonia disease of potatoes, economic importance.....	'14, 213
for egg production.....	'11, 113	field studies.....	'14, 203
new plan adopted.....	'11, 175	greenhouse experiments.....	'14, 208
recognition of individuality.....	'13, 104	history.....	'14, 194
selection for fecundity.....	'11, 155	in Maine.....	'14, 197
feed trough.....	'13, 151	preventive measures.....	'14, 215
feeding.....	'13, 114	scab.....	'14, 97
green food for.....	'13, 159	solani.....	'14, 193
housing.....	'13, 111	Rhodophora florida.....	'11, 1
inbreeding.....	'11, 135; '13, 108	Rhogas Canadensis.....	'13, 36
keeping, biology of.....	'13, 101	Rhopalosiphum nymphsae.....	'12, 171
importance of good stock.....	'13, 103	Rhopalosiphum lactucae.....	'14, 53
natural enemies.....	'13, 155	Rhymosia akelyi.....	'11, 312
notes.....	'11, 177	captiosa.....	'11, 313
protective coloration.....	'11, 198	diffusa.....	'11, 313
technical studies.....	'11, 193; '13, 161	filipes.....	'11, 312
Powdery scab, cause of disease.....	'14, 92	imitator.....	'11, 312
economic importance.....	'14, 99	inflata.....	'11, 311
effect upon the host.....	'14, 93	serripes.....	'11, 311
history and distribution.....	'14, 89	Rondaniella abbreviata.....	'11, 261
preventive measures.....	'14, 100	sororeula.....	'11, 261
Prepotency in breeding fowls.....	'12, 390	Roosting closets, abandonment of.....	'11, 185
Proanaclina.....	'11, 264	Rosa, aphids infesting.....	'14, 268
Probolaeus singularis.....	'11, 258	Rose aphids.....	'14, 253
Prociophilus corrugatus.....	'14, 253	scale.....	'12, 436
verafuscus.....	'12, 448	Rosy aphid of the apple.....	'14, 267
Protective coloration in poultry.....	'11, 198	Rotation experiments.....	'15, 63
Prunus aphids.....	'14, 258, 262	treatment and yield.....	'15, 64
Pseudoanthonomus validus, distribution.....	'15, 270	Rubus aphids.....	'14, 269
enemies.....	'15, 276	Russeting of apples.....	'14, 16
life history.....	'15, 270	relation to lime-sulphur.....	'12, 18
		Saliaceae, species affected by aphides.....	'13, 93
		Sackenia arcuata.....	'11, 292
		gibbosa.....	'11, 292
		San Jose scale.....	'12, 434; '11, 237
		Sap beetle.....	'11, 233
		Saperda candida.....	'11, 7
		obliqua.....	'11, 7
		tridentata.....	'12, 464

	Page.		Page.
Scab, common, of potatoes.....	'14, 95	Sprays.....	'15, 217
Scale insects.....	'12, 432	diluting concentrated solutions	'11, 75
insect attacking blueberry...	'15, 285	directions for making.....	'11, 74
differential characters.....	'12, 447	effects on apple foliage.....	'14, 6
Scaphoideus auronitens.....	'15, 115	the apple.....	'14, 9
carinatus.....	'15, 115	for orchards, formulas.....	'11, 54
immistus.....	'15, 116	Spruce bud moth.....	'12, 455
jucundus.....	'15, 114	budworm, bibliography.....	'13, 31
lobatus.....	'15, 114	habits and description.....	'13, 19
luteolus.....	'15, 116	history and distribution.....	'13, 13
productus.....	'15, 115	natural control.....	'13, 24
scalaris.....	'15, 114	remedial measures.....	'13, 28
Schizoneura. See woolly apple aphid		leaf miners.....	'13, 32
americana. '12, 236; '13, 263; '15, 197		Staff, changes in.....	'11, xii; '14, xv
lanigera..... '11, 236; '12, 236, 449; '13, 173, 264; '14, 266		Standard bushel measure.....	'14, 69
lanuginosa.....	'13, 263	Station, establishment of. '11, vi; '14, vii	
pinicola.....	'11, 20	organization.....	'14, ii
rileyi.....	'13, 260	Statistical constants, estimation of	
ulmi (fodiens)..... '13, 271; '14, 60		significance.....	'14, 85
Sciarinae.....	'12, 111	Stem rot of the potato.....	'11, 201
Sciophilinae.....	'11, 322	Sterility in the domestic fowl, somatic and genetic.....	'14, 287
Scolytidae.....	'11, 235	Sulfocide and calyx injury.....	'11, 69
Scurly scale.....	'12, 439	for spraying orchards.....	'11, 54
Sex-linked Mendelian inheritance.....	'15, 298	Sulphate of ammonia vs. nitrate of	
Shank colors in fowls, histological		soda.....	'15, 47
basis.....	'14, 237	Sulphur and sulphur compounds as	
methods of study.....	'14, 238	insecticides.....	'11, 39
of domestic fowl, external		as a fungicide.....	'11, 39
structure.....	'14, 239	compounds as fungicides.....	'11, 39
histology, corium.....	'14, 240	Sunscald in orchards.....	'12, 15
epidermis.....	'14, 240	Sweet spirit of nitre.....	'12, 147
pigment relations.....	'14, 243	Syntenna longicornis.....	'11, 296
pigmentation.....	'14, 241	polyzona.....	'11, 297
Sheep, are they profitable in Maine	'15, 59	rejecta.....	'11, 296
experiment at Highmoor Farm	'15, 59	separata.....	'11, 297
Silver scurf of potatoes.....	'14, 96	vittata.....	'11, 297
Simulium and pellagra.....	'11, 4	vittata, var. fasciata.....	'11, 297
hirtipes.....	'11, 4	Tanytarsus dissimilis.....	'11, 3
reptans.....	'11, 4	Tent caterpillars.....	'12, 452
venustum.....	'11, 4	Tenthredinoidea, immature stages	
Simultaneous ovulation, relation to		of.....	'14, 291
double-yolked eggs.....	'15, 289	Teratology.....	'12, 53
Sinapis avensis, control.....	'14, 49	Tetraneura graminis.....	'11, 23
Siphocoryne avenae.....	'12, 172	Tettigonia angulifera.....	'15, 102
Siphonophora solanifolia.....	'11, 92	bifida.....	'15, 99
Smynturus albamaculata.....	'11, 24	gothica.....	'15, 100
Soluble sulphur compound, data..	'14, 17	hieroglyphica.....	'15, 100
for apple orchards.....	'14, 6	mollipes.....	'15, 103
Southern elm leaf curl.....	'13, 267	obliqua.....	'15, 155
Soy beans, conditions of growth..	'14, 33	octolineata.....	'15, 105
fertilizing and culture.....	'14, 33	similis.....	'15, 100
for fodder, silage and seed....	'14, 32	telitormis.....	'15, 101
yield of green fodder.....	'14, 35	vitis.....	'15, 156
Spiraea aphids.....	'14, 270	Tettigoniella gothica.....	'15, 100
Spirit of nitrous ether, determina-		Tettigoniellidae, key to genera....	'15, 98
tion.....	'12, 147	Thamnotettix belli.....	'15, 135
method of analysis.....	'12, 150	chlamydatum.....	'15, 136
Spondylocladium atrovirens.....	'14, 96	ciliata.....	'15, 138
Spongospora subterranea.....	'14, 89	clitellarius.....	'15, 134
Sporotrichum anthophilum.....	'13, 211	cockerelli.....	'15, 134
bombycinum.....	'13, 218	decepiens.....	'15, 137
poeae.....	'13, 211	eburata.....	'15, 133
roseolum.....	'13, 218	fitchi.....	'15, 137
Spray formulas.....	'12, 28	infusata.....	'15, 136
injury.....	'11, 33	inornata.....	'15, 137
test for conifers.....	'12, 465	kennicottii.....	'15, 134
Spraying, calyx injury.....	'12, 16	melanogaster.....	'15, 136
effect on foliage..... '12, 12; '13, 63		morsei.....	'15, 134
fruit..... '12, 13; '13, 65		placidus.....	'15, 138
experiments..... '12, 1; '14, 2		punctiseuta.....	'15, 136
with orchards..... '13, 57; '15, 177		rufescens.....	'15, 135
tor fungus control.....	'12, 18	smithi.....	'15, 137
mustard.....	'14, 39	waldana.....	'15, 133
weeds.....	'14, 42	Thysanura.....	'11, 24
injurious effects.....	'14, 2	Tischeria malifoliella.....	'11, 2
mixtures, preparation.....	'12, 2	Tmetocera ocellana.....	'11, 1, 241
stock solutions.....	'12, 32	Tobacco decoction for aphides....	'13, 186
operations, time and methods	'11, 77	Top dressing grass land.....	'14, 25
potatoes with iron sulphate..	'15, 51	Tortrix fumiferana.....	'11, 241; '12, 455; '13, 113
problems.....	'11, 33	Torymus flavicoxa.....	'11, 8
relation to heat.....	'12, 19		

	Page.		Page.
Trap nest records, accuracy of . . .	'11, 186	Vaccinium, species found on the	
Treasurer's report	'11, 332; '12, 469;	barrens	'15, 251
	'13, 321; '11, '14, 297;	Variation and growth in maize . . .	'14, 299
Trichonta bellula	'11, 304	Vegetable cylinders for Fusarium	
cineta	'11, 303	cultures	'13, 228
difissa	'11, 305	Violet sawfly	'11, 8
foeda	'11, 305	Virginia etnueha	'12, 459
obesa	'11, 304	Wart disease of potato	'14, 98
patens	'11, 305	Weather observations	'11, 329; '12, 467;
perspicua	'11, 302	'13, 319; '14, 295;	'15, 309
triangularis	'11, 303	Weeds, control by spraying	'14, 42
vulgaris	'11, 304	Whale oil soap for aphides	'13, 188
Trioxa aylmeriac	'12, 225	White cornieled currant aphid	'14, 50
callaris	'12, 225	Willow, aphid pests	'13, 73
diospyri	'12, 226	Willows, species affected by aphides	'13, 93
dubia	'12, 226	Winter injury to orchards	'12, 54
forcipula	'12, 227	Wire worms in corn	'11, 229; '12, 460
longistylus	'12, 227	Woolly aphid of the apple	
marginata	'12, 228	'13, 173; '14, 255, 266	
maura	'12, 228	economic status	'13, 180
obtusa	'11, 18	habits	'13, 173
quadripunctata	'12, 229	life cycle	'13, 182
stylifera	'12, 229	preventive measures	'13, 185
tripunctata	'12, 230	structure key	'13, 183
Triplet calves	'12, 250	elm	'13, 259
Tumors, occurrence in domestic		and Juneberry	'15, 197
fowl	'15, 297	bark	'13, 260
Turnips as a stock food	'15, 54	habitat key	'13, 184
black hearted	'15, 57	hawthorn leaf	'14, 253
wild, control	'14, 40	apple aphid and elm leaf curl	'12, 235
yields and food value	'15, 54	economic status	'12, 244
Typhloeyba bifasciata	'15, 157	food plants	'12, 253
carneola	'15, 151	habits	'12, 237
comes	'15, 156	insect enemies	'12, 252
commisularis	'15, 158	life cycle	'12, 247
lethierryi	'15, 157	preventive measures	'12, 248
obliqua	'15, 153	sequence of generation	'12, 242
querei	'15, 157	spring migration	'12, 241
rosae	'15, 158	synonymy and literature	'12, 255
tencrrema	'15, 158	Xestoecephalus fulvocapitatus	'15, 109
vulnegrata	'15, 156	nigrifrons	'15, 109
Typhloeybidae, key to North		pulicarius	'15, 109
American genera	'15, 150	Xyleborus dispar	'11, 235; '12, 463
Typhoid fly	'11, 6	Yellow edge butterfly	'12, 450
		Yellow eye beans, standard types	'15, 161

THIRTY-FIRST ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE

1915

STATE OF MAINE

1916

MAINE
 AGRICULTURAL EXPERIMENT STATION
 ORONO, MAINE.

Organization January to June, 1915.

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WILLIAM G. HUNTON, Readfield,		<i>Maine Seed Improvement Association</i>	

AND THE HEADS AND ASSOCIATES OF STATION DEPARTMENTS, AND THE
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		ROYDEN L. HAMMOND,	<i>Seed Analyst and Photographer</i>
		CHARLES C. INMAN,	<i>Assistant</i>

MAINE
 AGRICULTURAL EXPERIMENT STATION
 ORONO, MAINE.

Organization July to December, 1915.

THE STATION COUNCIL.

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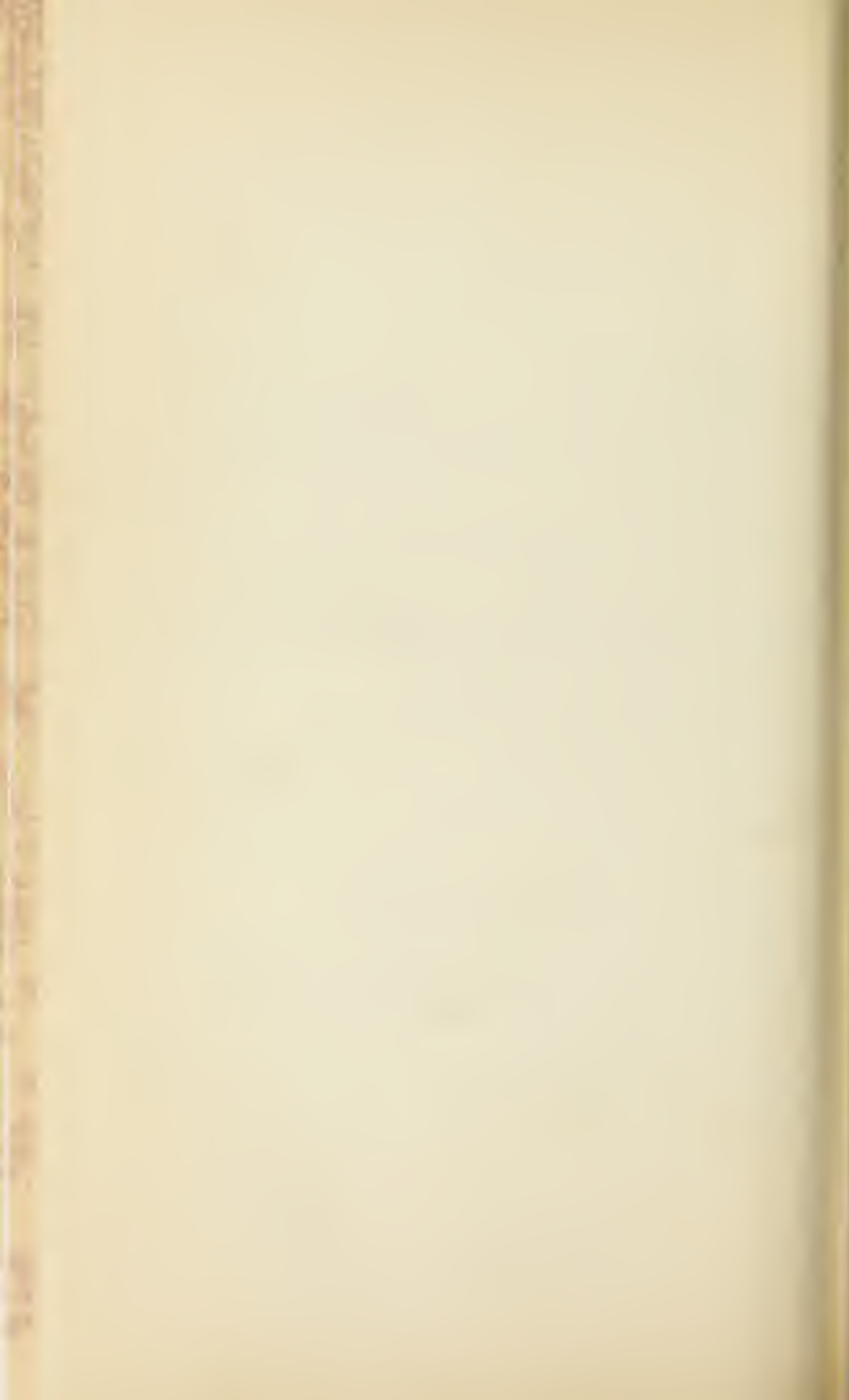
The publications of this Station will be sent free to any address in
Maine. All requests should be sent to

Agricultural Experiment Station,

Orono, Maine.

CONTENTS.

	PAGE
Organization of the Station	II
Announcements	VII
Studies on Oat Breeding. II Selection within pure lines (Bulletin 235)	1
Commercial varieties of oats grown at Highmoor Farm in 1914	41
Tests of new varieties of oats originated at Highmoor Farm (Bulletin 236)	44
Rate of seeding oats in Aroostook County (Bulletin 236)	45
Sulphate of ammonia compared with nitrate of soda in potato fertilizers (Bulletin 236)	47
Method of application of fertilizers upon potatoes (Bulletin 236)	49
Effect of spraying iron sulphate on potato tops (Bulletin 236)	51
Fertilizer experiments on apple trees (Bulletin 236)	52
Turnips, yields and food value (Bulletin 236)	54
Turnips, black heart disease (Bulletin 236)	57
Are sheep profitable in Maine (Bulletin 236)	59
Preparing land for crops with dynamite (Bulletin 236)	62
Rotation experiment (Bulletin 236)	63
Assumption of male secondary characters by a cow (Bulletin 237)	65
Leafhoppers of Maine (Bulletin 238)	81
Studies on bean breeding. I. Standard Types of Yellow eye bean (Bulletin 239)	161
Apple spraying experiments in 1914 (Bulletin 240)	177
Woolly aphid of Elm and Juneberry (Bulletin 241)	197
Pink and green aphid of potato (Bulletin 242)	205
Further data on the measurement of inbreeding (Bulletin 243)	225
Blueberry Insects in Maine (Bulletin 244)	249
Abstracts of Station publications in 1915 not included in Bulletins or Official Inspections (Bulletin 245)	289
Meteorology (Bulletin 245)	309
Report of the Treasurer (Bulletin 245)	311
Index for 1914 (Bulletin 245)	314
Index for 1911 to 1915	322



ANNOUNCEMENTS.

ESTABLISHMENT OF THE STATION.

The Maine Fertilizer Control and Agricultural Experiment Station, established by Act of the Legislature approved March 3, 1885, began its work in April of that year in quarters furnished by the College. After the Station had existed for two years, Congress passed what is known as the Hatch Act, establishing agricultural experiment stations in every state. This grant was accepted by the Maine Legislature by an Act approved March 16, 1887, which established the Maine Agricultural Experiment Station as a department of the University. The reorganization was effected in June, 1887, but work was not begun until February 16, 1888. In 1906 Congress passed the Adams Act for the further endowment of the stations established under the Hatch Act.

The purpose of the experiment stations is defined in the Act of Congress establishing them as follows:

"It shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantage of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manure, natural and artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective states or territories."

The work that the Experiment Station can undertake from the Adams Act fund is more restricted and can "be applied only to paying the necessary expenses for conducting original researches or experiments bearing directly on the agricultural industry of the United States, having due regard to the varying conditions and needs of the respective states and territories."

INVESTIGATIONS.

The Station continues to restrict its work to a few important lines, believing that it is better for the agriculture of the State to study thoroughly a few problems than to spread over the whole field of agricultural science. It has continued to improve its facilities and segregate its work in such a way as to make it an effective agency for research in agriculture. Prominent among the lines of investigation are studies upon the food of man and animals, the diseases of plants and animals, breeding of plants and animals, orchard and field experiments, poultry investigations, and entomological research.

The Legislature of 1913 provided for investigations by the Station in animal husbandry which make Chapter 141 of the Public Laws for 1913. The following quoted from the act outlines the purpose of the act. "The Maine Agricultural Experiment Station in addition to the investigations now conducted by it, shall conduct scientific investigations in animal husbandry, including experiments and observations on dairy cattle and other domestic animals. Said investigations shall be carried out under control of the director of the Maine Agricultural Experiment Station. There shall be appropriated annually from the State Treasury the sum of five thousand dollars to be paid to the Maine Agricultural Experiment Station and the same shall be expended by the director of said Station in executing the provisions of this act."

INSPECTIONS.

Up to the close of the year 1913 it had been the duty of the Director of the Station to execute the laws regulating the sale of agricultural seeds, apples, commercial feeding stuffs, commercial fertilizers, drugs, foods, fungicides and insecticides, and the testing of the graduated glassware used by creameries. Beginning with January 1914 the purely executive part of these

laws is handled by the Commissioner of Agriculture. It is still the duty of the Director of the Station to make the analytical examination of the samples collected by the Commissioner and to publish the results of the analyses. The cost of the inspections is borne by fees and by a State appropriation.

OFFICES AND LABORATORIES.

The offices, laboratories and poultry plant of the Maine Agricultural Experiment Station are at the University of Maine, Orono. Orono is the freight, express, post, telegraph and telephone address for the offices and laboratories.

Visitors to the Station will find it convenient to leave the steam cars at Bangor or Old Town, as the railway station at Orono is a mile from the University. Bangor and Old Town trolley cars pass through the campus. They pass the railway station in Bangor 5 minutes after the hour and half hour, and the railway station in Old Town, 20 minutes after and 10 minutes before the hour.

AROOSTOOK FARM.

By action of the Legislatures of 1913 and 1915 a farm was purchased in Aroostook County for scientific investigations in agriculture to be under "the general supervision, management, and control" of the Maine Agricultural Experiment Station. The farm is in the town of Presque Isle, about two miles south of the village, on the main road to Houlton. The Bangor and Aroostook railroad crosses the farm. A flag station, "Aroostook Farm," makes it easily accessible by rail.

The farm contains about 275 acres, about half of which is cleared. The eight room house provides an office, and home for the farm superintendent. The large barn affords storage for hay and grain and has a large potato storage house in the basement.

HIGHMOOR FARM.

The State Legislature of 1909 purchased a farm upon which the Maine Agricultural Experiment Station "shall conduct scientific investigations in orcharding, corn, and other farm

crops." The farm is situated in the counties of Kennebec and Androscoggin, largely in the town of Monmouth. It is on the Farmington Branch of the Maine Central Railroad, two miles from Leeds Junction. A flag station, "Highmoor," is on the farm.

The farm contains 225 acres, about 200 of which are in orchards, fields, and pastures. There are in the neighborhood of 3,000 apple trees upon the place which have been set from 20 to 30 years. Fields that are not in orchards are well adapted to experiments with corn, potatoes, and similar general farm crops. The house has two stories with a large wing, and contains about 15 rooms. It is well arranged for the Station offices and for the home of the farm superintendent. The barns are large, affording storage for hay and grain. The basement affords limited storage for apples, potatoes and roots.

THE AIM OF THE STATION.

Every citizen of Maine concerned in agriculture has the right to apply to the Station for any assistance that comes within its province. It is the wish of the Trustees and Station Council that the Station be as widely useful as its resources will permit.

In addition to its work of investigation, the Station is prepared to make chemical analyses of fertilizers, feeding stuffs, dairy products and other agricultural materials; to test seeds and creamery glassware; to identify grasses, weeds, injurious fungi and insects, etc.; and to give information on agricultural matters of interest and advantage to the citizens of the State.

All work proper to the Experiment Station and of public benefit will be done without charge. Work for the private use of individuals is charged for at the actual cost to the Station. The Station offers to do this work only as a matter of accommodation. Under no condition will the Station undertake analyses, the results of which cannot be published, if they prove of general interest.

PUBLICATIONS.

The Station is organized so that the work of investigation is distinct from the work of inspection. The results of investigation are published in the bulletins of the Station and in scientific journals, both foreign and domestic. The bulletins for the year make up the annual report. The results of the work of inspection are printed in publications known as Official Inspections. These are paged independently of the bulletins and are bound in with the annual report as an appendix thereto. Miscellaneous publications consisting of newspaper notices of bulletins, newspaper bulletins and circulars which are not paged consecutively and for the most part are not included in the annual report are issued during the year.

All the bulletins issued by the Station are sent to the members of the staffs of other Stations and the U. S. Department of Agriculture who ask for them, to all newspapers in Maine, to libraries and to agricultural exchanges. Bulletins which have to do with general agriculture and the Official Inspections which bear upon the feeding stuffs, fertilizer and seed inspections are sent to a general mailing list composed chiefly of farmers within the State. The publications having to do with the food and drug inspection are sent to a special list including all dealers in Maine and other citizens who request them. The annual report is sent to directors of experiment stations and to libraries. Copies of all publications are sent to the newspapers within the State and to those on the exchange list outside of the State.

BULLETINS ISSUED IN 1915.

- No. 235. Studies on Oat Breeding. II—Selection Within Pure Lines. 40 pages, 2 illustrations.
- No. 236. Field Experiments in 1914. 24 pages.
- No. 237. The Assumption of Male Secondary Characters by a Cow With Cystic Degeneration of the Ovaries. 16 pages, 10 illustrations.
- No. 238. Leafhoppers of Maine. 80 pages, 25 illustrations.
- No. 239. Studies on Bean Breeding. I. Standard Types of Yellow Eye Beans. 16 pages, 9 illustrations.
- No. 240. Apple Spraying Experiments in 1914. 20 pages.
- No. 241. Woolly Aphid of Elm and Juneberry. 8 pages, 2 illustrations.
- No. 242. Pink and Green Aphid of Potato. 20 pages, 3 illustrations.

- No. 243. Further Data on the Measurement of Inbreeding. 24 pages,
6 illustrations.
- No. 244. Blueberry Insects of Maine. 40 pages, 7 illustrations.
- No. 245. Finances, Meteorology, Index, Abstracts of Papers Not in
the Bulletins. 36 pages.

OFFICIAL INSPECTIONS ISSUED IN 1915.

- No. 66. Opened Shell-fish. 8 pages.
- No. 67. Milk and Cream. 20 pages.
- No. 68. Fungicide and Insecticide Inspection. 28 pages.
- No. 69. Cream and Milk. 12 pages.
- No. 70. Vinegar. 12 pages.
- No. 71. Cream and Milk. 20 pages.
- No. 72. Feeding Stuffs Inspection. 96 pages.
- No. 73. Seed Inspection. 28 pages.
- No. 74. Fertilizer Inspection. 60 pages.

MISCELLANEOUS PUBLICATIONS ISSUED IN 1915.

- No. 504. Abstract Bulletin 237. 7 pages.
- No. 505. Special Report to Commissioner of Agriculture for 1914. 39
pages.
- No. 506. Station Publications. 1 page.
- No. 507. List of Available Publications. 4 pages.
- No. 508. Abstract Bulletin 237. 4 pages.
- No. 509. Experiments at Highmoor Farm in 1915. 8 pages.
- No. 510. Suggestion of Breeding Yellow Eye Beans of Standard Type.
4 pages.
- No. 511. Abstract Bulletin 240. 7 pages.
- No. 512. Cooperative Experiments. 2 pages.
- No. 513. Abstract Bulletin 238. 7 pages.
- No. 514. Experiments at Aroostook Farm in 1915. 8 pages.
- No. 515. Poultry Management at the Maine Station (Revised) 98 pages.
- No. 516. Surplus Stock of Seed Oats at Aroostook Farm. 1 page.
- No. 517. Surplus Stock of Seed Oats at Highmoor Farm. 1 page.
- No. 518. Cultural Methods with Oats used by the Station. 8 pages.
- No. 519. Report of Progress on Animals Husbandry Investigations in
1915. 27 pages.
- No. 520. Growing Crops Without Potash in 1916. 16 pages.
- No. 521. Potatoes without Potash (placard). 1 page.

BIOLOGY PUBLICATIONS 1915.

- In the numbered series of "Papers from the Biological Laboratory:"
75. Studies on the Physiology of Reproduction in the Domestic Fowl.
XI. On the Relation of Simultaneous Ovulation to the Pro-
duction of Double-Yolked Eggs. By Maynie R. Curtis, Journal
of Agricultural Research, Vol. III, No. 5, pp. 375-385.

76. Studies on the Physiology of Reproduction in the Domestic Fowl. XII. On an Abnormality of the Oviduct and Its Effect upon Reproduction. By Maynie R. Curtis. Biol. Bulletin, Vol. XXVIII, No. 3, pp. 154-162.
77. On the Refractive Index of the Serum in a Guinea-Chicken Hybrid. By Raymond Pearl and John W. Gowen, Proc. Soc. Exp. Biol. & Med., Vol. XII, p. 48.
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92. Report of Progress on Animal Husbandry Investigations in 1915. By Raymond Pearl. *Maine Agricultural Experiment Station Circular No. 519*.

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- a. Brief Report of Progress on Animal Husbandry Investigations in 1914. By Raymond Pearl. *Maine Agricultural Experiment Station Circular 503*, pp. 1-11.
- b. A Case of Assumption of Male Secondary Sex Characters by a Cow. By Raymond Pearl and Frank M. Surface. *Science, N. S.*, Vol. XLI., pp. 615-616.
- c. Growth and Variation in Maine. By Raymond Pearl and Frank M. Surface. *Proc. Nat. Acad. Sci.*, Vol. I, pp. 222-226.
- d. Dynamic Evolution. By Raymond Pearl. *Journal of Heredity*, Vol. VI, pp. 254-256.
- e. Breeding for Sex. By Raymond Pearl. *Hoard's Dairyman*, Vol. L., p. 71.
- f. The Publication of the Results of Investigations made in Experiment Stations in Technical Scientific Journals. By Raymond Pearl. *Science, N. S.*, Vol. XLII, pp. 518-522.
- g. Further Data on the Measurement of Inbreeding. By Raymond Pearl. *Maine Agricultural Experiment Station Bulletin 243*, pp. 225-248.

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- Ent. 75. Pond-Lily Aphid as a Plum Pest. By Edith M. Patch. *Science*, Vol. XLII, No. 1074, p. 164, July 30, 1915.
- Ent. 76. Two Clover Aphids. By Edith M. Patch. *Journal of Agricultural Research*, Vol. III, No. 5.
- Ent. 78. Leafhoppers of Maine. By Herbert Osborn. *Bul. 238. Me. Agr. Exp. Station*.
- Ent. 79. Woolly Aphid of Elm and Juneberry. By Edith M. Patch. *Bul. 241. Me. Agr. Exp. Station*.
- Ent. 80. *Boisteres rhagoletis* Richmond, sp. n., a parasite of *Rhagoletis pomonella*, Walsh. By William C. Woods. *Canadian Entomologist*, Vol. XLVII, pp. 203-205.

- Ent. 81. Pink and Green Aphid of Potato. By Edith M. Patch. Bul. 242. Me. Agr. Exp. Station.
- Ent. 83. Blueberry Insects in Maine. By William C. Woods. Bul. 244. Me. Agr. Exp. Station.

CHANGES IN MEMBERS OF COUNCIL.

In January, 1915, Mr. William T. Guptill, Topsham, was elected Commissioner of Agriculture in place of Mr. John A. Roberts of Norway.

At the annual meeting of the State Pomological Society in November, 1915, Wilson H. Conant, Buckfield, was elected as their representative on the Council in place of Mr. Howard L. Keyser of Greene.

CHANGES IN STATION STAFF.

The Station counts itself as particularly fortunate in that it has been able to retain the services of the heads of the departments through so many years.

Mr. Bartlett has served the Station as Chemist continuously since 1885, Mr. Woods as Director since 1896, Miss Patch as Entomologist since 1904, Mr. Hanson as Associate Chemist since 1905, Mr. Morse as Plant Pathologist since 1907, Mr. Pearl as Biologist since 1908. Mr. Surface came to the Station as Associate Biologist in 1908. He was away with the Kentucky Experiment Station for two years but came back to this Station as biologist in 1913. It is only those who are familiar with the work of a Station that can appreciate the increased value that comes to a Station by having the continuous service of the heads of the departments. Such continuous service makes possible the carrying out of projects extending over long periods of time. While the Maine Station has an unusual staff in ability its marked success as a contributor to new facts underlying agricultural practice and as a high research institution is largely due to the continuity of effort possible only by the permanency of its staff.

April 1, Mr. Walter E. Curtis and Mr. C. Harold White were appointed Scientific Aids at the experiment farms.

June 1, Mr. Vernon Folsom resigned as Laboratory Assistant in Plant Pathology and Mr. Donald S. Clark was appointed in his stead.

July 1, Mr. John W. Gowen resigned as Assistant Biologist.

July 1, Mr. Hoyt D. Lucas resigned as Assistant Chemist and Mr. Walter H. Rogers was appointed in his stead.

Miss Janie L. Fayle, Stenographer, was absent on leave from August 1, and Miss Ella M. MacKenzie was employed in her stead.