A STUDY OF THE COMPARATIVE EFFICACY OF VARIOUS LOUSE POWDERS

THESIS FOR DEGREE OF M. S.

J. LYALL L. FRANK

1922

Insecticides

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Introduction.

From the viewpoint of the average poultryman, an efficient insecticide, to control lice on poultry, may be described as follows; (1) an insecticide that is reasonable in price, (2) one that is readily available for use, (3) easily applied, (4) harmful to neither birds nor operator, and (5) efficient with the least number of applications.

While ointments and dips may be used effectively, the objections to both these insecticides make the powder form the more desirable for poultry. Ointments may cause burning; they soil and may discolor the feathers, and frequently leave an undesirable odor. All of these last three objections are especially applicable to show birds. Dips may cause death by shock or exposure; only warm and sunny weather can be chosen for time of treatment, necessitating day handling which is objectionable for laying hens. Furthermore dips often soil and discolor the plumage. Also there is usually an unpleasant odor which is left for a long time after dipping. These last objections are also applicable especially to show birds.

Assuming that a powder form of insecticide is desirable this study of the comparative efficacy of

various louse powders is asvisable, in order that a powder which meets the above requirements may be selected.

Further,upon a review of literature on lice control, there is revealed many different powders, recommended highly for efficiency. Also a survey of the market today, discloses many powders advertised and recommended as efficient by the various manufacturers.

Several investigators have published some excellent work with different powders, many of which are recommended as one hundred percent efficient. However, there has been no mention made of how the number of lice which might have been on the birds after treatment, was determined. One is left to assume that the method of determining this fact has been only a careful observation in handling the birds.

Therefore, by means of special technique (fumigating with nitrobenzene, which is described later) for collecting any lice that might be present after treatment, an accurate comparative efficacy of many powders should be determined.

Thirty-two powders were tested in this manner. One of these powders was tested four times, and three others were each tested twice.*

While some of these were more efficient than others, Sodium fluorid was found to be most reasonable in price, the most readily available, and efficient (100%) with but one application.

* See table of comparative efficacy.

Because of these findings, it was thought advisable to conduct some experiments with sodium fluoride, these experiments to determine the following points : (1) whether its use in controlling lice would result in a decrease or an increase in egg production, (2) whether its use would have any effect upon the growth of young chicks.

The writer takes this opportunity to express his thanks to Dr.W.I.Chandler, under whose direction this work was carried out. He wishes also to thank the poultry department for use of birds and egg production charts.

Review of Literature.

Pyrethrum.

Theobald(1899) in an article in Hoard's Dairyman, recommends pyrethrum as an effective remedy for poultry lice. An article in the Agricultural Gazette(1900) deals with pyrethrum as a means of control of chicken lice. Sherwood (1914) states that pyrethrum is available at drug stores and may be used to dust small flocks. Bishopp(1912) advises dusting brooding hens with pyrethrum. Abbott (1920) states that in 12 tests, pyrethrum powder was found to be "very effective killing all the lice within 24 hours." He further states that in dilution tests it was found to be very effective at a dilution of 5%. This was effective "if very carefully and thoroughly applied." He makes the following conclusion about pyrethrum, "Good, fresh pyrethrum

powder is one of the best insecticides for control of lice, but it is too expensive for use on a large scale."

Dust Baths.

For many years before poultry culture became advanced to the point where it is today, undoubtedly the only means of protection against lice afforded, was a dust bath of some sort. Birds use this means of protection as a natural instinct. Man came to understand this method of protection directly from his observations upon the habits of birds.

One may sum up all the recommendations for the use of the dust bath, in stating that every poultry yard should have for available use, dust baths of some kind for the birds in it. Even one of ordinary road dust is better than no bath at all. We realize that what water is to man, dust is to the birds.

Abbott(1920) gives results of tests with dust baths that conclusively determine their value. He tested the efficacy of two dust baths to which had been added powders containing nicotine, naphthalene, and sulphur. He reports that when these baths were furnished lousy hens, 95 to 100% of the lice were killed. He sums up this result in a way that may apply to dust baths as a whole. "This method of treatment is not, however, a very practical one, since all fowls do not dust themselves and a few that do not, will eventually reinfest the whole flock.

Homemade Powders.

Bentley(1913) recommended a powder that is made at home. It can be made according to the following formula : 3 parts gasoline,1 part crude carbolic acid(90 to 95% strength) 1 part cresol. These are mixed together and added gradually (with constant stirring)to enough plaster of paris to take up all the moisture.About 4 quarts of plaster of paris are required to absorb 1 quart of the liquid. When this is dry it is used as a dust,applying it thoroughly over the birds.

Sherwood(1914) gives the following as a louse powder. 3 parts gasoline,1 part cresol. These are mixed and to the mixture is added as much plaster of paris or land plaster as the liquid will moisten. After this is dry it is stated it should be liberally applied to fowls. Sherwood remarks in this recommendation that the above powder is rather strong for young chicks.

Herrick(1913)gives the Cornell (Lawry) Powder as the best known remedy up to that time. It is made as follows; " Two and one-half pounds of plaster of paris is spread in a shallow pan or tray. One-fourth pint of crude carbolic acid is poured into a cup, and into this is poured three-fourths pint of gasoline. The mixture of acid and gasoline is poured over the plaster of paris and thoroughly mixed. It is then rubbed through a wire window screen on a piece of paper and allowed to stand for from one and one-half to two hours or until thoroughly dry.<u>It must not be placed near a flame or any heat.</u> The powder should be kept in a closed can or jar,where it will retain its strength for a long time.The powder is applied by means of a sifter or

with the finger, and is worked in among the feathers about the vent, in the fluff, and under the wings. In extreme cases the application should be repeated in about two weeks. A small pinch of the powder is sufficient for a fowl." Herrick also gives a table of cost of dusting fowls. Estimating cost of powder, labor in application etc., he finds the average cost per one hundred hens to be about thirty-two cents.

Lamson and Manter (1916) state that this powder was found unsatisfactory, for in a few days after it was used the live lice were not materially reduced. They do not consider dustion as a desirable remedy unless it is repeated at very frequent intervals.

Sulphur.

Bishopp and Wood (1917) state that flowers of sulphur when applied thoroughly in dust form has been found to destroy all stages of several species of lice. They also state that in a few instances some lice remained on the fowls after treatment. They attribute this to the difficulty of getting the dust over every portion of the fowls, and remark that thorough and careful application of sulphur is required. The following comment on sulphur is made by them; " About four days are required for the fowls to be freed of living lice. The ready availability of flowers of sulphur and its comparatively low cost per pound, tend to recommend it for this use. Furthermore, it is not disagreeable to handle. A number of poultry raisers, however, have stated that injury

to the fowls sometimes results from the use of sulphur, although the writers have seen no injury further than a very slight scaling of the skin following treatment. It is possible that the injury observed by some was due to mixing sulphur with grease or other substances. To accomplish complete destruction the writers have found it necessary to use considerable quantities of sulphur, averaging about 6 pounds per one hundred fowls, which at ten cents per pound would make a cost of sixty cents for the material."

Lamson and Manter(1916) warn against the use of sulphur and lard, as well as against the use of sulphur.

Abbott(1920) states that," Used freely as a dust, sulphur forms a cheap and very effective lice killer."

Naphthalene.

Abbott(1919) gives complete data concerning naphthalene. He examined fowls every one or two days after treatment with naphthalene as a dust, and estimated the results. He states the following concerning naphthalene; 1.5% of naphthalene in lime as an inert carrier, kills from 5 to 10% of the lice. 5% of naphthalene (in flour) kills about 10% of the lice. 10% (in flour) kills from 90 to 95% of the lice. This percentage of naphthalene made all the birds treated sick for a time, but they all recovered. 15% of naphthalene (in flour) kills from 95 to 98% of the lice. (Birds sick, but recovered). 20% (in flour) kills from 95 to 100% of the lice (Hens sick but recovered). 60% (in charcoal) not rubbed in kills 100% of the lice. (Birds sick but recovered). 60% (in charcoal) rubbed in, kills 100% of the lice but also the

birds treated.100% of naphthalene when not rubbed in is 100% efficient(birds sick but recovered). 100% when rubbed in is also 100% efficient but kills the birds treated.

Abbott(1920) comments as follows ; "A powder containing 10% of naphthalene was effective against these pests(lice) but slightly injured the birds,and 60% killed the birds when well rubbed in. Naphthalene sprinkled over the backs of fowls at roost proved to be of considerable value against chicken lice. Naphthalene nest eggs were of no value.against lice and proved injurious to sitting hens."

Sodium flourid.

Bishopp and Wood(1917) were the first investigators to use Sodium flourid as a dust for killing chicken lice.In its use they also originated the method of applying a dust to fowls termed the "pinch method".

These workers report that in a series of tests with various substances generally advocated for lice destruction, nothing else was found to be as satisfactory as Sodium flourid.They find that although the pure powder is effective it is not as easily applied as a dust as is the commercial form.(The commercial form should contain from 90 to 98% sodium flourid). They recommend Sodium flourid over all other substances,stating that " one application... to all fowls on a given premises will completelt destroy all lice present."They also recommend this powder in treating young chicks as well as for older birds.

They find no ill effects on the chickens results from the use of sodium flourid. The only irritation that may

result is the effect upon the air passages. This may cause labored breathing or sneezing, but they find that this condition is not noticeable a few minutes after treatment. When the powder remains on the body of the operator for several hours, the report a slight irritation or burning on tender portions of the skin. They find that by the pinch method one pound will be sufficient to treat one hundred birds. This is an approximation based on treatment of large number of fowl.

Wells(1919) recommends sodium fluorid as "the best remedy."

Kinghorne and Green(1920) in a popular bulletin for boys and girls' clubs, recommends sodium fluorid.

U.S.D.A. Dept.Circ.16 also recommends this powder.

Babcock(1920) as well, recommends sodium fluorid.

Abbott(1920) reports that this substance has been found to be very effective.

Miscellaneous powders.

Abbott(1920) reports on various powders testes as follows; "Forty-five of the common proprietary powders generally sold as 'Lice Powder', 'Lice Killer', 'Lice Exterminator' etc., were tested and with few exceptions were found to be effective if thoroughly applied. These powders are all of the same general typeand contain one or more of the following active ingredients : Naphthalene, nicotine, sulphur, or phenols, and are mixedwith lime, sand, fuller's earth, or diatomaceous earth as a filler or carrier. Most of these active ingredients have been tested separately and the minimum amounts that will

be completely effective when very carefully and thoroughly applied by experienced persons are as follows: Naphthalene 10%,nicotine.7%,sulphur 20%,(?),pyrethrum 5%,phenols 15%, (?),.

In some cases the preparations failed to kill below the minimum for some or all of the ingredients effective,but the combined effect of all of the active ingredients was sufficient to make the preparation effective.

The following substances were reported to be effective against lice when used as a dust : Arsenic triiodid,barium fluorid,borax,boric acid,cloves,naphthalene,paradichlorobenzene,cubadilla seeds,sassafras bark,flour of sulphur, and refined sulphur. Of these Abbott states,"Arsenic triiodid is too poisonous",to be considered very practical in control of chicken lice. "Barium fluorid,cloves,sabadilla seeds, and paradichlorobenzene,are too expensiveor not readily available in large quantities;naphthalene is too dangerous if too freely applied."

Derris.

Derris was first reported as an insecticide and a means of lice control in 1911,by Sievers,McIndoo,and Abbott. Wells, Bishopp,and Laake(1922) reported that Derris kills all forms of lice on cattle and fowl,with no apparent effect upon the operator.

They advise caution with its immediate use,however, until more shall be known of its toxic qualities.

Technique.

The powders used were applied as per directions on the cans, with the exception that a second application was administered even if directions did not so state. The pinch method was used also, and in some cases the powders were sprinkled on the birds from the cans.

In some instances, when two applications proved effective that powder was tested with one application.

Five days after the the last application of each powder unless otherwise stated in the experiment, the birds were fumigated with nitrobenzene, according to recommendations by Chandler(1917)**. The actual fumigation chamber used during investigation with the physiological action of nitrobenzene, by Dr. W.L. Chandler at Cornell University*, was employed throughout the period of these experiments.

Before fumigation a clean paper was spread upon the floor of the chamber, and folded up about four inches against every side. The birds were then carefully introduced, and left within for not more than one and one-half hours, at a temperature of not more than twenty degrees Centigrade. This method of fumigation was used only as a means of collecting the lice, and at the short time fumigated, no injury resulted to the birds.

After fumigation was completed, the birds were removed and the paper examined. The lice were collected, classified, and recorded.

** Chandler, W.L.- Investigations of the value of nitrobenzol as a parasiticide, with notes on its use in collecting external parasites. Jour. Par. 4 : 27-32., 1917.

* Chandler, W.L.- Physiological action of Nitrobenzene vapor on animals. C. U. expt. sta. Memoir 20, 1919.

In removing the paper, care was exercised to do so slowly and watchfully, that no lice might be lost. The lice were stupified by the nitrobenzene vapor, and did not crawl off. After careful examination of the paper with a large magnifying glass, and after collecting all lice found in this manner, the debris left on the paper was carefully brushed into a glass basin, from which it was again examined with binoculars. In this was every precaution, and every care was taken that none of the lice be lost. Upon exposure to the air for a short time, the lice would begin to move legs slowly. Thus it was determined whether or not the powder used before fumigation had or had not killed the lice.

For each experiment three birds were used. After these birds had been obtained from the poultry plant, each set of three was put in clean cages. The powder then at hand was applied, and the birds kept under observation for the entire time of the experiment.

As the birds were kept in the laboratory which had cement flooring, a board floor was used under each cage. Between each experiment these floors were scrubbed with chlorinated lime, so that no chance of reinfestation of the next set used, occurred.

The cages were exhibition cages made of heavy wire. These were easily cleaned and were adapted to use in the laboratory. Around the bottom of each cage, and under the floor board, a large sheet of heavy brown paper was spread. This paper was then folded and tied up around the cages for about one foot. Thus there was little debris scattered about, and there was little chance of contact between cages. Each cage

was placed at least three feet from any other cage. Usually there were not more than five cages in the laboratory at one time so this distance was greater. The birds were not removed from cages except to apply a powder or to fumigate.

After fumigation, unless otherwise noted, the birds were returned to the poultry plant, where they were kept separate from all other birds, in a pen isolated from other pens. In no case were any birds used more than once, either for an experiment or for a check fumigation. None of the birds used had been previously treated at the plant.

The birds used as a check, (three in each set) were fumigated with no previous application of any powder. Thus it will be observed that the difference in lice counted, between the check fumigations and the fumigations after treatment with a powder, will give a means of determining the percentage of efficiency of the powder tested.

A simple example might be given to illustrate how the percentage of efficacy of a powder was determined. Suppose three birds fumigated with no previous treatment (Check). Assume lice counted to be 100. Suppose three birds fumigated after using a powder. Assume lice counted to be 40. The difference in lice counted is 60, and therefore the efficacy of the powder tested is 60%.

The fact that fumigation with nitrobenzene was incidental in collecting only about half of the lice present on the birds, makes no difference in these figures. The same percent of lice present was collected from both experiment birds and check birds.

As all the birds used were in the same environmental conditions, at the start and during the period of investigation, a series of check fumigations were run at regular intervals, throughout this period.

Description of experiments.

Experiment I Powder Licex.

Manufacturer's analysis : "Containing Pyrethrum, Naphthalene, Sulphur, Sopinol, in an anti-parasitic base. For lice and fleas on horses, cattle, dogs, cats, and poultry."

Directions : "Sprinkle freely into hair or feathers and repeat in ten days to destroy lice hatched from nits. Sprinkle freely into kennels and nests."

Manufactured by : R. J. Strasenburgh Co, Mfg. Chemists.

3-18-21. First application as per directions.

3-18-21. Second application.

Fumigated- 4-4-21.

Results.

Species of lice.	living.	dead.
* Menopon stramineum, Nitzsch.	47	2
Menopon gallinae, Linn.	56	1
Lipeurus caponis, Linn.	7	
Lipeurus heterographus, Nitzsch.	10	
Goniocotes hologaster, Nitzsch.	41	1
Total	161	4

Found, 83.9% efficient.

* Nomenclature used according to Harrison, Parasitology, Vol.9, #1, 1916.

Experiment II Powder Sodium fluoyrid.

Purchased in bulk by Dept.of Entomology.

4-13-21 First application by "pinch method" *

Fumigated- 4-20-21. Returned to same pen from which taken.

Fumigated- 4-27-21.

Results.

After first fumigation- Abdomen of M.stramineum found in a dried up condition. No living lice found.

After second fumigation- No living lice found.

Found, 100% efficient.

Experiment III Powder Sodium fluoyrid.

Purchased in bulk by Dept.of Entomology.

Six birds were put in a large pen. After about six hours three were fumigated for a check count,and returned to poultry plant. The remaining three birds were left in the same uncleaned pen.

4-30-21. Treated by pinch method.

Fumigated- 5-6-21,and returned to pen from which taken.

Fumigated- 5-14-21.

Results

After first fumigation, 8 dried up,dead lice were found.

After second fumigation, 5 dried up,dead lice were found.

Found, 100% efficient,with one application.

* As described in Farmers' Bulletin # 801,U.S.D.A.

Experiment IV Powder Sodium fluorid.

6-21-21. First application, pinch method.

Fumigated- 6-27-21

Results.

No living lice were found.

Found, 100% efficient with one application.

Experiment V Powder. Sold to Veterinarians,
By American Veterinary Supply Co.

Manufacturer's Analysis as per catalogue :"Sulphur, Pyrethrum, Tobacco, Naphthalene, Oil Cedar, Calcium precipitated. A dark brown powder, persistant but not unpleasant odor. Being applied in dry form it contacts whole surface of animal, without danger of absorption, irritation, or poisoning likely to occur from liquid preparation. In addition there is less opportunity for bad affects from exposure in cold or stormy weather."

5-3-21. First application. Sprinkled from can, fluffing into feathers thoroughly.

5-13-21. Second application.

Fumigated- 5-20-21.

Results.	living	dead
Goniocotes gigas, Tasch.	1	
G. hologaster	11	2
M. gallinae	18	1
M. stramineum	23	1
L. caponis	3	
Total	56	4

Found, 89.4 % efficient.

Experiment VI Powder Hess' Instant Louse Killer.

Manufacturer's analysis : " Naphthalene 14%, Tobacco powder(inert with exception of nicotine present)3.8 %, Nicotine .1%, Phenols .1%, Commercial hydrated Lime 49%, Ochre (inert) 33 %. "

Directions : "Sieze fowl by legs, head downward, sprinkle in feathers, dust thoroughly, especially about vent where lice are most numerous. Repeat in one week. Also dustabout floors, roosts, nests, etc.,"

Manufactured by : Dr. Hess & Clark.

5-25-21. First application as per directions.

5-27-21. Two days after treatment one bird found dead. Removed from cage and buryied.

6-1-21. Remaining two birds treated a second time.

Fumigated. 6-6-21

Results

Species of lice	living	dead
G. gigas	1	
L. heterographus	4	
L. caponis	10	
M. gallinae	28	
M. stæamineum	2	
G. hologaster	43	
Total	88	0

Found, 75.2 % efficient.

Experiment VII Powder Paradichlorobenzene.

Purchased in bulk by Dpet.of Entomology.

5-25-21 Fluffed into feathers from sprinkler can.

6-4-21 Second treatment.

After each treatment, birds staggered about for a few hours, but apparently were normal after that perion.

Fumigated- 6-9-21.

Results.

Species of lice	living	dead.
L.caponis	17	
L.heterographus.	39	
M.gallinae	53	
M.stramineum	47	
G.hologaster	27	
Total	183	0

Found, 65.6% efficient.

Experiment VIII Powder Sulphur.

Purchased in bulk by Dept.of Entomology.

5-25-21. First treatment, pinch method.

6-4-21 Second treatment.

Fumigated- 6-10-21

Results.

Species of lice.	living	dead
G.hologaster		2
M.gallinae	5	2
L.caponis	0	2
Total	5	6

Found, 99.% efficient.

Experiment IX Powder Sulphur.

6-21-21 Fluffed into feathers, sprinkling from can. This was a thorough treatment, using a vast amount of sulphur.

Fumigated- 6-27-21.

Results.

Species of lice	living	dead
M. stramineum	17	
M. gallinae	15	
G. hologaster	87	
L. caponis	7	
L. heterographus	31	
Total	157	0

Found, 79.4% efficient with one application.

Experiment X Powder Lee's Louse Powder

Manufacturer's analysis : "Active ingredients(sulphur, naphthalene, pyrethrum) 70 %, Inert ingredients(Kaolin 29%, Umber 1%) 30 %."

Directions for poultry : " Rub powder into feathers and fluff thoroughly. This may be done best by holding fowl head down (by legs) and sprinkling the powder over fluff around legs and vent. It may be rubbed in and worked down through feathers to head of fowl. It is also well to scatter a handful of powder in the nest box."

6-29-21 First application as per directions.

7-11-21 Second application as per first.

Fumigated- 7-15-21

Results. Found, 98.8% efficient.

Species of lice	living	dead
L. heterographus	1	
L. caponis	5	
G. hologaster	7	
Total	13	0

Experiment XI Powder Lambert's Death to Lice.

Manufacturer's analysis : "Nicotine,not less than .5%, Creosote oil,not less than .6%,Inert ingredients not more than 98.9%."

Directions : "Laying hens and large chicks well dusted at night.Work well among fluffy feathers,especially below vent."

6-30-21. First application as per directions.

7-11-21. As per first.

Fumigated- 7-16-21.

Results.

Species of lice	living	dead
M. stramineum	22	
M.gallinae	21	
G.hologaster	29	
L,heterographus	4	
L caponis	5	
Total	81	0

Found, 92.9 % efficient.

Experiment XII Powder Pratt's Louse Killer.

Manufacturer's analysis : "Pyrethrum 4%,Nicotine.34%, Naphthalene 5.60%,Inert ingredients,90.06% ."

Directions : "For poultry lice. Hold chicken by feet,head down,this will open feathers in good shape to receive the powder. After dusting fowls with powder,work it in their feathers and skin thoroughly. The powder should be used liberally around the vent, as there the lice are moren numerous. Also dust powder throughout poultry house,in dust baths,nests,roosts and on floor. Be sure to sprinkle the powder on the ground where the chickens usually run during the summer months."

Manufactured by Pratt Food Co.

Experiment XII (Continued)

7-11-21. First application as per directions.

7-21-21 Second application, as per first.

Fumigated- 7-26-21.

Results.

Species of lice	living	dead
M.gallinae	2	
M.stramineum	3	
L.caronis	2	
G.Hologaster	4	
Total	11	0

Found, 99.% efficient, for lice.

Two living mites were collected ,also, (Dermanyssus gallinae, DeGeer.)

Experiment XIII Powder Fleck's Lice Powder.

Manufacturer's analysis : " Active ingredients Naphthalene 15%, Nicotine, not less than .01%, Pyrethrum 1%, Inert ingredients 84 %."

Directions : "To kill lice on poultry. Hold bird by legs and dust the powder thoroughly through the feathers, especially under wings, about vent, and head, as lice are usually found in these places. As this operation only requires a moment, a large flock may be dusted in a short time if an assistant catches the birds. The dead lice will drop fro the birds in a few minutes after the powder has been applied. If you are skeptical try the powder on a fowl even if you think there are no lice. Place an old newspaper under it and shake out the feathers for 4 or 5 minutes and then examine the paper carefully; you will then undoubtedly be convinced that the powder 'kills'. "

Experiment XIII (Continued)

7-12-21. First application as per directions.

7-22-21 Second treatment as per first.

Fumigated- 7-27-21 (There was evidence of powder still on the birds)

Species of lice	living	dead
L.caponis	727	1
G.hologaster	154	
G.gigas	3	
M.gallinae	112	2
M.stramineum	102	
Total	1098	3
D.gallinae	2	

Found, 4.7% efficient.

Experiment XIV Powder Sabadilla seeds (ground)

Purchased by Dept.of Entomology.

7-13-21 First application, pinch method.

2-23-21 Second application, pinch method.

Fumigated- 7-28-21

Results.

Species of lice	living	dead
M.gallinae	18	
L.caponis	10	7
Total	28	7

Found, 97.5% efficient.

Experiment XV Powder Barium fluorid.

Purchased by Dept of Entomology.

7-14-21 First application, pinch method

7-24-21 Second application as per first.

Fumigated- 7-29-21

Results

Experiment XV (Continued)

Species of living lice

M.stramineum	7
M.gallinae	6
L.caponis	139
G.hologaster	17
Total	169

Found, 85.3% efficient.

Experiment XVI Powder Cloves(powdered)

7-18-21 First application,pinch method

7-23-21 Second application,pinch method.

Fumigated 8-2-21.

Results

Species of living lice.

M.gallinae	9
M.stramineum	8
L.caponis	18
G.hologaster	13
G.gigas	1
Total	49

Found, 95.7% Efficient.

Experiment XVII Powder Carbola.

" A disinfectant powder-to be used with water as a paint,or instead of whitewash. "
(Advertised as a louse powder in dry form)

7-19-21 First application,by sprinkling and fluffing.

7-29-21. Second application as per first.

Fumigated- 8-3-21.

Results.

Species of living lice		dead.	
M.stramineum	97	2	Total 412(living)
M.gallinae	123	4	11(dead)
G.hologaster	89		
L.caponis	103	5	Found, 64.3% efficient.

Experiment XVIII Powder Sassafras bark (ground)

7-20-21 First application, pinch method

7-30-21 Second application, pinch method.

Fumigated- 8-4-21

Results.

Species of living lice

M. stramineum	198
M. gallinae	179
L. canonis	207
G. hologaster	158
Total	742

Found, 35.7% efficient.

Experiment XIX Stinson's Insect Powder.

Directions :" Blow powder into feathers until it reaches all parts of the body, especially under wings, and on head and neck."

7-22-21. First application as per directions.

8-1-21 Second application as per first.

Fumigated- 8-6-21.

Results.

No living lice were found.

Found, 100% efficient with two applications.

Experiment XX Powder Pyrethrum.

Purchased by Dept. of Entomology.

7-23-21 Sprinkled and fluffed thoroughly into feathers.

8-2-21 Second application as per first.

Fumigated- 8-8-21.

Results

No living lice found. Six mites (D. gallinae) (living) were found.

Found, 100 % efficient for lice with two applications.

Experiment XXI Powder Borax

7-21-21 First application, pinch method.

8-3-21 Second application pinch method.

Fumigated- 8-8-21

Results.

No living lice found.

*Found, 100% efficient with two applications.

Experiment XXII Powder Bar-on-Flies.

Directions :"Fleas and chicken mites . Sprinkle next to animals or fowl's skin, dust coop, kennels, or stall."

7-27-21 First application as per directions.

8-6-21 Second application as per first.

Fumigated- 8-11-21

Results.

No living lice found. One live mite(D.gallinae) found.

Found, 100% efficient with two applications.

Experiment XXIII Powder Naphthalene

7-28-21 Sprinkled through feathers and fluffed about.

8-7-21 Second application as per first.

Fumigated- 8-12-21.

After each treatment birds were sick, staggering about cage, for two or three hours. Apparently normal in actions the following days. The lice were observed to come to the surface of the plumage, and many were seen crawling about the floor of the cage.

*See expt. XIX for one application.

Experiment XXIII (Continued)

Results.

Species of lice	living	dead.
M.stramineum	35	2
M.gallinae	16	1
L.caponis	185	6
G.hologaster	12	
Total	248	9

Found, 78.6% efficient.

Experiment XXIV Powder Arsenic trioxid.

8-3-21 Sprinkled and fluffed through feathers.

8-13-21 Second application as per first.

8-16-21 One bird observed very weak.

8-17-21 Same bird found dead, body covered with mites.
Body removed and burried.

Fumigated- 8-18-21

Results.

No living lice were found. Collected 2802 mites (D.gallinae) from the remaining two birds.

Found 100% efficient for lice.

Experiment XXV Powder Cornell(Lawry) Powder.

Made as specified by Herrick.*

8-4-21 Sprinkled and fluffed thoroughly through feathers.

8-14-21 Second application, as per first.

Fumigated- 8-19-21.

Results.

Species of living lice.

M.stramineum	91
M.gallinae	73
G.hologaster	62
Total	226

Found, 67.3% efficient.
*See literature cited.

Experiment XLVI **Homemade Powder.**

Made as follows: one part creolin, one part carbolic acid, 3 parts gasoline,; these were mixed into enough plaster of paris to give moist result. Then the substance was mixed thoroughly and screened. After drying for a time was put in can and used as a dust.

8-5-21 First application, sprinkled and fluffed into feathers.

8-15-21 Second application as per first.

Fumigated- 8-20-21

Results.

Species of living lice.

M. stramineum	194
Mgallinae	62
L. caponis	181
G. Hologaster	35
Total	472

Found, 32.3% efficient.

Experiment XLVII Bee Brand Insect Powder.

Manufacturer's Analysis : "Ground from pure closed pyrethrum flowers."

Directions : "For fowls and Animals- Separate feathers or hair and scatter powder next to skin."

8-9-21 Applied as per directions.

Fumigated- 8-23-21

Results.

L. caponis (living) 7 (dead) 2
Two mites (living) D Gallinae

Found, 98.9 % efficient with one application for lice.

Experiment XXVIII Powder Hoofstra.

Manufacturer's analysis:"Inert ingredients Cornstarch, 46.6% "

Directions: "Chicken mites,lice.and fleas- Spray poultry coops and nests. Kills in 10 to 15 minutes."

8-10-21 Blown by gun,about birds thoroughly.

8-20-21 Second application as per first.

Fumigated- 8-25-21

Results.

No living lice found.

Found, 100% efficient with two applications.

*Experiment XXIX Powder Sodium flourid.

8-10-21 Pinch method.

Fumigated- 8-22-21

Results.

No living lice found. Three dried up specimen were found.

Found,100% efficient with one application.

Experiment XXX Powder Borax.

8-10-21 Pinch method of application,covering the birds thoroughly.

Fumigated- 8-17-21

Results.

Species of living lice.

M.stramineum	4
L.caponis	4
L.heterographus.	2
Total	10

Two mites D.gallinae,(living) were found.

Found, 98.5% efficient with one application(for lice)

* Fourth experiment with Sodium flourid.

Experiment XXXI Powder El Vampiro.

Manufacturer's analysis : "Active ingredients Pyrethrum flowers 75%, Inert ingredients 25%."

Directions : "For lice on chickens-Blow powder carefully under wings and between legs,and on body. Powder absolutely useful for chicks first hatched;will not hurt them."

8-11-21. First application as per directions.

8-21-21 Second application as per first.

Fumigated- 8-26-21

Results.

No living lice found.

Found, 100% efficient with two applications.

Experiment XXXII Powder Bigler's Lice and Mite Powder.

Manufacturer's analysis : " Ingredients,Calcium(hydrate)96.5% Calcium carbonate.57%, Silica.56%,Iron oxideand alumina .84%, Magnesia .66%,Sulphur trioxid .24%, Fineness 100 mesh,99.93% Fineness 200 mesh,98.48%, Sulphur .4%,Naphthalene.4%,Sodium flourid .1%,Inert ingredients 90.5%."

Directions : "Laying fowls and chicks should be well dusted at night; work it well among feathers,especially about vent."

8-12-21 First application as per directions.

8-22-21 Second application as per first.

Fumigated- 8-27-21

Results.

Species of living lice

L.heterographus	16
L.caponis	34
C.hologaster	42
M.gallinae-	34
M.stramineum	3
G.gigas	1
Total	130

Found,81.3% efficient.

Experiment XXXIII Powder Boric acid.

Purchased at drug store.

8-13-21 First application, pinch method.

8-23-21 Second application, pinch method.

Fumigated- 8-28-21

Results.

No living lice found.

Found, 100% efficient with two applications.

Experiment XXXIV Chieftain Powder.

Manufacturer's analysis : "Ground from pure pyrethrum flowers."

8-14-21 First application, blown over birds, fluffed into feathers.

8-24-21 Second application as per first.

Fumigated- 8-29-21

Results

No living lice found.

Found 100% efficient with two applications.

Experiment XXXV Powder U-Zit.

Manufacturer's analysis : " Paraform 2%, Naphthalene 12% Flour of sulphur 50%, Inert matter Carbide residue 20%, Sodium flourid 16%."

Directions : "Poultry- Part feathers and sift powder on skin Sift powder in nests and lice will disappear."

8-30-22 First application as per directions.

7-10-22. Second application asper first.

Fumigated- 7-15-22.

Results.

Experiment XXXV (Continued)

Species of lice	living	dead
M.stramineum	1	
M.gallinae	4	
G.hologaster	20	1
L.caponis	46	1
L.heterographus	5	
Total	76	2

Found, 93.1% efficient with two applications.

Second fumigation, 7-17-22. 15 living lice were collected.

Experiment XXXVI Powder Boric Acid.

Purchased at Drug Store.

7-12-22. First application, pinch method.

Fumigated - 7-18-22.

Results.

Species of lice	living	dead
M.gallinae	2	
M.stramineum	6	
L.caponis	4	
Total	12	0

Found, 98.9% efficient, with one application.

Experiment XXXVII Powder Harmond's Slug shot.

Manufacturer's analysis, "Active ingredients, Sulphur 6%, Copper sulphate 1%, Nicotine, trace, Copper arsenite 1.50%, Crude carbolic acid .40%.

7-5-22. First application, pinch method.

7-15-22 Second application, pinch method.

Fumigated- 7-20-22.

Results.

Experiment XLVII (Continued)

Results.

Species of lice.	living	dead
L. caronis	9	
L. heterographus	4	
G. holocaster	23	
M. gallinae	26	
M. stramineum	19	
Total	86	

Found, 92.2% efficient, with two applications.

Experiment XLVIII Powder Derris. *

7-15-22. First application, pinch method.

Fumigated- 7-20-22.

Results.

No living lice found.

Found, 100% efficient with one application.

Experiment XXXIX Powder Derris (diluted one-half)

Equal volume of 100% Derris powder was mixed with corn starch.

7-22-22. First application, pinch method.

Fumigated- 7-27-22.

Results

Two living lice found.

Found, 99.9% efficient.

* Obtained from Tobacco By-products & Chemical Corp. Derris is not sold commercially at this date.

Table of Comparative Efficacy of Powders Tested.

Two applications		One application.	
Powder	% efficient	Powder	% efficient.
Pyrethrum	100	Sodium flouryid	100
Stinson's	100	Derris	100
War-on-Flies	100	Bee Brand (Pyrethrum)	98.9
Hoofstra	100	Boric acid	98.9
El Vampiro	100	Borax	98.5
Chieftain	100		
Borax	100		
Boric acid	100	Sulphur	79.4
Arsenic trioxid	100		
		Derris (50% strength)	99.9
Sulphur	99		
Pratt's	99		
Lee's	98.8		
Sabadilla seeds	97.5		
Cloves	95.7		
U-Zit	93.1		
Lambert's	92.9		
Hammond's Slug Shot	92.2		
Powder of Am.Vet.Co.	89.4		
Barium flouryid	85.3		
Licex	83.9		
Bigler's	81.3		
Naphthalene	78.6		
Hess'	75.2		
Cornell(Lawry)	67.3		
Paradichlorobenzene	65.6		
Carbola	64.3		
Sassafras	35.7		
Homemade Powder	32.3		
Fleck's	4.7		

Check fumigations.

During the period of time occupied by the experiments, birds, which had not been treated, were fumigated at regular intervals. From these check fumigations the efficacy of the various powders was computed.

Species of lice	number of lice. *4-27-21.	number of lice. 5-27-21	number of lice. 6-20-21	number of lice. 7-28-21
M. stramineum	314	103	85	115
M. gallinae	365	121	97	127
L. caponis	49	67	409	627
L. heterographus	70	53	79	112
G. hologaster	203	183	92	167
G. gigas	1	5	2	7
Totals.	1002	533	764	1155

	8-23-21.	7-12-22.
M. stramineum	15	223
M. gallinae	252	268
L. caponis	141	71
L. heterographus	20	25
G. hologaster	289	498
G. gigas	1	22
Totals.	698	1107

* Date when fumigated.

Summary and conclusions.

The table of comparative efficiency on page 34, gives an idea of the relative killing qualities of the verious powders tested. Of these, nine powders were found to be 100% efficient with two applications. Only two powders were found to be 100% efficient with one application.

Of these two latter powders (Sodium fluorid and Derris), Sodium fluorid is at present the more deairable powder. It is readily available, not too expensive (about $.40 per pound) and does not have any apparent ill effects on adult birds or man. Derris is not on the market at the present time.

When Derris is available, if it is not too expensive, it seems advisable to undertake more investigation with it as compared to Sodium fluorid.

After the findings with sodium fluorid, it was thought necessary to obtain results after its use. These results to determine the following two points : its effect upon egg production, by exterminating lice on birds; its effect upon growth of young chicks.

Accordingly, on the evening of June 30th, 1922, the writer treated approximately half of all the birds on the poultry plant. The other half were left untreated to serve as control to treated birds.

There were treated 205 birds, with an equal number left untreated. The following data may be of interest : About 2½ hours were required to treat this number of birds. Four pounds of sodium fluorid were used. Figuring time at $.40 per hour this would cost, $1.00. Sodium fluorid at $.40 per pound would cost $1.60. (This amount of powder is

two times the amount necessary) so this cost may be figured at one-half, or $.80. Total cost, therefore, may be given as $1.80, or about $.90 per 100 birds.

Since if all birds upon a given area are treated once, and then kept from being reinfested (by not placing other untreated birds with them) sodium fluorid will destroy all the lice, the above cost is not excessive to pay.

The following tables of egg production will give the needed data to show what effect sodium fluorid has upon egg production. (This effect shown by lice exterminated, as all birds used in this experiment were lousy when half were treated.) It would be advisable to investigate the effect of this powder upon number of eggs produced, by treating half of a number of birds, all of which were free from lice at the start.

At the end of July, fumigations of three birds from each pen revealed the fact that all pens, treated or untreated with one exception, held birds that were lousy. The treated birds showed a decided smaller number of lice present than did the untreated birds. This, undoubtedly, shows that during the latter weeks of July, the treated birds were reinfested in some way. This fact will in some degree make the results of this experiment of less value, than they could have been had the treated birds not been reinfested. It is necessary to repeat this experiment, under absolute segregation of the two sets of birds (treated and untreated). Then the results will show accurate records, and will be definite as to the number of eggs produced by each set.

Conditions at the poultry plant were not such that the

writer could keep the treated birds from being reinfested. Before July 30th some birds were sold, and that would tend to make the final results less definite, than had been anticipated. Then too, there were many times during the period of observation when certain birds would be taken out of their respective pens, for class room work. Also, in one instance, one pen of treated birds was put with the adjoining pen of untreated birds, and this further made the results less definite.

However, the results are given in the following pages, and conclusions are drawn as nearly as possible to accuracy, from them.

Daily Egg Record for June and July

Pen #1 19 birds Anconas Treated June 30,1922.

Day	Number of eggs. June	Remarks	Number of eggs July	Remarks.
1	7		8	
2	7		9	
3	8		13	
4	10	*One broody.	11	
5	7		5	
6	5		12	
7	8		9	
8	8		5	
9	8		9	
10	7		4	
11	9		7	
12	7		5	
13	10		7	
14	8		8	
15	8		2	**One dead.
16	11		6	
17	6		8	
18	8		7	
19	11		8	
20	6		9	
21	11		5	
22	8		9	
23	7		8	
24	8		7	
25	11		8	
26	6		8	
27	10		5	
28	10		5	
29	6		7	
30	11		5	
Totals	241		219	

* Hereafter represented by - B
** Hereafter represented by- D

From three birds from this pen, fumigated July 29,1922, there were collected 147 lice. This shows that throughout July the birds were not entirely free from lice.

Daily Egg Record for June and July

Pen #2 16 birds W.Leghorns Treated June 20,1922.

Day	Number of eggs June	Remarks	Number eggs for July	Remarks.
1	8		8	
2	7		6	
3	8		11	
4	8		10	
5	7		11	
6	8		6	
7	8		10	
8	7		5	
9	9		7	
10	7		9	
11	3		9	
12	7		10	
13	9		8	
14	7		8	
15	4		12	
16	6		9	
17	8		9	
18	4		8	
19	7		8	
20	10		9	
21	8		9	
22	5		5	
23	8		12	
24	10		9	
25	7		7	
26	9		6	
27	8		11	
28	8		9	
29	6		7	
30	8		8	
Totals	219		256	

From three birds from this pen, fumigated July 29,1922, there were collected 12 lice. This shows that for the month of July there were comparatively few lice on the birds in this pen.

Daily Egg Record for June and July.

Pen #3 10 birds. B.Rocks. Not treated. Check.

Day	Number of eggs June	Remarks	Number eggs for July	Remarks.
1	4		2	
2	3		3	
3	1		4	* 2 B
4	4		3	
5	4	1 B	2	
6	5		1	
7	3		3	
8	3		2	2 B
9	5		1	
10	4		0	
11	4		2	
12	1		4	
13	3		2	
14	5		5	
15	4		2	
16	3		4	
17	4		4	
18	2		5	
19	4		5	
20	4		4	
21	3		5	
22	5		1	1 B
23	4		4	
24	3		3	
25	6		3	1 B
26	3		3	
27	5		2	1 B
28	4		2	
29	3		1	
30	3		2	
Totals	109		84	

From three birds from this pen, fumigated July 29, 1922, there were collected 311 lice. This shows that during July these birds were lousy. About 100 lice per bird.

Daily Egg Record for June and July.

Pen # 4 10 Birds. B.Rocks. Treated June 30, 1922

Day	Number of eggs June	Remarks	Number of eggs July	Remarks
1	8		7	
2	5		2	
3	5		6	1 B
4	5		5	
5	6		7	
6	2		2	
7	6		5	
8	4		7	
9	3		5	
10	2		4	
11	2		5	
12	3	1 B	6	
13	2		6	
14	3		4	
15	5		5	
16	5		4	
17	3		6	
18	3		6	
19	2		3	
20	2	2 B	4	1 B
21	4		6	
22	3		4	
23	5		4	
24	3		5	
25	6		6	
26	5		5	
27	5		5	1 B
28	5		3	
29	5		1	
30	4	1 B	6	
Totals	121		144	

From three birds from this pen, fumigated July 29, 1922, there were collected 9 lice. This shows that for July there were only about three lice on each bird.

Daily Egg Record for June and July.

Pen 5 12 birds Blocks. Not treated. Check.

Day	Number of eggs June	Remarks	Number of eggs July	Remarks
1	5		4	
2	5		4	
3	6	1 B	5	
4	7	1B	4	
5	3		6	
6	4		6	
7	7		4	
8	5		4	2 B
8	6		5	
10	6		5	
11	5		4	
12	7		7	
13	6		8	
14	5		9	
15	6		8	
16	7		5	
17	3		9	
18	5		10	
19	8		4	
20	6		8	
21	6		9	
22	3		8	
23	5		6	
24	7		6	
25	6		5	
26	8		6	
27	8		4	1 B
28	6		6	
29	4		2	1 B
30	4		6	
Totals	169		177	

From three birds from this pen, fumigated July 29,1922, there were collected 528 lice. This shows that for July there were lice present on birds in this pen. About 150 lice per bird.

Daily Egg Record for June and July.

Pen # 6,11 Birds. P.Rocks(Pullets) Not Treated. Check.

Day	Number eggs June	Remarks	Number eggs July	Remarks
4	3		8	
5	2		6	
6	2		5	
7	5		8	
8	5		7	
9	5		8	
10	5		8	
11	7		9	
12	6		9	
13	3		9	
14	7		9	
15	6		10	
16	5		9	
17	7		8	
18	5		8	
19	4		9	
20	6		8	
21	8		6	1 B
22	7		8	
23	8		7	
24	6		7	2 B
25	10		6	2 B
26	7		5	
27	7		4	1 B
28	9		6	
29	7		2	1 B
30	8		4	
Totals	160		193	

From three birds from this pen, fumigated July 30, 1922, there were collected 590 lice. This shows that for July lice were present on birds in this pen; about 192 lice per bird.

Daily Egg Record for June and July.

Pen # 7, 11 Birds. Reds. Not treated. Check.

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	4		4	
2	6		6	1 B
3	6		6	
4	5		7	
5	6		5	
6	6		7	
7	7		6	
8	5		5	
9	7		7	
10	5		6	
11	5		4	
12	6		5	
13	7		6	
14	4		4	
15	4	1 B	7	
16	3		5	
17	5		6	
18	5		6	
19	5		5	
20	5		6	
21	5		5	
22	5		6	1 B
23	6		6	
24	6		6	
25	5		8	
26	3		3	
27	4		6	
28	4		6	
29	5		5	
30	3		5	
Totals	150		169	

From three birds from this pen, fumigated July 30, 1922, there were collected 524 lice. This shows that for July there were lice present on birds in this pen; about 141 lice per bird.

Daily Egg Record for June and July.

Pen # 8 35 birds. W Leghorns. Treated June 30,1922.

Day	Number eggs June	Remarks	Number eggs July.	Remarks
1	16		25	
2	16		18	
3	16		18	
4	17		24	
5	13		24	
6	21	1 B	18	
7	21		24	
8	18		20	
9	24		19	
10	13		17	
11	19		28	
12	22		23	
13	23		26	
14	14	1 B	23	
15	17		21	
16	19		25	
17	13		27	
18	22		18	No birds sold.
19	22		17	
20	23		17	
21	18		18	
22	20		18	
23	18		14	
24	23		17	1 D
25	18		19	
26	17		15	1 B
27	21	1 B	13	
28	25		19	
29	17		14	
30	18		26	
Totals	568		602	

From three birds from this pen, P migated July 30,1922, there were collected no lice. This shows that during July there were no lice or at least a very few on each bird.

Daily Egg record for June and July.

Pen 7 C, B.Rocks. 40 Birds. Started June 30,1922.

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	12		11	1 B
2	16		15	2 B
3	15		11	2 B
4	14		20	2 B
5	16		13	1 B
6	12		19	
7	20		12	1 B
8	14		7	1 B
9	16		7	
10	12		9	
11	16	1 B	12	
12	16		9	
13	15		12	
14	16		12	
15	17		13	
16	14		12	
17	16		12	10 birds sold.
18	14	2 B	12	
19	17		16	
20	12		14	
21	12		12	
22	13		11	
23	14		15	
24	12		18	
25	9	3 B	18	1 B
26	13		13	1 B
27	13		15	
28	18		14	2 B
29	12		16	
30	15		13	
Totals	438		393	

From three birds from this pen, fumigated July 30,1922, there were collected 30 lice. This shows that for July there were about 10 lice per bird in this pen.

Daily Egg Record for July.

Pen # 10 W Leghorns, Pullets. 49 birds. Treated June 30, 1932.

Day	Number eggs	Remarks.
1		
2	16	
3	18	
4	21	
5	20	
6	21	
7	20	
8	19	
9	25	
10	26	
11	27	
12	23	1 B
13	25	
14	25	
15	22	
16	17	
17	14	1 B
18	24	
19	17	
20	21	
21	15	
22	19	
23	16	
24	21	
25	22	
26	19	
27	18	
28	23	
29	17	1 B
30	21	
Total	598	

From three birds from this pen, fumigated July 30, 1932, there were collected 35 lice. This shows that during July there were about 10 lice on each bird.

Daily Egg Record for June and July.

Pen # 11 27 birds, W Leghorns. Treated June 30, 1922.

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	16		14	
2	19		10	
3	14		6	
4	16		6	
5	21		2	
6	18	1 B	7	1 B
7	17		4	28 untreated
8	20		4	birds from Pen #
9	21		11	12 put in with
10	19		13	these birds.
11	18		12	
12	13	1 B	14	
13	15	1 B	12	
14	14	2 B	12	
15	12		13	
16	14		12	
17	14		12	14 birds sold.
18	13		6	
19	13		4	
20	10		6	
21	14		7	
22	12		8	
23	10		4	
24	12		9	
25	7		5	
26	13		4	
27	11		5	
28	12		7	
29	11		7	
30	12		7	
Totals.	431		244	

From three birds from this pen, fumigated July 30, 1922, there were collected 209 lice. This shows that for July there were about 69 lice on each bird in this pen.

Daily Egg Record for June and July.

Pen " 12 20 Birds, 4 Leghorns. Not treated, Check

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	18		13	
2	13		16	
3	16		26	
4	18		26	
5	16		25	1 B
6	12		20	1 B
7	14		14	All these birds were put in Pen " 11.
8	17		24	
9	14		13	
10	18		11	
11	15		12	
12	17		13	
13	15		11	
14	18		13	
15	14		15	
16	17		17	
17	16		5	18 birds sold
18	17		6	
19	12		5	
20	17		9	
21	15		7	
22	11		8	
23	13		5	
24	18		9	
25	10		10	
26	15		10	
27	13		4	1 B
28	14		8	
29	12		6	
30	11		8	
Totals	447		376	

From three birds from this pen, fumigated July 30, 1922, there were collected 216 lice. This shows that for July there were about 72 lice on each bird.

Daily Egg Record for June and July

Pen # 13 25 birds B Rocks Not treated. Check

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	13		13	
2	11		11	3 B
3	11		12	
4	16		11	
5	16		11	1 B
6	16	1 B	12	1 B
7	13		13	
8	18		13	
9	14		13	
10	11		15	1 B
11	15		15	
12	17		12	Four birds from
13	11		8	pen 9, in this pen.
14	12		10	Eggs added to those
15	13		10	of Pen 9.
16	11		12	
17	10		16	
18	14B	2 B	16	
19	8		14	
20	16	1 B	16	1 B
21	10		13	1 B
22	11		15	
23	13		16	
24	13		17	
25	14		17	
26	12	1 B	10	2 B
27	15		12	3 B
28	12	1 B	13	
29	9		10	
30	10		11	
Totals	385		387	

From three birds from this pen, fumigated July 30, 1922, there were collected 703 lice. This shows that for July there were about 234 lice on each bird in this pen.

Daily Egg Record for June and July.

Pen # 15 24 W Dotts. Not treated. Check

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	9		8	
2	15		9	
3	13		7	
4	13		13	1 B
5	12		11	
6	15		8	
7	11		13	
8	15		13	
9	15		10	
10	10		16	
11	12		8	
12	12		9	
13	12	1 B	8	
14	11		8	
15	9		9	
16	11	1 B	11	
17	11		8	
18	9		12	1 B
19	9		15	
20	5	1 B	7	
21	7		6	
22	8	1 B	12	
23	8		13	
24	8		7	
25	7		9	
26	9		9	
27	8		8	
28	6	1 B	11	
29	9		12	
30	4		12	
Totals	303		302	

From three birds from this pen, fumigated July30, 1922, there were collected 428 lice. This shows that for July there were about 143 lice on each bird in this pen.

Daily Egg Record for June and July.

Pen 16 20 Birds. Reds Not treated. Check

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	8		12	
2	7		7	
3	6		10	
4	9		10	
5	5	1 B	9	
6	6		6	
7	7		11	
8	4		7	
9	4		6	
10	7		7	
11	7		9	
12	8		6	
13	10		9	
14	6		6	1 D
15	9		10	
16	7		12	
17	8		7	
18	6		10	
19	5		11	
20	9		12	
21	7		12	
22	8		12	
23	6		11	
24	7		10	
25	9		12	
26	10		11	
27	9		11	
28	9		12	
29	8		10	
30	5		10	
Totals	216		288	

From three birds from this pen, fumigated July30, 1922, there were collected 685 lice. This shows that for July there were about 338 lice on each bird in this pen.

Daily Egg Record for June and July.

Pen 17 56 birds, W Leghorns Not treated. Check.

Day	Number eggs June	Remarks	Number eggs July	Remarks
1	37		33	
2	33		37	
3	34		31	
4	32		29	
5	31		38	
6	28	2 B	25	
7	34		30	
8	24		28	
9	27		30	
10	28	3 B	31	
11	27		25	
12	33		26	
13	28	1 B	28	
14	30		25	
15	30		24	
16	29		22	
17	30		25	1 B 34 birds
18	27		11	sold.
19	27		8	
20	30		8	
21	29		9	1 B
22	27		10	1 B
23	31		10	
24	26		9	
25	25		10	
26	40		7	
27	22		11	
28	32		11	
29	35		11	
30	25		9	
Totals	891		611	

From three birds from this pen, fumigated July 30, 1922, there were collected 796 lice. This shows that for July there were about 265 lice on each bird in this pen.

Comparisons between Treated Birds and untreated birds.

Treated						Untreated					
Pen #	No. birds June 30	No. birds July 30	Eggs June	Eggs July	*Lice count	Pen #	No birds June 30	No birds July 30	Eggs June	Eggs July	*Lice count
1	19	17	241	219	147	3	10	16	109	84	311
2	16	21	219	256	12	5	12	14	169	177	529
4	10	10	121	144	9	6	**11	11	160	193	641
						7	11	16	150	169	513
					--TOTALS--						
	45	48	581	619			44	57	588	623	
8	35	28	569	602	0	16	20	24	216	288	637
9	40	29	438	593	30	17	56	22	891	611	796
					--TOTALS--						
	75	57	1006	995			76	46	1107	899	
10	**49	49	not laying	598	55	13	25	32	385	387	703
						15	24	22	303	302	428
					--TOTALS--						
	49	49		598			49	54	688	689	
11	27	18	431	244	209	12	28	12	447	376	238

* Lice count on three birds, fumigated last of July.

** Pullets.

Conclusions from egg production tables.

Drawing conclusions from birds in pens 1,2,3,4,5,6,7, 8,9,16,17.,we note the following : 120 treated birds (reduced during July to 105) produced 1587 eggs in June and 1614 eggs in July; 120 untreated birds(reduced during July to 103) produced 1695 eggs in June and 1582 eggs in July.

These figures show that ridding the birds of lice results in increased egg production,while not treating birds results in decreased egg production.

It would have cost about $1.00 to have treated the 120 control birds. With an equal cost for the 120 treated birds,the total cost would be about $2.00.

There were lost by not treating control birds 173 eggs,and gained by treating an equal number of birds,27 eggs. This will give a total of 200 eggs gained by treatment,and assuming that the control birds would have laid an equal number eggs as did the treated birds, we may add 27 eggs to this 200 as the total eggs gained by treatment,or 227.

Figuring eggs at wholesale price at $.20 per dozen, the value of eggs gained would be 18 11/12 dozen X $.20 or $3.78 1/3. The cost of treating birds would have been $2.00.

For a larger number of birds this would have resulted in quite a bit of money,and the desirability of treatment is shown as a distinct gain in dollars and cents.This gain would undoubtedly have been proportionately larger,had all the birds been treated,for in most cases those treated were reinfested by lice,and to some extent egg production was decreased.

Drawing conclusions from birds in pens 10,13,and 15, it seem that 5.3 eggs (for 30 days in July)(no reduction in number of birds during July), is a goodly number of eggs for pullets to lay. Comparing this to the number laid by 49 hens(30 days in July)(increased during July to 54 in number) or to 889 eggs,we note that pullets are not more than 100 eggs behind the hens for July. The untreated birds (hens) laid 888 eggs in June,while the pullets (treated June 30) had not yet commenced to lay.

In comparing pens 11 and 12,we note the following : there was a greater reduction in egg production for the treated birds than for the untreated ones. Early in July these birds were mixed together,and on July 7th,the attendant at the poultry plant put both pens of birds into one pen. At the end of July the treated birds showed only a slight difference in lice counted from those untreated. Although no definite conclusions can be drawn from these sets of birds,it is interesting to note that after putting the birds together, the treated birds showed a decided drop in daily egg production. This may have been caused by the birds being reinfested with lice,or it may have resulted from numerous other causes.

On July 12,1922, two broods of young chicks were selected,banded,recorded,and weighed.One brood of thirteen (with their brood hen) was treated with sodium fluorid. Only 4 ounces of sodium fluorid was used for the thirteen chicks and brood hen. One brood(with their brood hen) of thirteen chicks was isolated from the treated brood,and left untreated,as a control.

Every third day the individual chicks of each brood were weighed,and comparisons noted. The following tables will give required data to show the effect of sodium fluorid on young chicks.*

Treated Brood.

Banded chick #	Dates every third day weighed. 7/12	7/15	7/18	7/21	7/24	7/27	7/30
337	2**	2.3/8	2.9/16	2.3/8	2.9/16	2.7/8	3.3/4
192	2	2.3/8	2.1/8	2.1/16	2.1/16	2.	died 7-28.
344	1.7/8	2.1/2	2.3/8	2.1/4	2.1/16	2.1/4	2.9/16
144	1.7/8	2.1/8	2.	1.15/16	found dead.		
391	1.7/8	2.3/8	2.7/16	2.6/8	2.15/16	3.1/4	3.7/8
339	2.1/8	2.3/4	2.11/16	2.13/16	2.1/2	2.7/16	2.3/16
349	1.3/4	2.	2.	1.13/16	found dead.		
363	2.1/2	3.1/8	3.5/16	4.	4.1/8	4.5/8	5.9/16
545	1.3/4	2.1/16	2.1/16	2.	1.11/16	found dead.	
136	2.1/4	2.3/8	3.1/16	3.7/16	4.1/16	4.3/8	5.3/8
459	1.1/2	1.7/8	1.13/16	1.3/4	1.5/8	missing.	
504	2.1/4	2.7/8	3.	3.7/16	3.3/4	4.1/8	4.15/16
297	1.1/2	1.1/2	1.1/2	1.3/4	1.7/8	1.7/8	2.1/4

* All chicks were about two weeks old, July 12,1922.
** Weights on ounces.

Untreated brood.

Banded chick #	Dates every third day weighed. 7/12	7/15	7/18	7/21	7/24	7/27	7/30
461	2	2.5/16	2.11/16	2.7/8	3.3/16	3.7/8	4.11/16
611	2	2.3/8	2.11/16	2.7/8	2.3/16	3.1/2	4.3/16
287	1.7/8	2.1/8	2.5/16	2.7/16	2.5/8	2.13/16	3.3/16
333	1.7/8	2.	2.3/16	2.1/4	2.1/2	2.11/16	2.15/16
434	1.7/8	2.1/16	2.7/16	2.5/8	2.7/8	3.1/4	3.7/8
318	2.1/8	2.3/8	2.11/16	2.5/8	2.1/4	2.1/4	died 7/28.
409	1.3/4	2.1/16	2.3/16	2.1/16	2.1/8	2.3/8	2.7/8
481	2.1/2	3.	3.3/16	3.7/16	3.11/16	4.1/16	missing.
352	1.3/4	2.	2.3/16	2.5/16	2.5/8	3.	3.7/8
438	2.1/4	2.1/2	2.1/2	2.13/16	3.	3.3/16	3.11/16
304	1.1/2	1.11/16	2.	2.3/8	2.11/16	2.7/8	3.1/8
373	2.1/4	2.6/8	2.13/16	3.1/16	3.1/8	3.3/8	4.1/8
539	2.	2.5/16	2.11/16	2.7/8	3.1/4	3.5/8	4.3/16.

In comparing these weights, one notes that on July 24th, there were two treated chicks found dead. Both these chicks had decreased in weight up to the time of death. One of these dead chicks showed apparent normal condition upon autopsy. There were noted small pin point like hemorrhages of the intestinal tract. Otherwise no abnormal conditions, were noted.

Chick 192 (died 7-28) examined same day, showed that direct cause of death was constipation. Lungs, liver and kidneys were congested. There were also pin point hemorrhages along the intestinal tract. These hemorrhagic spots were noticeably larger and more numerous than noted on previous autopsy.

Of the untreated brood, chick 510 was found dead 7-30, with its body covered with lice. The lice were the apparent cause of death.

From a general study of the two tables of weights it will be obviously concluded, that for young chicks (two weeks or under) sodium fluorid is not safe.

Conclusions and Recommendations.

In general conclusion of this investigation, the following points may be stated : one application of sodium fluoride is an economical remedy to control lice on adult fowls; its use will give an increase in egg production if laying hens are treated; at present it meets all the requirements of the best powder obtainable; setting hens should be kept free from lice by its use; quarantine methods should be employed to keep young chicks free from lice, and if this fails, two applications of pyrethrum should be used to rid the young birds of lice. Sodium fluorid should not be used to control lice on young chicks.

Investigations with both Sodium fluorid and Derris should be made, to determine the toxicity, physiological effect (if any) and the least amounts that can be used in dilutions and still be 100% efficient with one application.

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