

AGRICULTURAL EXPERIMENT STATION

KANSAS STATE AGRICULTURAL COLLEGE
MANHATTAN, KANSAS

DEPARTMENT OF BACTERIOLOGY.

PREVENTION AND CONTROL OF POULTRY DISEASES¹

L. D. BUSHNELL AND W. R. HINSHAW.

TABLE OF CONTENTS.

	PAGE		PAGE
INTRODUCTION.....	1	SPECIAL DISEASES OF POULTRY.....	25
ESSENTIALS OF POULTRY HYGIENE.....	2	Coryza—Catarrh—Canker—Bird pox—	
Value of cleanliness—The cleaning process—		Ophthalmia—Fowl cholera—White diarrhea—	
Disinfectants and insecticides—Isolation and quarantine.		Flockhead—Botulism—Coccidiosis—	
CARING FOR THE FLOCK.....	7	Favus—Aspergillosis—Gapes—Roundworms—	
Houses—Runs—Utensils.		Tapeworms—Gizzard worms—Mites—	
VIGOR OF STOCK.....	9	Scaly leg—Air sac mites—Chiggers—	
HEALTH FEEDING.....	9	Other mites—Lice—Fowl tick—Poisoning—	
Vitamin A—Vitamin B—Vitamin C—Vitamin D.		Paralysis of domestic fowls—Heat stroke—	
DISEASES OF POULTRY.....	15	Scd disease—Lameness—Bumblefoot—	
General directions—Scheme to aid in diagnosis—Autopsy of fowl.		Tumors—Vent gleet—Crop bound—Egg bound—	
		Prolapse of Oviduct—Frozen comb and wattles—	
		Wounds and fractures—Vicious habits—Some things which kill young chicks.	
		APPENDIX.....	72
		Useful information—Questionnaire on poultry diseases—Test for white diarrhea.	

INTRODUCTION.

Poultry furnishes a cash crop which can be marketed when money is most needed. The poultry flock will also turn the raw products from the farm into a finished product for the market more rapidly than any other farm animal.

One of the important reasons for failure in the poultry industry is that of disease. The poultry raiser is largely responsible for this, since poultry diseases can be controlled with comparatively little effort. It should not be the aim of the farmer or poultry raiser to cure disease after it enters the flock, although this will be necessary after it has appeared. The economical method of controlling disease is prevention and not cure. The low unit value of the bird prevents extensive individual medical treatment. In some cases the medicine would cost more than the bird is worth.

1. Contribution No. 69 from the Department of Bacteriology.

Although there is great individual variation among birds in the same flock, treatment must be based on the flock as a whole rather than on the individual. Birds must be given considerable care and attention, proper feed, shelter, and sanitary living conditions if they are to be a financial success.

It is impossible to estimate the exact losses resulting from diseases in farm flocks, because no accurate method of reporting poultry diseases has been devised. Probably no greater per cent of losses is suffered now than 10 years ago, but the poultry industry has advanced to a point at which it is recognized along with other agricultural industries and, as with diseases of cattle, sheep, and swine, poultry diseases have become of economic importance.

Kansas ranks sixth in number of fowls raised, and eighth in poultry products sold. In 1923, \$20,722,566 worth of poultry and eggs were sold in Kansas. This is nearly one-third of the total amount realized from the sale of all other food animals, and is five times as great as the total sales of poultry products in 1900. When one considers that an industry involving such a vast yearly income is at stake, the economic importance of poultry diseases can be placed on a par with the economic importance of the diseases of any other farm animal.

The purpose of this circular is to aid poultrymen in preventing and controlling disease in their flocks. It is hoped that it will be of value; not only to the specialist in poultry raising, but also to the general farmer whose birds are a side issue and yet often are an important asset in his business.

ESSENTIALS OF POULTRY HYGIENE.

VALUE OF CLEANLINESS.

To determine more accurately the effect of cleanliness, test pens were maintained under farm conditions at the Kansas Agricultural Experiment Station. One was given a minimum of care, which meant very little more than feed and water. Another was given a maximum of care, which meant sufficient to maintain thoroughly clean and sanitary quarters. Table I shows the result. It will be noted that a death loss of 42 per cent in the insanitary pen could have been reduced to 7 per cent by simple clean-up methods.

TABLE I.—Effects of cleanliness on death rate.

	Losses per hundred birds.												Total for the year.
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Minimum of care,	1	3	6	10	8	5	3	2	1	1	1	1	42
Maximum of care.	0	0	0	1	2	2	1	1	0	0	0	0	7

The same results are shown diagrammatically by figure I.
 Sanitation can be maintained only by having a regular schedule for cleaning and disinfecting. No matter how small the flock the weekly cleaning should not be omitted.

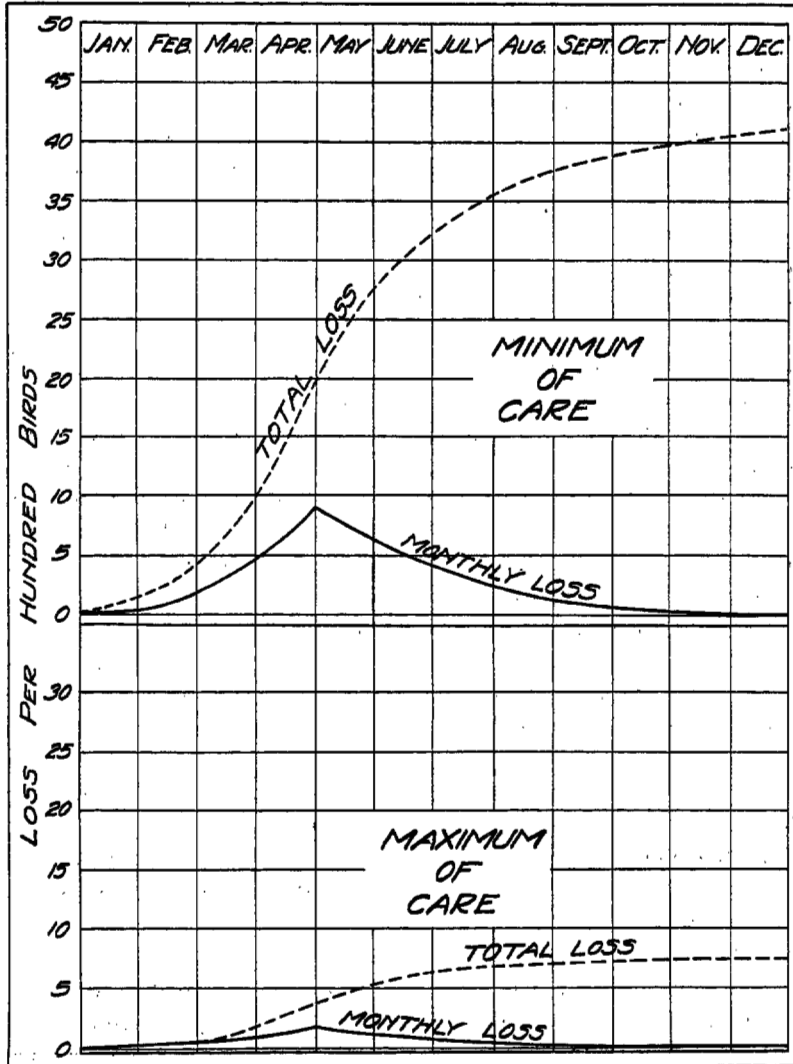


FIG. 1.—Graphs showing the effect of cleanliness on disease control.

THE CLEANING PROCESS.

The object of cleaning is not so much the removal of all visible dirt and filth collections as the destruction of those invisible forms of life, the disease-producing bacteria. Most people would consider the intestinal excreta, the manure, as so much lifeless and inert refuse, but the bacteriologist knows that this is not true. In a state of health the bowel discharge from all animals contains an enormous number of organisms which are so small that their form and movements can be observed only by using the highest powers of the microscope. The amount of feces that would adhere to the point of a pin would contain an uncountable number of bacteria. The diarrheal discharges from sick birds may also contain disease-producing organisms and thus become a very serious menace to the health of all other members of the flock. Other birds, unless removed at once, will carry the infectious material on their feet to the feed and water pans. The contaminated grain and water will be consumed, and soon the entire flock will be suffering from the same trouble. Besides the harmful bacteria in the bowel excreta there are many other dangerous organisms. Of these, the intestinal tapeworm and roundworm deserve mention. These worms at times become so numerous as to cause the death of the bird. Their eggs, which are always produced in large numbers, are continuously passed off with the droppings, and, as in the case of the bacteria, may find their way into the intestinal tract of a healthy bird.

But while control of the so-called internal parasites is chief in point of importance, control of the external (skin) parasites—the lice, mites, and others—is also important. Large numbers of external parasites will so lower the vitality of a bird that it is thereby rendered an easy prey to bacterial infection. In order to hold in check the disease-producing bacteria, it is necessary to control also these external skin pests. The cleaning process therefore should consist in (1) the removal of the manure and refuse, (2) the use of insecticides to destroy lice and mites, and (3) the use of disinfectants to destroy bacteria.

Fortunately, in practice, this scheme can be simplified, since most of the agents that will destroy bacteria are equally destructive to lice and mites. This is not always true of the insecticides, which

2. Bishopp, F. C., and Wood, H. P. Mites and lice on poultry. U. S. Dept. of Agr. Farmers' Bul. 801: 1-26. Figs. 1-14. 1917

are not, as a rule, good disinfectants. Kerosene, for example, is excellent for killing mites, but has little effect upon bacteria.

Removal of Refuse.—The efficiency of a disinfectant depends primarily on the thoroughness of the cleaning of the houses and premises previous to the application of the disinfectant. Solutions will not penetrate into large masses of refuse and great care should be taken to remove all loose material such as straw and droppings before a disinfectant is applied. The ideal way is to scrub the interior of houses with hot water after removing the refuse and before applying the disinfectant.

In case of disease the refuse in the house should be soaked thoroughly before removal. This will disinfect the material and reduce the danger of carrying the infection to other parts of the farm. It is best to burn all such refuse or bury it deepiy. It should never be thrown on the manure heap.

DISINFECTANTS AND INSECTICIDES³

One of the very best disinfecting agents is the direct rays of the sun. However, its penetrating power is limited to a thin surface layer and consequently thick clumps of filth are not completely sterilized. Several hours' action should be allowed even for thin layers.

Apparatus for disinfecting need not be expensive. For a small coop a hand sprayer is sufficient; for a large building a bucket spray pump or "knapsack" sprayer is more desirable. By using some form of pump, disinfectants can be injected forcibly into cracks and crevices that would not be reached by application with broom or brush. The important point is to soak every nook and corner with the disinfectant. The means of application is of less importance.

Many farmers keep on hand so-called stock dips, which are coal tar preparations. These products are, as a rule, very thorough and satisfactory germ destroyers. A safe rule to follow in their application is to use too much rather than too little. Common, but good, disinfectants are carbolic acid, used in a 5 per cent solution, and lysol in a 3 per cent solution. Potassium permanganate in about a 1 per cent solution is somewhat less desirable because of the dark red stains that result when it comes in contact with the skin or clothing. Formalin in an 8 per cent solution is very good but is

3. Dorset, M. Some common disinfectants. U. S. Dept. of Agr. Farmers' Bul. 926: 1-12. 1918.

irritating to the nose and eyes of the worker. Bichloride of mercury (corrosive sublimate) in a 1 to 1,000 solution is effective but is very poisonous and corrodes metal so that it could not be used in a metal pump. In some cases dry quicklime, or chloride of lime, sprinkled over a foul or decomposing mass is more convenient and effective than a fluid disinfectant.

At this laboratory many of the trade-preparation disinfectants have been tested and usually the coefficient (value compared with carbolic acid) as given by the manufacturers is not far from correct. A disinfectant with a coefficient of 4 is four times as strong as carbolic acid and can be diluted with four times as much water as is used in diluting carbolic acid and still be as effective. When two disinfectants have the same price the one with the highest coefficient is the most economical because it can be diluted more and, therefore, will go farther.

A spraying mixture long used with success in this laboratory is 5 per cent crude carbolic acid or a 3 per cent solution of compound cresol. This is sprayed over the walls and floors. After drying it is followed by a spray of whitewash.

The disinfectant action of the carbolic acid or compound cresol is aided directly by the lime, which is both an insecticide and a germicide. The whitewash also aids mechanically by filling the small cracks and crevices, thus preventing mites getting into the building.

Crude petroleum (preferably thinned with 1 part kerosene to 4 or 5 parts crude oil) is a good insecticide. Repeat the application after two or four weeks. Pure kerosene will destroy mites, although several applications are necessary since the eggs are not always killed by one treatment. Remember that kerosene has very little effect upon bacteria.⁵

Some authorities recommend painting the roosts, etc., once each year with one of the undiluted cresol compounds. When the undiluted compound is used one treatment per year is usually sufficient.

ISOLATION AND QUARANTINE.

On the average farm, isolation of sick birds for treatment is impractical and expensive. In most cases it is greater economy to kill the sick birds and burn or bury deeply. This is not only cheaper, but it often removes a serious source of infection from the premises.

4. See appendix, p. 72.

5. A formula for making a kerosene emulsion that is effective for both mites and bacteria is given in the appendix.

Isolation means complete separation of the sick from the well birds. It does not mean putting up a wire fence between them. An isolation building is ideal, and this should be so located and constructed that it will be impossible for the well birds to come in contact with the sick birds or their droppings. Just as soon as one of the flock shows symptoms of disease it should be removed and either destroyed or isolated. Persons passing back and forth from an isolation coop to the healthy birds should take every precaution to prevent the spread of disease by their shoes, clothing, and hands. The ideal way is not to allow the person feeding the healthy flock to go near the isolation room. At least, one can wash his hands and shoes with a disinfectant solution when leaving the sick birds. The well birds can always be cared for first and this will lengthen the time between visits and thus minimize the danger of carrying the infection to the unaffected fowls.

Quarantined birds should never be put back with the healthy ones, but should be fattened for the market as soon as they are cured. A cured bird is a menace to a flock, since it may be a carrier of an infection that will be the direct cause of another outbreak. Remember that an ounce of prevention is worth a pound of cure.

When new birds are to be introduced into the flock or when they are to be returned from fairs and shows they should be placed in quarantine for three weeks before being placed with other birds. Many epizootics are started by introducing new birds from other flocks. It is always best to ask for a clean bill of health for all new birds purchased for breeding purposes. This is especially true as regards white diarrhea. If eggs are purchased, the chicks hatching from these should be kept by themselves for several days to avoid introducing white diarrhea, since chicks may be infected through the egg. This also holds true for day old chicks purchased on the market. Sparrows and other birds may carry disease from one flock to another, and if there is disease in the locality, sparrows should be kept away from the chicken runs.

CARING FOR THE FLOCK.⁶

Houses.—The living quarters of the flock require as much attention as do those of other classes of live stock if the fowls are to be kept free from disease. Space will not permit a discussion of poultry-house construction, but a few of the important essentials

6. For reliable and detailed information on any phase of poultry management the reader is referred to W. A. Lippincott's textbook on "Poultry Production." Third edition. 541 pages. 243 illustrations. Published by Lea and Febiger, Philadelphia. 1921.

7. Taylor, D. J., and Ward, W. G. Poultry Houses for Kansas. K. S. A. C Extension Cir. 49: 1-16. Figs. 14. 1924.

that should be considered in connection with prevention of diseases are mentioned herewith.

First of all, the house should be provided with sufficient drainage to insure dryness at all times, since dampness promotes the growth of bacteria and makes the birds subject to colds, roup, and other diseases. Ventilation without drafts is essential, for fowls require more oxygen per pound of flesh than do most animals. Birds do not have sweat glands in the skin, so that the moisture is eliminated through the lungs. Since the metabolism of the bird is very high, 1,000 pounds of live weight of fowl requiring two or three times as much air as an equal live weight of horse or cow,⁸ large amounts of moisture are eliminated that must be removed by ventilation if the house is to be kept dry. Plenty of room should be provided in order to eliminate crowding of the birds. At least three and one-half square feet per bird is advisable. Houses should face the south and be provided with a large open front through which direct sunlight can reach the interior. Experiments have shown that sunlight is as necessary as good food in the daily life of the chicken. Sunlight also serves another purpose in being an efficient and cheap disinfectant. Lastly, the interior of the house should be constructed to facilitate easy cleaning and disinfection. The ideal house has all nests, roosts, etc., removable, thus minimizing the labor required. Colony houses for growing birds make it possible to remove them to new fields readily and thus aid in keeping the birds on clean, fresh soil.

Runs.—Fenced-in runs should be the exception rather than the rule. By fencing the birds out of the garden and other crops that they might injure, they can be given the run of the farm. This is a much better method than to try and keep them in small fenced-in runs that soon become devoid of green food.

If the flock must be raised under intensive methods, rotation of yards is the ideal to work towards. Two fenced-in runs should be provided for each house and crop grown on one while the other is given over to the flock. By this plan, plenty of green food is grown and the cropping of the runs aids in keeping down infection. Crowding too many birds into one yard should also be avoided; four hundred birds to one acre are usually enough if sod is to be maintained. If rotation is impossible, great care must be taken to clean the runs often and keep them well limed.

Utensils.—The essentials of good feed and water utensils, when

8. Lippincott, W. A. (loc. cit.), p. 259.

looked at from the standpoint of disease prevention, are that they must be easy to clean and disinfect and that they must be so constructed that birds cannot get into them with their feet. Watering pans should be of a material that will not be affected by antiseptics that are placed in the water. Crockery containers are ideal for this purpose but have the disadvantage of breaking in freezing weather. Wooden troughs have a disadvantage in that many solutions lose strength rapidly when placed in them, while iron vessels react chemically with some drugs, causing loss of strength in a very short time.

Most diseases are spread through contaminated water and feed, and it is very important to guard against this in every possible manner. Keeping the utensils clean will do much to minimize this source of infection. Many forms of feeding and watering pans, troughs, etc., are on the market, and plans for homemade devices are found in many textbooks and bulletins on poultry production. The important thing is to keep all these utensils clean and well disinfected.

Scratch feed that is fed out of doors should not be thrown on the same area at all times. Feed thrown in one place continually, means heavy contamination of that spot and, therefore, it is better to change feeding areas often.

VIGOR OF STOCK.

All breeds have their advantages and disadvantages and all are subject to disease. However, the bird that is vigorous, is well up on its feet, has a good color, is full-sized and a leader, will keep healthy longer than the one that is thin, scrawny, under-sized, and weak in the legs. Excessive fat indicates lack of vigor in a hen and such a bird will be apt to succumb to disease much sooner than the one that exercises of its own free will. Birds in enclosed runs should be made to work for their feed by throwing it into deep litter. Continual selection and culling of the flock do more than anything else to increase the per cent of layers and eliminate the unfit birds. They are an insurance against disease, since they help to keep weaklings out of the flock.

HEALTH FEEDING.

Great care should be exercised to give the birds an adequate feed. Even birds that have the run of the farm do not always obtain a balanced ration, especially in the winter. Besides the usual feed of protein, carbohydrates, fat, and ash, birds require vitamins in order to develop and function properly. Vitamins are found normally in whole milk, green leaves, fruits, the covering of grain, in cultures

of certain yeasts and bacteria, and in the glandular and some other tissue of animals. They are not found in abundance in muscle tissue, in tubers, or white flour. At present four different vitamins, required by poultry, are recognized; namely, A, B, C, and D. A lack of one or more of these vitamins in the feed may lead to certain characteristic symptoms in the affected bird.

Diseases due to improper feeding have been recognized for many years, but exact knowledge of the lacking elements have been known but a short time.



FIG. 2.—A typical case of “nutritional disease” due to lack of Vitamin A in the feed. Note white exudate in eye similar to beginning of ocular roup.

VITAMIN A (ANTIXEROPHTHALMIC).

Vitamin A is soluble in fat and is called “fat soluble A.” It is present in greatest amount in butter, yolk of eggs, green leaves, cod liver oil yellow corn, good grade alfalfa hay, etc. The lack of this vitamin causes sore eyes (Xerophthalmia) in rats. In chickens the symptoms are somewhat different, and a lack of the vitamin results in a disease called “nutritional disease.” This disease is widespread in Kansas, especially in the winter when birds are fed chiefly on grains. It is also seen in commercial and city flocks kept in small runs and without adequate green feed.

Symptoms.—The disease develops slowly when the birds are deprived of this vitamin. In experimental pens conducted at the Kansas Agricultural Experiment Station it has been found that it usually requires 158 days to develop a typical case of nutritional disease when the birds are fed on feeds entirely lacking this vitamin.

There is loss of weight, the comb becomes pale, the feathers ruffled, and many of the birds show progressive muscular weakness. In the late stage of the disease diarrhea may be observed and the droppings contain considerable white material (urates). A white exudate usually collects in the eye (fig. 2) but there is no marked involvement of the tissues surrounding the eye as in typical ocular roup.

A differentiation should be made between "ocular roup" and the roup-like condition as seen in nutritional disease. In the former the exudate is more yellowish and cheesy and has a very offensive odor. In nutritional disease the exudate is nearly white, without a putrid



FIG. 3.—Characteristic nodular lesions as seen in the lining of the oesophagus of a bird having died from nutritional disease.

odor, and is easily removed from the eye. One of the most important features which may be followed in the differentiation of these two diseases is the appearance of the lining of the esophagus (gullet). In birds affected with nutritional disease there are found small white or yellowish raised nodules in this tissue about the size of a millet seed. (Fig. 3.) These may be few or many in number and may be located near the upper end of the oesophagus or scattered over the entire surface. The borders of these nodules are regular in outline, a condition which distinguishes them from those seen in diphtheritic roup. In some cases, however, birds may be suffering from both these diseases at the same time.

In addition to the nodules in the esophagus, birds suffering from nutritional disease may show very characteristic changes in the kidneys. They appear large, pale in color, and streaked with a net-

work of white lines. These lines are due to the presence of excessive deposits of urates. Occasionally there is a general distribution of urates throughout the body and the surface of the intestinal organs appears as if sprinkled with a white powder.

VITAMIN B (ANTINEURITIC).

Vitamin B was the first vitamin discovered and has been given the name "water soluble B," because it is soluble in water. This vitamin is present in yeast, milk, green leaves, eggs, fruits, and the covering of most grains. It is found most abundantly in yeasts, but there are many other and much cheaper sources of this substance.



FIG. 4.—Three cockerels of the same age. The one on the left received adequate diet and sunlight. The others did not receive an adequate diet or direct exposure to the sun.

The most marked disease in man, due to a lack of the Vitamin B in the diet, is beriberi; in birds it is called polyneuritis.

Symptoms.—In birds the disease is characterized by extreme nervous symptoms and inability to coordinate certain muscular movements. Sometimes there is a paralysis of the legs and slight paralysis of the muscles of the neck. The symptoms are not as marked as in case of botulinus poisoning and develop much more slowly. There are no eye lesions.

The internal organs appear shrunken and darker than normal in color. The muscles also appear to be darkened as if they had been exposed to the air. Symptoms, other than those due to emaciation

and nervous incoordination, do not seem to be marked. The disease develops rapidly. Birds may die from a lack of Vitamin B in about 54 days.

VITAMIN C (ANTISCORBUTIC).

Vitamin C is of recent discovery (1918). It is less resistant to drying than A and B and seems to be of less importance to poultry than the others. It is found in fresh milk, fruits, vegetables, and green leaves. The lack of this vitamin in the food of man and animals leads to a disease called scurvy. Accordingly this vitamin is generally referred to as the antiscorbutic vitamin.

Symptoms.— There are no well recognized symptoms or lesions in birds fed feeds lacking this Vitamin C, except perhaps a general unthrifty condition of the feathers.

VITAMIN D (ANTIRICKETIC).

Vitamin D is the latest discovery in field of vitamins. It has been found to prevent rickets when present in proper amounts in the feed. It is present to some extent in green leaves and milk and in cod liver oil in large amounts. Sunlight seems to take the place of Vitamin D so that birds given plenty of sunshine will probably not suffer from rickets or leg weakness.

Symptoms.— The most characteristic symptom of a Vitamin D deficiency in the diet is that of "leg weakness" in young chicks. This disease is very common in early hatches, but it is not so common in late hatches because of the greater ease with which they obtain green feed and sunshine. One to five per cent of cod liver oil added to the feed will prevent the appearance of this trouble in young chicks.

Figures 4 and 5 show characteristically some of the effects of failure to provide growing chicks with a diet adequate in vitamins or failure to provide them with proper and sufficient direct sunlight.

Table II shows the influence of lack of vitamins by death in young adult birds at the Kansas Agricultural Experiment Station. Each pen contained 10 birds at the beginning of the experiment. Pens 1, 2, 3, 4, and 5 were inside and received no cod liver oil or sunlight. They were thus considered to have received no Vitamin D. Pens 6 and 7 were outside and received sunlight according to weather conditions.

9. The investigational project which furnished these specimens was in charge of Dr. J. S. Hughes of the Department of Chemistry, Kansas Agricultural Experiment Station.

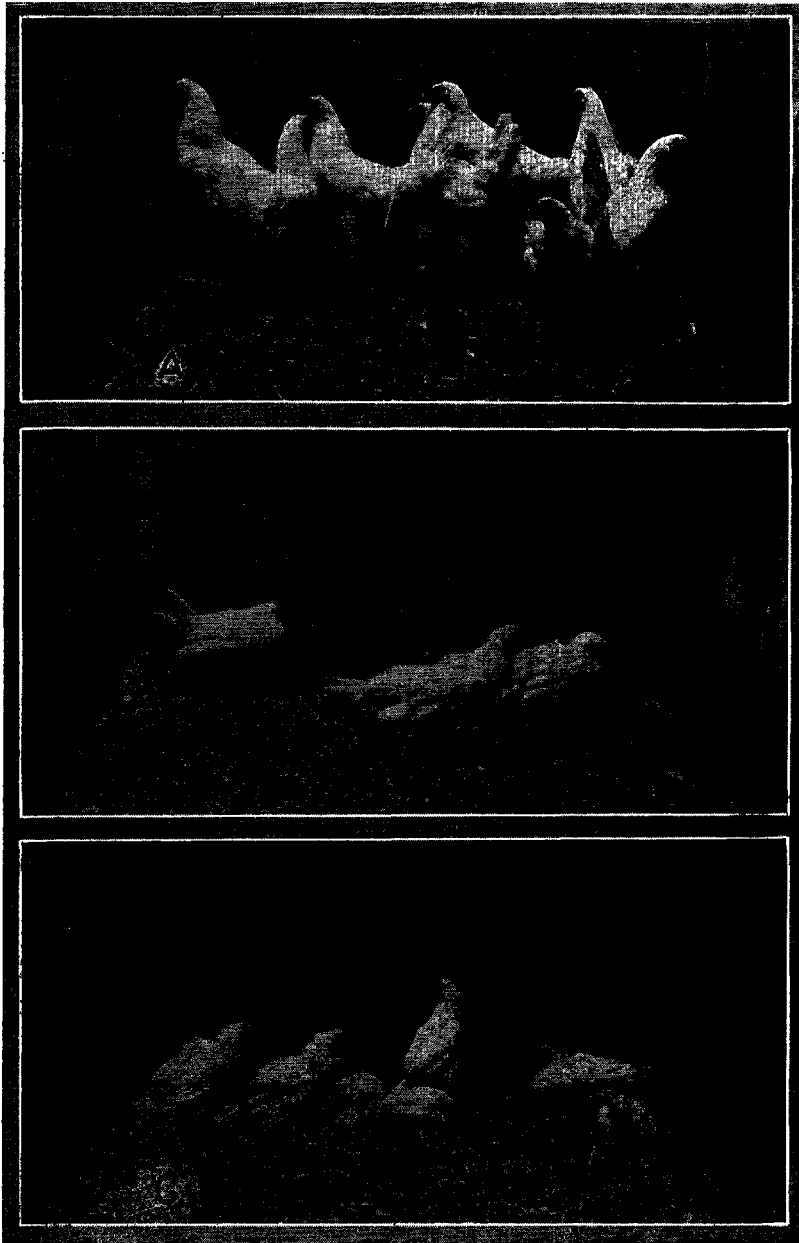


FIG. 5.—Groups of birds of the same age. Group "A" was given adequate diet and exposed to sunlight six hours per day. Group "B" was given adequate diet but not exposed to sunlight. Group "C" was given adequate diet and exposed to sunlight which had passed through window glass. Window glass removes most of the ultra-violet rays.

TABLE II.—Influence of lack of vitamins on adult birds.

PEN NUMBER.	Number of birds.	Vitamins lacking in diet.	Percent of birds dying.	Number of birds shown by symptoms to be suffering from—	
				Nutritional disease.	Polyneuritis.
1.....	10	D	10	1	0
2.....	10	CD	40	4	0
3.....	10	ACD	(a)100	6	3
4.....	10	BCD	100	3	7
5.....	10	ABCD	100	4	6
6.....	10	none	0	0	0
7.....	10	ABC	40	2	2

(a) One bird died of hemorrhage.

It will be noted from this table that Pen 6 was the only one in which no losses occurred. In this pen the birds were fed on an adequate diet and were allowed to run out of doors in the sunlight.

It is becoming more and more evident that the poultryman should recognize the value of vitamins in the feed. Many outbreaks of disease could undoubtedly be prevented if the poultry raisers of the country would consider the fowl as a delicate living organism, requiring proper food, subject to various diseases, and one which must receive care and attention.

During the summer the birds on free range probably receive a well-balanced ration if compelled to range for themselves. Birds held under artificial conditions, or fed too much during the summer, do not range far enough to obtain a balanced ration. Of course range is not possible during the winter and the birds must be fed. During the winter season the birds should be fed sour milk, sprouted oats, alfalfa leaves, and bran to furnish the necessary vitamins. It is not necessary for the farmer to buy expensive feeds to supply vitamins in concentrated form. A well-balanced ration containing grains and green feed, such as sprouted oats, with plenty of exercise and sunshine, will supply all the vitamins necessary.

DISEASES OF POULTRY.

The term disease in its broadest sense means any deviation from the normal. Consequently, any factor that interfered with the fullest performance of the normal functions of growth, development, or egg production is to be regarded as causing disease. Underfeeding or overfeeding, excess of heat or cold, lack of water, or annoyances by lice, mites, worms or other parasites, are all capable of disturbing the normal state of health and must therefore be considered as causing disease.

When disease appears in a flock of birds the important question to the owner is: Can anything be done? In general, poultrymen are agreed that it does not pay to give individual treatment, as the low unit value of the bird does not justify the expenditure of much time or money. However, in the case of especially valuable birds, and in case the treatment is very simple, individual treatment might be allowable, although there are certain objections, as the recovered cases show inferior stamina, vigor, and resistance to disease. Further, it is possible that the recovered bird may be a source of danger to other birds on the premises. It might still be a "carrier" of the disease even though immune itself. In man this possibility has been established beyond doubt in several diseases where it is known that occasional individuals that have recovered still carry the infectious organism and are a danger to their fellow citizens. It is believed that many cases of annual or periodic outbreaks of fowl cholera on a farm may be due to recovered cases which are "carriers." The only valid excuse for curing a bird is to fatten it as soon as possible for an early market.

GENERAL DIRECTIONS.

For the past few years the veterinarian has been familiarizing himself with diseases of poultry and their control, and whenever it is possible he should be consulted. He has the advantage of experience, can see unfavorable conditions as they exist on the farm, and can often prevent a large loss by his timely treatment. It is often impossible to make a correct diagnosis without a bacteriological study, but if such cases arise, the veterinarian can give immediate attention to preventing a spread of the disease until he can send some sick birds to the laboratory at the college for further study. By the time a letter is written to the college for advice, or birds shipped for direct examination, a week may have elapsed before treatment can be started. Therefore, it will usually pay to get the advice of the veterinarian as soon as a serious outbreak is observed in the flock.

If a reliable veterinarian is not available and a diagnosis can not be made from the symptoms given in this circular, one or two live birds in the first stages of disease should be shipped to the college for examination. Birds that show characteristic symptoms should be selected and shipped by express to the Department of Bacteriology, Kansas State Agricultural College, Manhattan, Kansas. A letter giving the following information should be mailed at the time

the birds are shipped:¹⁰ (1) History of the outbreak; (2) age of the birds affected; (3) a full description of the symptoms; (4) number in the flock; (5) the feed; (6) the treatment that has been given; and (7) a description of the condition of the runs, houses, etc. It sometimes requires two or three days before a correct diagnosis can be given, but a reply giving the diagnosis and advice on control will be forwarded as soon as possible after the receipt of the specimens.

Whenever an outbreak of a disease occurs the precautions given below should be observed until a diagnosis and method of treatment can be determined. It will often be found that nothing can be done other than the application of the following sanitary measures:

1. Isolate, or kill all affected birds. Do not attempt isolation unless the sick birds can be placed where the well birds can not come in contact with them. It is even better to move the well birds from the affected area to noninfected quarters.

2. Bury deeply or burn all dead birds.

3. Clean and thoroughly disinfect all coops. Remove and burn all refuse from houses and runs. Lime and plow the ground.

4. Keep fresh water before the birds at all times. Put potassium permanganate¹¹ into the drinking water until it is a bright wine-red color. This acts as a preventive in that it inhibits the growth of bacteria, but it is not a cure for the disease. This solution should be used in crockery or wooden vessels, since it soon becomes decomposed and useless in iron or galvanized fountains. The solution should be changed at least twice daily and kept before the birds continually.

5. Look after the feed ration and see that the birds are getting plenty of green feed. Also see that the birds have to work for their feed, since exercise is more essential than drugs in keeping birds well.

6. Give the birds Epsom salts at the rate of one pound per one hundred adult birds, reducing the dosage according to the age of the birds. This may be mixed in a wet mash and placed in small piles so that each bird will get its share. It is better to starve the birds for 12 to 18 hours before giving salts.

10. See appendix, page 72, for further details regarding information desired.

11. See appendix, page 72, for instructions regarding the preparation of drinking water.

SCHEME TO AID IN DIAGNOSIS OF POULTRY DISEASE.

<i>External Symptoms.</i>	<i>Diseases.</i>
Comb.....	Congested (deep red)..... { Cholera (early). Botulism.
	Cyanotic (purple)..... { Cholera (late). Blackhead.
	Anæmic (pale)..... { Tuberculosis. Air sac mites. Intestinal parasites (worms). Fowl typhoid. Nutritional disease. Lice and mites. Cholera (chronic).
	Tumors..... { Contagious epithelioma (Bird pox). Nonspecific.
Eyes and nostrils (exudate in).....	{ Colds. Ophthalmia (ocular roup). Coccidiosis. Nutritional disease. Sod disease.
Mouth and throat (ulcers in).....	{ Injuries. Avian diphtheria (roup).
Feathers.....	{ Unthrifty appearance..... { Worms. Lice. Nutritional disease. Scurvy.
	Falling out.....
Wings (drooping).....	{ Intestinal parasites (late stages). Lice and mites. White diarrhea. Nutritional disease. Coccidiosis. All acute diseases.
Lameness.....	{ Scaly leg. Beriberi (polyneuritis). Bumble foot. Tuberculosis. Sod disease. Rheumatism. Injury. Gout.

POULTRY DISEASES.

<i>External Symptoms.</i>	<i>Diseases.</i>
Legs and feet	{ Rickets (weak legs). Dry and rough—Scaly leg. Blisters—Sod disease. Foot swollen—Bumblefoot.
	{ Joints swollen { Gout. Rheumatism. Rickets (weak legs).
Neck	{ Limberneck { Cholera (late). Botulism.
	{ Wry neck { Poisoning. Worms. Ocular roup.
Vent (inflamed and protruding)	{ Prolapse of oviduct. Inflammation of cloaca. Vent gleet.
Emaciation (loss of flesh)	{ Tuberculosis. Air sac mites. Intestinal parasites. Nutritional disease. Blackhead. Intestinal coccidiosis. Cholera (chronic type).
Diarrhea	{ Green Fowl typhoid.
	{ White { White diarrhea. Cholera. Botulism. Nutritional disease. Intestinal coccidiosis.
	{ Yellow { Cholera. Blackhead (sulphur drop- pings).
	{ Bloody Intestinal coccidiosis.
Temperature	{ Elevated { Cholera. Fowl typhoid. Blackhead. White diarrhea. Tuberculosis (late stages).
	{ Subnormal { Botulism (late). Nutritional disease.

<i>Internal Symptoms.</i>	<i>Diseases.</i>
Æsophagus (nodules in).....	Nutritional disease.
Liver.....	{ Enlarged..... { Fowl typhoid. Leucemia. Blackhead.
	{ White spots..... { Blackhead. Coccidiosis. Tuberculosis. Fowl typhoid (white or gray).
Intestinal tract....	{ Congestion..... { Cholera. Worms. Coccidiosis. Poisoning. Berberi.
	{ Thickened wall or ulcers..... { Worms. Coccidiosis. Tuberculosis. Blackhead.
	{ Nodules on..... { Tuberculosis. Tapeworms (<i>Davainea echinobothrida</i>).
Kidneys.....	{ Ureters distended with urates..... { Nutritional disease. Cholera.
	{ Enlarged..... { Fowl typhoid. Nutritional disease.
Ovaries.....	{ Hard, shrunken, angular, dark brown, or greenish..... { Bacillary white diarrhea of adult hens.
Heart.....	{ Petechiæ (small hemorrhages).. Cholera.
	{ Grayish spots..... Fowl typhoid.
Lungs.....	{ Congestion (filled with blood).. Cholera.
	{ Dark, gray, firm, pus in..... Pneumonia.
Crop.....	{ Filled with food..... Crop bound.
	{ Filled with feathers..... Depraved appetite.
	{ Putrid odor..... Botulism.
Fat.....	White..... Nutritional disease.
Connective tissue..	{ Yellowish spots in..... { Connective tissue mites. Gout.
	{ Minute yellow spots on air sacs..... { Air sac mites.

It will not be possible in all cases to make a diagnosis by the above symptoms. Certain diseases can be diagnosed only in a bacteriological laboratory by use of cultural and microscopical examinations.

AUTOPSY OF FOWL.

The first part of the above scheme will aid in the diagnosis of disease by an examination of external symptoms. However, it is not possible in most cases to make an accurate diagnosis by means of symptoms alone. A bird may show certain symptoms that will indicate several diseases. As an example, a bird may show an

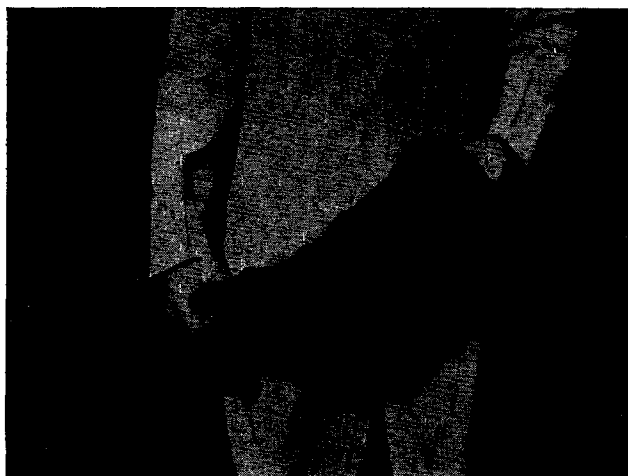


FIG. 6.—A bird being held in position ready to break the neck.

anæmic comb and emaciation and be suffering from tuberculosis, air sac mites, intestinal parasites, lice or mites, fowl typhoid, or nutritional disease; and lameness may indicate scaly leg, beriberi, bumblefoot, tuberculosis, sod disease, or injury. While the symptoms exhibited by a living bird may be of considerable value in indicating a certain disease, a post-mortem examination will usually lead to a more exact diagnosis. Also the low unit value of the bird makes it possible to destroy several for examination.

To Kill the Bird.—In killing the sick bird, care should be exercised not to scatter blood where it may affect other birds. This may be done by breaking the neck. To do this grasp both the legs and wings in the left hand and the head in the right hand (fig. 6) in such a way that the back or side of the head rests in the palm of

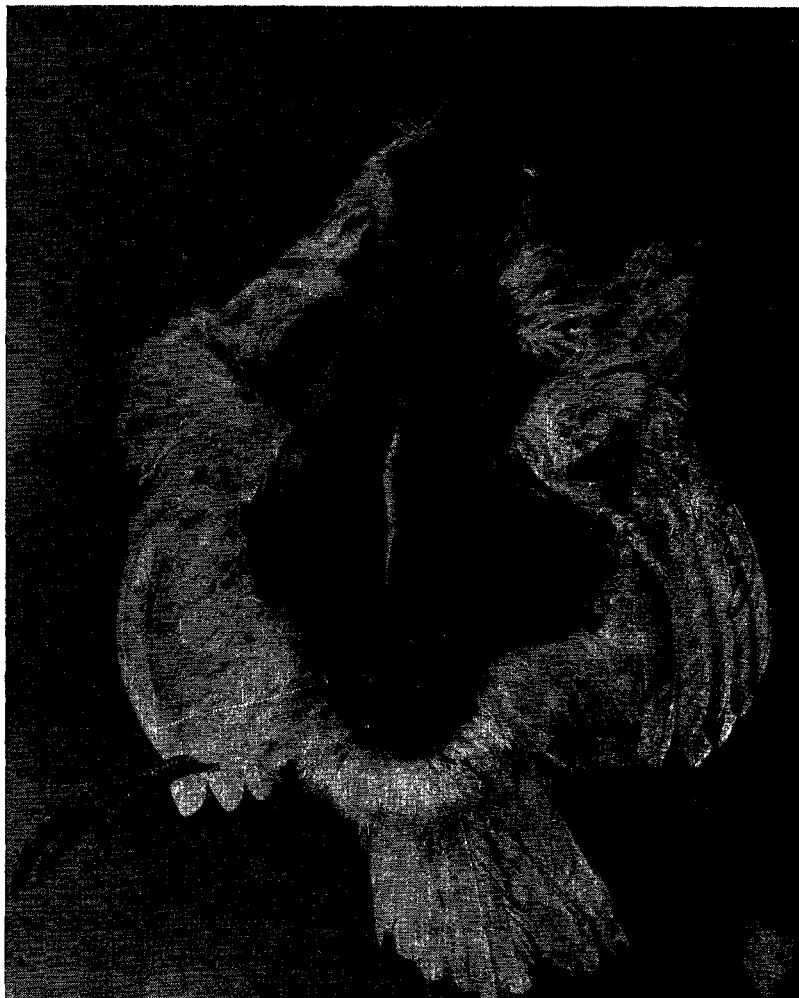


FIG. 7.—Stage of work in the autopsy of a bird showing skin properly pulled back and surface exposed.



FIG. 8.—Stage of work in the autopsy of a bird showing viscera exposed

the hand and the base of the skull between the thumb and forefinger. Grasp the head firmly and pull slowly down on the head and at the same time twist the head to one side or back until the neck is broken. The pressure should be discontinued as soon as the vertebræ are pulled apart. If this is carefully done the skin will not be broken and blood will not be lost to contaminate the soil.

Post-mortem Examination.—Several minutes after the bird has been killed it should be thoroughly wet with water and opened in such a way as to expose the internal organs. This may be done by cutting the skin between the legs and the body and making a cross cut just back of the end of the breast bone. The legs are then pulled away from the body until they are thrown out of joint, and the skin pulled forward and back to expose the entire surface. (Fig. 7.) A cut is then made through the muscles just back of the point of the breast bone and forward through the ribs on each side in the direction of the attachment of the wings. This cut can best be made with scissors. Care should be exercised not to injure the internal organs during this operation. The choracoid and clavicle (wish bone) may be crushed with a pair of pliers in old birds, or broken by pulling the entire breast forward while the back of the bird is held firmly to the table. This operation will expose the liver, heart, lungs, spleen, and intestines. (Fig. 8.) These should be examined carefully for size, color, consistency, etc., before they are removed. After this examination is complete the organs may be removed and dissected. The intestines should be removed and split open from end to end with a pair of scissors. A careful examination should be made for thickening of the walls, hemorrhage, ulcers, worms, etc. The contents of the ceca (blind gut) should be examined carefully for very small hair-like worms. These are likely to be overlooked unless special care is used in searching for them. The contents of the gizzard and crop should be examined carefully and the odor noted. The contents of the gizzard normally have a sour odor, but in some cases, as in botulinus poisoning, they may have a putrid odor. The œsophagus and trachea should be dissected out and split open for examination. In some cases of roup the upper end of the trachea may be plugged with a yellowish exudate, while in nutritional disease the upper third of the œsophagus is covered with nodules. The kidneys, heart, and lungs should then be examined for signs of abnormality. All post-mortem work should be done in the direct sunlight so that small variations from the normal may be easily noted.

SPECIAL DISEASES OF POULTRY.

The following pages are devoted to a discussion of some of the more common diseases known to be present in Kansas and surrounding states. New diseases are occasionally discovered to be present, and undoubtedly, as the poultry population becomes more and more extensive and as new birds are shipped into the state from different sources, still more diseases will appear.

Since the poultry industry is so closely associated with the agricultural industry of the state, all people engaged in farming should have some knowledge of poultry diseases and methods for their control. The low unit value and short life of the bird makes this a comparatively easy matter as compared to that of other classes of live stock.

CORYZA (COLDS).

Coryza affects the fowls most commonly during the winter months, and young birds are more susceptible than mature birds. The chicken seems to be the most susceptible, but all types of poultry may suffer. This disease, of itself, is not a serious menace to the flock, but may lead to severe forms of ocular or diphtheritic roup if not controlled. Usually but a few of the individuals of the flock suffer from this trouble.

Symptoms.—The first symptom noted by the poultryman is that bits of straw and feathers stick to the beak and nostrils. There is more or less sneezing and mouth breathing. The birds appear to be sluggish, the comb may be pale, and the feathers have an unthrifty appearance. If the birds are allowed to remain quiet and watched carefully, affected birds will be seen to hold the head up and to gasp for breath because of the plugging of the nostrils by dried exudate. In many cases the eyes will be closed. Usually there is no foul odor connected with this disease as is noted in cases of well-advanced nasal catarrh or canker.

Treatment.—The treatment for colds lies chiefly in removing the cause. The first birds to suffer are those of low vitality. Crowding, drafts, moist and poorly ventilated houses, insanitary conditions, lice and mites, worms, and inadequate feed will all tend to predispose birds to this disease.

The condition can best be considered as an infectious disease of unknown cause. As in colds in man, there are no definite and characteristic bacteriological findings. Many organisms can be found in these conditions that may or may not be pathogenic for healthy birds. It is quite possible that under conditions to which

fowls are exposed numerous organisms may assume a disease-producing power.

The chief causes of colds are drafts that strike the birds while at roost. Birds roosting in trees rarely suffer from colds because drafts come from all directions. However, birds roosting in direct drafts and currents of air directed at a small part of the body will suffer from colds, especially if devitalized by some condition as mentioned above. Cracks, knot holes and crevices on opposite sides of the house will almost always lead to colds. The temperature of the house makes little difference. It is essential that birds be given fresh air without drafts and be kept in clean, dry houses flooded with sunshine. This means that three sides of the house should be absolutely tight, and the house so constructed that birds will not be reached by drafts of cold air from the fourth. A properly constructed open-front house is suitable.

Equally as dangerous as drafts is lack of ventilation. The temperature of the bird is normally high, about 106° F. In order to maintain this temperature the birds must have a plentiful supply of oxygen. The bird also expires large amounts of moisture from the lungs. This must be removed by ventilation. Cold dry air is not dangerous since the bird is fairly well protected against all but extremes of cold.

During the daytime the bird must be made to work vigorously for its feed by throwing it into deep litter. This exercise will keep up the temperature of the bird, increase its vigor, and prevent over-eating and the development of sluggish conditions.

The first steps to be taken when colds appear in a flock are to free the house and birds of lice and mites, to examine the intestinal contents of some slaughtered birds for worms, and to see that the birds have a place to roost that is dry and free from drafts. The birds should be given a dose of Epsom salts at the rate of one pound per 100 adult birds. Affected birds should be removed from the flock and the nostrils treated with pure kerosene, a 2 per cent potassium permanganate solution, or a 10 per cent watery solution of baking soda.¹² This should be forced into the eyes, mouth, and nostrils by means of a medicine dropper, or a feather dipped in the solution. In some cases it is easier to submerge the bird's head in the solution for 20 to 30 seconds. See that the nostrils are opened and well irrigated with one of these solutions at least twice each day. These birds should be given an abundance of

12. See appendix for instructions for the preparation of percentage solutions.

green feed until they recover. In most cases the birds will recover more rapidly if placed in small cages so they cannot exercise.

It should be kept in mind that a cold is probably a contagious disease and may be transmitted from one bird to another through feed hoppers and drinking fountains. For this reason sick birds should be removed from the flock as soon as discovered and not returned until entirely cured.

CATARRH (NASAL ROUP).

Catarrh is very similar to coryza, but is characterized by a more chronic course and greater difficulty of control. It usually follows a cold that has not been properly treated. The cause is not known, but probably many types of bacteria are active.

Symptoms.—The symptoms are those seen in coryza, but are more serious and tend to persist for long periods of time. This condition may become chronic and cure impossible. The nostrils are plugged with dried mucus and mouth breathing is a characteristic symptom. This leads to drying of the mucous membrane of the mouth and tongue, resulting in a disease sometimes called "pip." An offensive odor develops in some cases. This will depend upon the type of secondary invaders present.

Treatment.—The treatment is the same as that described under coryza. Sick birds should be isolated into separate small cages, placed in a warm place, and fed carefully. The nostrils should be cleaned out twice daily with a 2 per cent solution of potassium permanganate or 10 per cent solution of baking soda.

All insanitary and unhygienic conditions must be corrected. The birds must be freed from lice and mites and given an adequate diet containing some such feed as sprouted oats. Potassium permanganate should be kept in the drinking water until the trouble disappears. This will aid in preventing the spread of the disease to well birds.

CANKER (AVIAN DIPHTHERIA).

Canker is a very serious disease of all types of poultry, but more especially the chicken. The disease is often associated with bird pox and may be one form of bird pox. The common type is also called diphtheritic roup and fowl diphtheria. It is difficult to classify diseases affecting the head of the bird because the causative factor is not known and bacteriological findings to date have been contradictory. However, some of the most serious outbreaks of these diseases seem to be associated closely with *Pasturella*

aviceda, the organism causing chicken cholera. Some authorities consider that canker is caused by a filterable virus too small to be seen with the microscope, and that the *P. avicida* is merely a secondary invader. However, in those outbreaks associated with *P. avicida* the losses are usually heavy and the disease is very difficult to control.

Symptoms.—Canker is characterized by the development of cankers and diphtheritic patches in the mouth and throat. These may be few in number and small, or so numerous and large as to cover nearly the entire mucous membrane of the mouth and tongue. The lesions are covered by a yellowish membrane that is removed with difficulty, leaving a raw surface. In many cases this stage of the disease is characterized by a very offensive odor due to the invasion of putrefactive bacteria.

The birds may show symptoms of catarrh, wart-like growths on the skin, or ocular and sinus troubles. Mouth breathing is also a characteristic in many cases. The birds appear pale, show lack of appetite, and are unthrifty in appearance. The mucous membranes of the mouth show the diphtheritic patches and are usually thickened and reddened. There are occasionally symptoms of pneumonia, whitish diarrhea with high temperature and excessive thirst. Some authorities consider vent gleet as one form of canker as it is commonly found in the same flock with canker. The lack of constant bacteriological findings makes a classification of these diseases difficult. Whenever vent gleet appears in a flock the treatment of the lesions should be the same as for canker.

Post-mortem Findings.—Birds dead of canker show a variety of lesions. Aside from the diphtheritic patches in the mouth, throat, larynx, and occasionally the trachea, there may be a thickening and inflammation of the wall of the intestine with ulcerations. The liver may be enlarged and pale with yellowish areas on the surface. The lungs are usually not affected, but may show inflammation. Birds suffering from these troubles may show an excessive number of ruptured egg yolks and lesions of the heart and joints.

Treatment.—Sick birds should be placed by themselves and given individual treatment. The houses and runs must be carefully cleaned and disinfected. Mites, lice and worms predispose birds to canker and care must be exercised to free the birds and houses of all parasites. This disease does not respond readily to treatment, and unless the birds are valuable it is best to kill them if they are

badly affected. Mild cases may be treated successfully by removing the membrane from the surface of the lesions with a bent wire or hair pin and painting the raw area with a 10 per cent solution of argyrol or tincture of iodine. A 5 per cent solution of silver nitrate is very effective, but is also very irritating and should be used with care. Potassium permanganate in the drinking water will aid in preventing the spread of this infection.

If the disease once appears all precautions must be exercised to control its spread. Great care should be exercised not to introduce the disease with newly purchased birds, or birds that have been exhibited at shows. Prevention is much more effective than attempts to cure sick birds.

BIRD POX (CONTAGIOUS EPITHELIOMA).

Bird pox is very common in the southwestern part of this country and rather prevalent in Kansas. Usually the disease is not serious here, although this is not always the case, and heavy losses have been known to occur in this state. Bird pox is also called "contagious epithelioma" and is probably closely related to canker. The cause is not definitely known but is thought to be a filterable virus. In many of the more severe outbreaks it is associated with a cholera-like disease, and the organism causing fowl cholera is commonly found to be present in these cases. The disease is called "bird pox" from the appearance of the peculiar wart-like growths which appear on the skin, chiefly on the comb and wattles.

Symptoms.—The most characteristic symptom of bird pox is the development of small blister-like eruptions, smooth, grayish to white, which appear on the skin. These areas enlarge and later become covered by dry, wrinkled crusts which vary in color from yellow to black. When these tumor-like structures are removed the underlying surface is raw and bleeding. In some cases there may be but a few of these lesions while in others the head is almost entirely covered. Associated with the development of these tumor-like growths on the skin there may develop cankers in the mouth and the involvement of the eye.

Usually there are no well developed constitutional symptoms in uncomplicated cases of bird pox. There is no offensive odor unless there is involvement of the mouth or eye. Post-mortem lesions are not well marked. Very few birds show congestion of the lungs and other internal organs. There may be a few hemorrhages on the heart and in some cases there is pneumonia. If the lungs are affected

the birds may cough out masses of yellow exudate that will collect in the trachea, or at the epiglottis, and cause suffocation.

Treatment.—Sick birds should be isolated and given a treatment of Epsom salts, one teaspoonful per bird. They should be kept warm and fed plenty of green feed and sour milk. The tumors may be softened with glycerine or vaseline and removed. The infected area thus left exposed should be treated with a 5 per cent silver



Courtesy J. R. Beach.

FIG. 9.—Head of cockerel showing typical bird pox eruptions (natural infection).

nitrate solution or tincture of iodine. The tumors that are removed should be burned.

A medicated vaseline may also be used to advantage for treating the early stages of bird pox. (See appendix.)

The houses and runs should be rid of lice and mites and sprayed with a disinfectant. The birds should also be freed of worms.

A vaccine has been prepared that seems to be of considerable value in certain localities but of no value in others. It is best to make the vaccine from a local flock for use in any locality. Persons wishing to try this vaccine may write the Department of Bacteriology, Agricultural Experiment Station, Manhattan, Kansas, for

further particulars. The vaccine is made by using the tumor-like growths from the skin. It should be used soon after making as it does not long retain its immunizing properties. One dose is usually sufficient, but it may be well to repeat the treatment two or three times.

A typical example of bird pox (natural infection) is shown in figure 9.

OPHTHALMIA (OCULAR ROUP).

The most outstanding form of disease of the head under the old classification of roup, is ophthalmia. It is a disease affecting the eye



(B) Courtesy J. R. Beach.

FIG. 10.—Typical cases of ophthalmia (ocular roup). (A) A severe chick case This is a highly infectious form of the disease. (B) A typical case in a cockerel.

and closely related surrounding tissues. As in case of the other affections of the head of the bird the cause is unknown. Ophthalmia may be merely another manifestation of pox or canker, but it is not definitely known.

Symptoms.—Ophthalmia is characterized by its chronic course, rather light losses, the characteristic bulging of the eye, and the offensive odor associated with the later stages of the disease. The first symptom is that of a common cold. There is a slight watery discharge from the nostrils and eyes. This discharge in the early stages of the disease is generally characterized as “foaming.” If the disease progresses; the discharge dries in the nostrils, the eyelids

become glued together, and the exudate beneath the lids causes the eye to swell. The swelling may attain the size of a hickory nut. When the lids are pulled apart a tough yellow cheesy mass protrudes. This stage is often called "swellhead" or "ocular roup." This stage is also associated with the offensive odor so characteristic of the disease. The sinuses (spaces) about the eye may also become affected and cause marked swelling of the tissues. In some cases the sinuses alone are affected.

Treatment.—Sick birds should be placed in isolation pens and given a dose of Epsom salts, one pound per 100 birds. The eye should be freed from all exudate. If the sinuses are affected they should be opened with a sharp knife and cleaned thoroughly. The eye socket or the sinuses should be treated with hydrogen peroxide to clean thoroughly. In stubborn cases a 5 per cent solution of silver nitrate or a 10 per cent solution of argyrol may be used.

Birds that have suffered from a severe case of ophthalmia (fig. 10) are usually of little value and should be fattened for the market as soon as possible after recovery.

FOWL CHOLERA.

Fowl cholera is an acute disease of all domesticated fowls, characterized by its sudden onset and widespread occurrence. It is caused by a specific organism, *Pasteurella avicida*, that is found in large numbers in the blood and other tissues of affected birds. The disease seldom lasts longer than 48 to 72 hours, though it may become chronic and persist for weeks.

Symptoms.—In the peracute form, no symptoms are usually noticed except that the birds are found dead under the roosts in the morning. In the acute type a yellowish diarrhea is noticed; the comb, red at first, later turns to a purple color; the temperature is elevated; loss of appetite is common; and the bird exhibits excessive thirst. Other symptoms that are present are extreme drowsiness, ruffling of the feathers, and an increase of mucus in the mouth. Death usually occurs in from 24 to 72 hours.

The chronic type generally follows an acute attack and is characterized by an intermittent or persistent diarrhea, emaciation, paleness of the comb, and often a stiffness of the joints. Death may not occur for several weeks.

Internal Organs.—When a bird infected with fowl cholera is autopsied the general hemorrhagic condition of the tissues and organs is usually diagnostic. However, it is often impossible to determine definitely until a bacteriological examination is made. The post-

mortem lesions found in this disease are given in the outline, page 18, "Scheme to Aid in Diagnosis of Poultry Diseases."

Treatment.— Individual treatment is not recommended in this disease, and sick birds should be destroyed and burned. The measures outlined under "Essentials of Poultry Hygiene," page 2, should be carefully followed and the general control measures given under "General Directions," page 16, practiced. The object after the disease has a start is to try and save the healthy birds. It is best to move the well fowls to new quarters until the disease subsides. Then the infected houses and runs should be thoroughly cleaned and disinfected before the birds are returned.

If any birds do recover they should be fattened for the market as soon as possible. Any birds which develop chronic cases should be killed, since they might recover, get back into the flock unnoticed, and, as carriers, be the cause of an outbreak another year.

BACILLARY WHITE DIARRHEA.

White diarrhea is a highly acute fatal infectious disease of young chicks. It usually affects the chicks within two or three days after hatching. The development of diarrhea is due to the action of a specific bacterium, *Salmonella pullora*,¹³ which soon devitalizes the young bird. The death rate is very high.

Symptoms.— The chicks appear stupid and remain under the hover or hen most of the time. They remain much by themselves and many of them peep continually, or utter a sharp cry, apparently of pain, when attempting to void the excrement. Their feathers become rough and the wings droop. They eat little and appear unable to pick up food. The characteristic whitish discharge from the vent soon makes its appearance. The discharged matter may be creamy or mixed with brown. In many cases this clings to the down in sufficient quantity to plug up the vent. This condition is known as "pasting up behind." The chicks often become "big bellied" and bunch out behind. In some cases they die without warning and show few symptoms. In other cases they will live for a long time and show all the above symptoms. On post-mortem examination the liver is often found to be of a yellow color and the yolk of the egg is unabsorbed in most cases.

Treatment and Control.— Treatment of sick birds is unsatisfactory, and only control measures can be practiced. For several

13. The reader should keep in mind that all cases of diarrhea in chicks are not due to infection with this organism. Improper feeding, overheating, or chilling, etc., may cause severe losses with symptoms of bacillary white diarrhea. Only a bacteriological examination can determine the cause in all cases. (See "Some Things Which Kill Young Chicks," page 69.)

years the following method has been used with success in combating this disease in young chicks. As soon as the chicks are hatched, take them away from the incubator and place them in a freshly scrubbed and disinfected box or brooder. Give no food for 36 to 48 hours; then furnish a generous supply of sour milk or buttermilk. (Do not put sour milk or buttermilk in metal drinking fountains since poisoning may result from this practice.) Allow the chicks to partake of this as freely as they will. It will serve as both a feed and a drink for the first two or three days of feeding. The box should be disinfected and dried in the sun at least once a day, or preferably have a second box to which the chicks may be transferred while one is being cleaned and disinfected. It is well to sprinkle a layer of fine ashes over the floor for the chicks to scratch in. At the end of three days some dry corn bread or corn meal may be mixed with the sour milk. Continue this diet in the usual manner for three weeks, after which time the chicks are safe from danger of this disease. Keep everything scrupulously clean.

In some cases the organism causing white diarrhea is present in the adult bird and may be transmitted to the young chick through the egg. Since infection may be brought upon the place through purchased eggs or stock, such purchases should be made from farms where bacillary white diarrhea is not present.

In the case of infected breeding stock the marketing of the entire flock, followed by proper methods of cleaning and disinfecting, and then starting with noninfected birds, is probably the best way to get rid of the disease. However, in flocks of high-grade stock, which have been selected for some special purpose, a satisfactory method is to determine which birds are "carriers" of the infection by careful pedigree records or by sending sample of blood to this laboratory for agglutination tests.¹⁴ By these methods it is possible to eliminate the infected birds.¹⁵ The agglutination test is a much more rapid method. It is, however, considerable trouble to collect the samples of blood and there is a small charge to cover cost of material and postage.

FOWL TYPHOID.

Fowl typhoid is an acute infectious disease of fowls that affects both young and old birds. It is caused by *Eberthella sanguinaria*, an organism that somewhat resembles the one causing typhoid fever in man.

14. For further information see appendix, page 75, "Information Concerning the Agglutination Test for Carriers of *Salmonella pullora*."

15. Every bird reacting to the agglutination test should be removed from the flock, regardless of how valuable it may be. A bird valued at \$100 will be as great a menace to the flock as one valued at \$1.

Symptoms.—The acuteness of fowl typhoid often causes it to be confused with fowl cholera. However, it is not usually as fatal as cholera. Birds that have shown no symptoms may be found dead under the roost and about the yard; others will show a tendency to stray from the flock; they will become weak, and will have a greenish diarrhea. It is generally believed that a pale comb is characteristic, but the cases that have been examined at this laboratory recently seem to show a bright red comb as often as an anemic one. The appetite is lost and the affected fowl shows a rise in temperature as indicated by its increased thirst. Five or six days after symptoms are noticed the birds will usually be found dead, although a few may recover.

Post-mortem Findings.—Upon opening a fowl that has died, an enlarged darkened liver covered with minute necrotic (grayish) spots is noticed. The spleen is usually mottled in appearance, and the gall bladder distended with thick bile. The kidneys may be enlarged and friable (easily broken). The heart often shows several small necrotic areas on its surface.

Treatment.—The same treatment outlined for fowl cholera should be practiced. If the best possible care is taken somewhat better results may be obtained than with cholera. The free use of Epsom salts and potassium permanganate will control this trouble except in severe outbreaks.

TUBERCULOSIS.

Tuberculosis is generally called “going light” by the poultryman. It is caused by a microorganism, *Mycobacterium tuberculosis*, similar to that which is responsible for the same disease in man and cattle. It is not probable that man will contract the disease from fowls but cases are reported where birds have died from the type that affects the human, and it is possible that man may get the disease from birds. It is possible for pigs and calves to get the avian tuberculosis by association with affected birds. Fowls may get the disease from cattle, but the greatest source of infection is from other birds that have the disease. All classes of fowls are susceptible to the infection.

Symptoms.—The disease runs a chronic course and usually the first indication that it is on the farm is that a bird will be found that is “going light.” The comb will become pale and when picked up it will be noticed that the bird has very little flesh on its breast bone. (Fig. 11.) The bird will eat well until death and only one or two in the flock may be noticed with the disease at one time, al-

though it is usually widespread in an affected flock. Some birds well advanced in the disease will show lameness.

Post-mortem Findings.—The surest method of diagnosis is to kill an affected fowl and observe the lesions in the liver, spleen, and intestines. A few will show no lesions at all, but these cases are rare. Lesions are seldom noticed in the lungs. Occasionally the joints are affected, and skin tubercles may be seen. The lesions commonly seen are white to yellow tubercles of various sizes, few to many in number, on the surface of an enlarged liver, and possibly on the surface of an enlarged spleen. These tubercles may

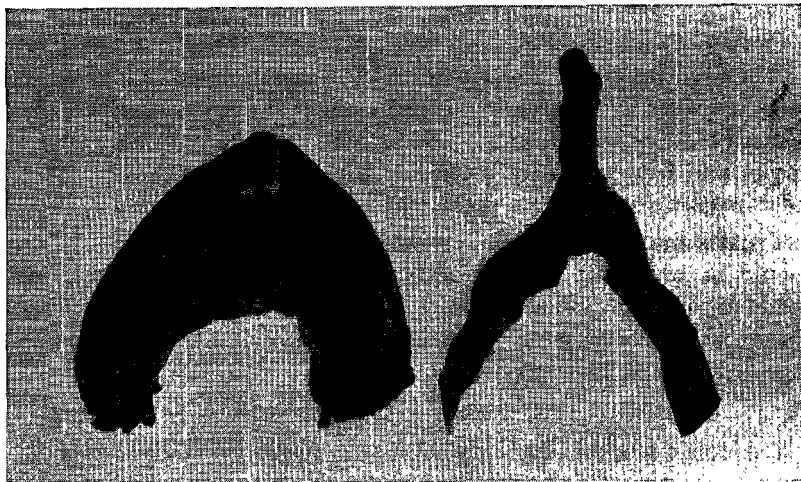


FIG. 11.—Picture of the breast bone and muscle of a normal bird (a) and of a bird (b) suffering from a well-advanced case of tuberculosis.

or may not be found along the intestinal tract. (Fig. 12.) When lesions are present in the walls of the intestine they are firm to the touch, irregular in outline, and yellowish in color. They generally are of cheesy-like consistency and when cut open show a central area of softer material than that which makes up the outer portion of the lesion.

Treatment and Prevention.—Treatment of an infected fowl is useless, and once tuberculosis gets into a flock, destruction of the entire flock is the only sure method of eradication. However, since the disease usually attacks birds over one year of age, a cheaper method is to get rid of all birds of one year of age or over, each year for a number of years, and thus gradually eradicate it from the

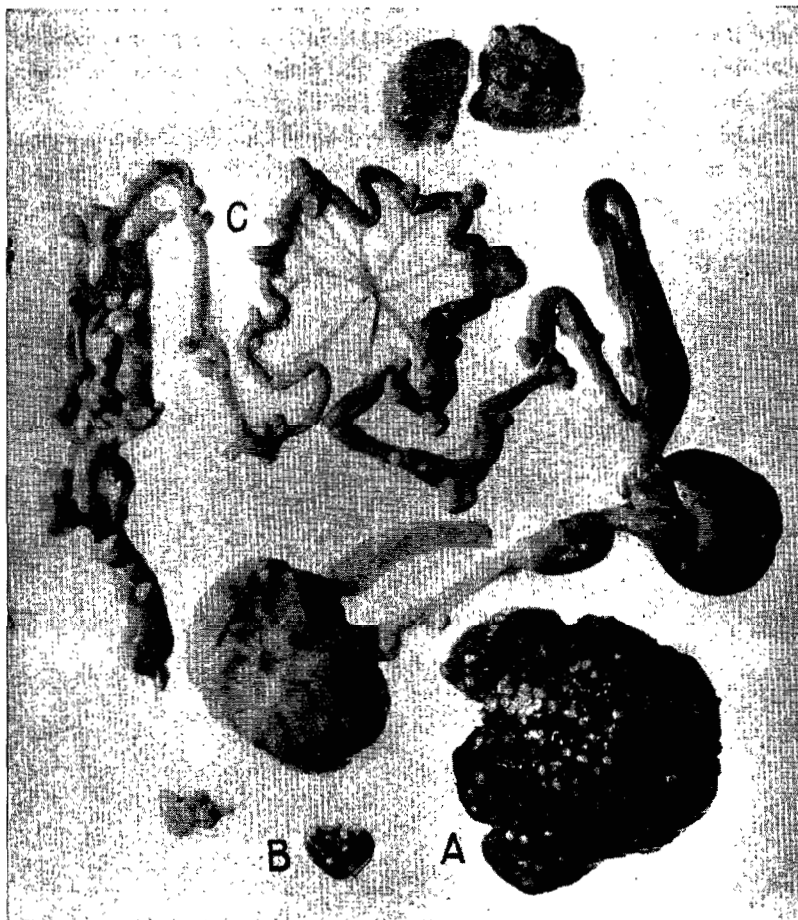


FIG. 12.—A portion of the viscera of a tuberculous chicken showing lesions of tuberculosis on liver (A), spleen (B), and intestines (C).

flock. A third and much better method is to have a competent veterinarian apply the tuberculin test on each bird at least twice a year and eliminate all reactors. The cost of this method is low when one considers that all well birds can be saved when this test is used as a means of detecting the infected birds.

Not only must the infected birds be got rid of, but the premises must be carefully cleaned and disinfected. Especially should all runs under old sheds and barns be closed up so that new birds can not get in these places. The tubercle bacillus will live in dark places under buildings, and in refuse, for long periods of time and if

the entire flock is killed new birds should not be brought on the place for at least six months. During this time the premises should be disinfected at least once a week. Extreme care should be taken to disinfect thoroughly and often in any case.

All birds that are killed need not be a total loss, for those showing no lesions are suitable for food if they are thoroughly cooked. Therefore, if the entire flock is to be killed, the birds may be dressed



FIG. 13.—Typical position of a turkey affected with blackhead disease. (The position and the sulphur-colored droppings are usually diagnostic of blackhead.)

and those that shown no signs of the disease may be sold to the butcher. All affected fowls should be burned.

BLACKHEAD (INFECTIOUS ENTEROHEPATITIS).

Blackhead (Infectious Enterohepatitis) is one of the most common of the diseases affecting turkeys and is very prevalent in Kansas. It is caused by a microparasite that affects especially the liver and ceca (blind pouches of the gut) of birds from six weeks to four months of age. Older turkeys and chickens are not immune. In fact chickens may be a source of infection and not show signs of the disease. The term “blackhead” is misleading, since any disease that causes a decrease in the oxygen supply of the blood

may cause the head to become darkened in color. *Histomonas meleagridis* is now thought to be the cause of blackhead, and some investigators maintain that the presence of the small roundworm, *Heterakis papillosa*, is also essential in the development of the disease.

Symptoms.—The disease runs a rapid course in young birds while in older ones it usually causes death in three or four weeks after the first indication of infection. The characteristic symptoms are drowsiness, a tendency to lag behind the flock, loss of appetite, diarrhea, and sulphur-colored droppings. As was mentioned before,

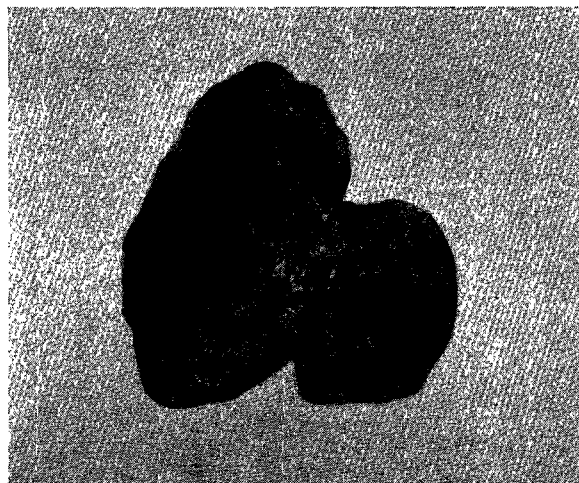


FIG. 14.—Liver from turkey affected with blackhead showing irregular yellowish areas on the surface.

the blackhead is not a constant symptom and may even indicate some other infection. As the disease progresses, the feathers become ruffled, the wings droop and general debility is noticed. (Fig. 13.) Several poults are usually stricken at once.

Post-mortem Findings.—When a blackhead carcass is autopsied the liver and the ceca (blind pouches) should be examined first for lesions. Yellowish or yellowish-green areas are seen on the surface of the liver (fig. 14) in most cases, but some do not show these. The ceca (fig. 15) are generally impacted with a thick mass of foul-smelling necrotic material and the inner surface may show an ulcerated condition. The ulcers may be large or small and may perforate the wall of the cecum and lead to peritonitis.

Treatment and Prevention.—Treatment of blackhead is of little value, the only hope lies in prevention. Remove the birds to new quarters as soon as the disease is noted, and see that all drinking and feeding vessels are thoroughly cleaned and disinfected. Sick birds should be killed and buried deeply, or burned. A treatment



FIG. 15.—A portion of the intestines showing swollen and ulcerated ceca (A) (blind pouches) characteristic of black-head. Note the large areas of ulceration on the left cecum.

that is now being used by some is as follows: For each 20 birds give two teaspoonfuls of powdered ipecac mixed in a mash, twice a week until the poults are three months of age; then reduce the dosage one-half and give once each 10 days until the birds are ready for market. Crude catechu at the rate of one-third teaspoonful per

gallon of water is also recommended where it can be kept before the flock continually. Fresh water should be given often and the fountains kept thoroughly cleaned and disinfected at all times. Epsom salts should be given at the rate of one pound per one hundred adult birds. This may be given in a wet mash and the dose should be repeated once every two weeks while catechu is being given.

Other preventive measures that should be observed are: Do not let chickens and turkeys run together, since the former may harbor the disease and show no visible symptoms; quarantine all newly purchased birds for 30 days before admitting them to the flock; and do not feed the poults on the same area for long periods of time, as the ground is apt to become heavily infested with the causative organism and thus be a continual source of infestation. Eggs for hatching should be purchased from healthy flocks and, to have double insurance that they are not contaminated, it is well to dip each egg in a solution of 70 per cent pure grain alcohol before placing in the incubator.

In view of the fact that the cæcum worm, *Heterakis papillosa*, may be an intermediate host of the organism causing blackhead, the addition of tobacco dust to the ration, as described under treatment of roundworms, may be beneficial if fed to growing poults from the time they are old enough to eat mash until they are ready for market.

The danger of overfeeding cannot be too strongly emphasized. Some successful turkey raisers claim that next to blackhead this is the greatest cause of death to young poults. In the wild state these birds are never overfed, and overfeeding may predispose to disease.

Too much stress should not be placed on the use of drugs as curative agents. Their only value is in the tonic effects derived, and they are not known to be specific for blackhead.¹⁶ As far as is known the flesh of slightly infected birds is fit for human consumption if the liver is discarded. Well birds from flocks which are suffering from blackhead should be sold for the early trade. Sick birds should not be sold. Sometimes poults that are in the first stages of the disease may fatten well and show no outward symptoms, and if such birds reach the market in that condition their food value is not lessened.

16. Tonics suggested for keeping poults of various ages healthy and vigorous and thus aid in preventing blackhead may be found in the appendix under the heading, "Tonics Suggested for Prevention of Blackhead in Turkeys."

Concerning the feeding of poults, Dr. Philip B. Hadley¹⁷ makes the following suggestions that seem, in the main, to agree with the practices of successful turkey raisers:

1. After collection from the nests, hatch the turkey eggs in incubators, in the meantime having ordinary hens set on china eggs in nest boxes or brooders on the permanent range.

2. Remove the poults from the incubator about 24 hours after hatching, and distribute at night among the hens, giving from 12 to 14 to each hen. Be sure that the hen accepts them before they are left.

3. Give no feed before the poults are two days old. Each family may then receive 2 teaspoonfuls of egg chopped fine with some green food such as nettles, dandelion, onion tops or lettuce. A little cracker may be added to take up surplus moisture so that the mixture will not be pasty.

4. This ration may be repeated for the remainder of the feedings upon this day, or bread soaked up in sweet milk may be substituted for one meal.

5. During the first three or four days of feeding the poults receive four meals each day, at about 8 o'clock, 11, 2, and 5 o'clock; after this but three meals are given.

6. On the second day of feeding about the same rations are given, but one of the meals may be of chick grain, and some rolled oats may be added to the chopped egg mixture.

7. The third day of feeding is like the second. The poults are allowed to run in their enclosure.

8. On the fourth or fifth day of feeding, the number of meals may be reduced to three, at 8 o'clock, 12, and 4:30, respectively. The amounts are slightly increased and a little grit may be added.

9. When the poults are about a week old they may be allowed to run free with the old hen on the range on pleasant days when the grass is dry. Chopped egg in the ration is reduced, and omitted by the seventh day of feeding.

10. On the sixth day of feeding the feeding is put on a time basis. Several spoonfuls of food are put on a tray and well distributed, but the poults are not allowed to eat for more than about three minutes at any one meal.

11. By the end of the second week, the time limit is reduced to two and one-half minutes, since the poults are now obtaining more food on the range in the form of insects.

12. About the same time sour milk is introduced. It is placed, whey and curd well mixed, in shallow pans or in troughs, scattered about the range. It is at first given each morning and night at the rate of about one quart to 40 poults, and is gradually increased in amount until by the beginning of the fourth month one quart may be given for each 20 birds, each morning and night.

13. During the second month, which is the critical period for the young birds, the feeding is continued about as in the latter part of the first month. But, after the age of about six weeks the number of meals per day may be

17. Hadley, Philip B. Blackhead in turkeys: A new conception of the nature of the disease and suggestions for new methods in prophylactic feeding. *Jour. Amer. Assoc. of Instructors and Investigators in Poultry Husbandry*. 2: 57-61. May, 1916.

reduced to two. Green food in the form of chopped carrot tops, onion tops, or lettuce should be given in abundance; it should comprise at least one-half of the ration for each meal. The time limit remains at about two and one-half minutes.

14. When the poults are about six weeks old the nest or brooder coop should be replaced by a larger house made of laths and covered partly with roofing paper. This house may be about 3 by 5 feet, and three feet high at the apex. Such a house may suffice until the poults are about three or four months old. Family houses should then be given up and all the poults, with their mothers, be brought together in a single roosting shed.

15. The feeding for the third month is like that of the second except that the amount of sour milk is gradually increased and that a grain mixture of equal parts or cracked corn and wheat may be gradually substituted for the chick grain.

16. As the autumn months advance and insect life disappears, the time limit may be lengthened to three or three and one-half minutes. In rainy weather the noonday meal may be added and a four-minute period allowed. Rolled oats may be omitted and the ration made to consist of the grain mixture with an occasional feed of rolled oats or bread and milk. A mash may now be added containing some beef scrap.

17. Before Thanksgiving the breeders for the coming season should be selected and marked. Their feeding for the winter may consist of the following grain mixture fed at the rate of one quart for six or seven turkeys each night and morning:

Cracked corn	3 parts	:
Barley	2 parts	:
Wheat	2 parts	:
Oats	1 part	:

BOTULISM (LIMBERNECK).

Botulism (limberneck) is a disease caused by the toxins of a micro-organism that is common wherever spoiled food or grain is found. The organism, *Clostridium botulinum* types A & C, is commonly found in spoiled foods or decaying carcasses of animals. The disease is characterized by limberneck and is often called by this name.

Symptoms.—A sudden appearance of several cases of typical limberneck in the flock is usually the first indication of the disease. This condition is caused by paralysis of the neck muscles which lets the neck hang limp. It must not be confused with the wry-neck found in worm troubles where the neck is twisted or held to one side but has not the limpness found in botulism. A bright red comb, ruffed feathers easily pulled out, and a limber neck are probably the most characteristic symptoms of the disease. (Fig. 16.) Usually a large number of the flock are affected at once, and are found lying in a prone position. When picked up they will utter a cry of pain. A subnormal temperature is sometimes present but it does

not seem to be a constant symptom. A watery or whitish diarrhea may be present, and the skin, soiled by this discharge, may appear red and congested.

Often when a bird that is dead from the disease is opened and the crop examined a number of maggots and bits of decomposed meat will be found. There is usually a putrid odor of decomposed meat noted in the mass of material found in the crop. Sometimes the crop will be filled with spoiled corn or other food that has carried the toxic material.

Treatment.—First of all, the cause should be sought for and removed. Often, when there is no knowledge that spoiled food has

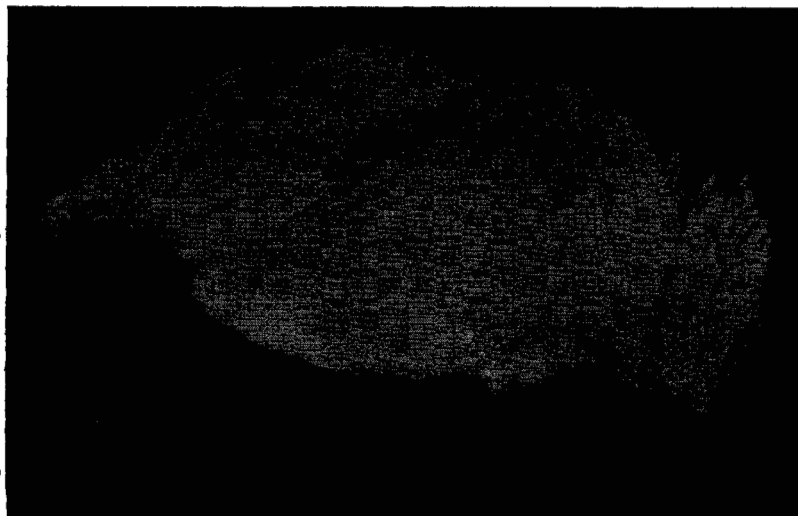


FIG. 16.—A bird showing characteristic symptoms of botulism (limberneck).

been given, a careful search about the premises will reveal a dead and decaying carcass of a bird, rabbit, or other animal. Spoiled ensilage and canned foods are examples of food that might harbor the organism and these should be sought for when looking for the cause.

The sick birds should be moved to a cool place and given a physic, such as a teaspoonful of Epsom salts in a half tumbler of water or two teaspoonfuls of castor oil to each fowl. The unaffected fowls should be shut up until the cause is removed and given a dose of Epsom salts or oil as described above. Sometimes simply shutting birds into small runs or changing the feed will be sufficient to stop the loss.

If the disease can be correctly diagnosed "botulism" (types A and C mixed), antitoxin may be used to prevent the well birds from getting the disease. In some cases the sick fowls can be cured with this biological preparation.

COCCIDIOSIS

Coccidiosis is a protozoan disease that is found most often in chicks from two weeks to four months of age, although older birds often suffer from it. Some cases have been reported in turkeys and

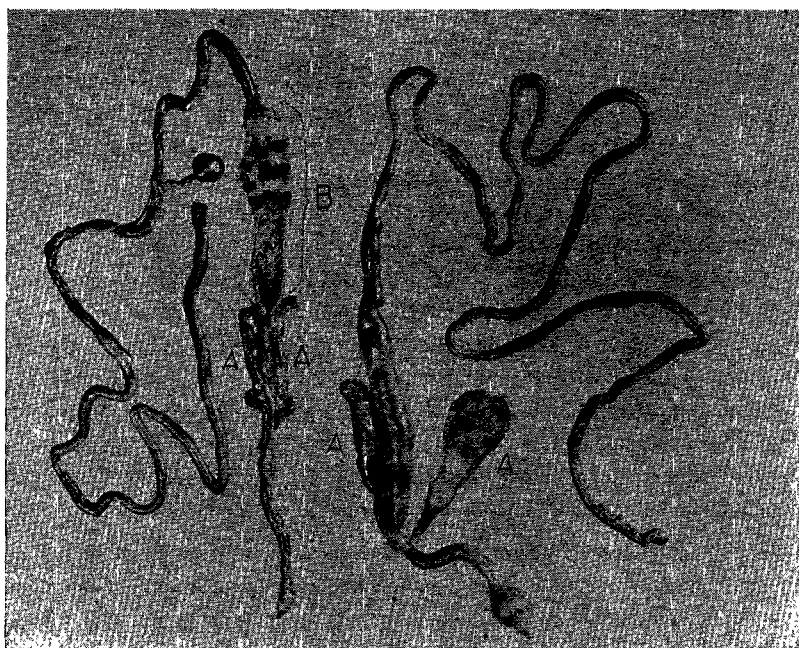


FIG. 17.—Lower portions of the intestines of two young chicks showing lesions of coccidiosis. Note the ceca, (A), one of which is cut open showing ulcerations on the inner wall. Note also a portion of one intestine (B) split open and showing ulcerations on the inner wall.

other birds and it is thought that some of the wild birds such as the crow, the pigeon, and the sparrow are common sources of infestation to the domesticated fowl. The organism, *Eimeria avium*, responsible for the disease, may live for a year in the soil and enter the body through food and water that become infected. Its action is primarily on the mucous membrane of the cecum (blind gut) where it causes a severe inflammation. (Fig. 17.) The liver and the rest of the digestive tract are also affected at times. After passing

several cycles of its life history within the body of the fowl, the organism is voided in the droppings and may be picked up by other fowls. Old birds may harbor the disease but are hardy enough to resist its ravages.

Symptoms.—The first symptoms noticed are that the affected bird becomes droopy, the wings sag, and the bird lags behind the rest of the flock. Usually a large per cent of chicks will show symptoms at the same time, and generally a few will have a white exudate in the eye similar to that seen in roup. This exudate is caused by the organism getting into the eyes from the feet when they are used to scratch the eye and head. The irritation that is set up makes a favorable condition for secondary infection to enter, which, with the coccidial organism, causes the exudate to collect in the eye. This white exudate must not be confused with that found in ocular roup, which is usually yellow and more adherent to the eyelid as well as having a foul odor. The chicks may die in a few days after the first symptoms are noticed, or they may live for weeks and become very emaciated. The symptoms in general so resemble those of some other diseases, such as worms or nutritional disease, that it is almost impossible to diagnose the trouble unless a bird is autopsied and a microscopic examination made of some of the intestinal contents to determine the presence or absence of the microorganism, *Emeria avium*. If the local veterinarian is not in a position to make such an examination, one or two of the birds should be shipped to this laboratory for diagnosis.

Treatment and Prevention.—Treatment is very unsatisfactory in most cases. Powdered catechu at the rate of one-third teaspoonful per gallon of drinking water is said to give fair results if kept before the birds continually. Epsom salts at the rate of one pound per one hundred adult birds should be given in a feed of wet mash every ten days while catechu is being used, since the catechu is constipating in its action.

Precautions should be taken to prevent the disease from getting a start on the premises. Rotation of runs will help to prevent an outbreak. Brooder houses so constructed that they can be moved will provide a method of giving chicks new ground to range on each year. Care should be exercised to see that young chicks come from healthy flocks, and the exclusion of pigeons and other birds from the poultry yards will do much to keep coccidiosis off the premises.

Once the chicks become diseased care must be taken to stop the spread by practicing isolation methods previously outlined and by giving catechu as described above. It is essential that the yards be kept clean, and if possible new chicks should not be put in infected runs until at least a year after the infected birds have been removed. Only the strongest disinfectants will act on the coccidia and a 10 per cent solution of compound cresol is recommended for this purpose.

If the eyes are affected they may be treated as described under nutritional disease or ocular roup.

FAVUS (WHITE COMB).

Favus is caused by a fungus, *Lophophyton gallinæ*, that attacks especially the wattle and comb, but may spread to other portions of the body. When the crusts are removed the skin appears irritated and somewhat raw. If the feathered portions become affected the feathers become dry, erect, and brittle and finally break off or fall out, leaving a disk-shaped scale with a depression at the bottom where the feather was located. The affected parts appear white, as though covered with powder. The disease often spreads rapidly.

Treatment.—After removing as much of the scale as possible with warm water or glycerine and gently scraping with some blunt instrument, apply tincture of iodine. Early stages of the disease often respond favorably to an application of lard, or oil, or to a salve made by mixing about equal parts of lard and sulphur. This mixture should be worked into a smooth salve before using. Keep the birds apart during treatment. Follow with the usual clean-up methods.

ASPERGILLOSIS (BROODER PNEUMONIA).

One of the most common causes of brooder pneumonia, in young chicks is the invasion of the mold known as *Aspergillus fumigatus*. This mold is very common in nature, especially on grain and hay kept in damp places. Crowding chicks in a poorly ventilated brooder house is a predisposing factor that favors the entrance of the mold into the bodies of the chicks. However, *Aspergillus fumigatus* does not confine itself to the young bird for it is found in the adult as well.

Symptoms.—The brooder chick, when affected, shows symptoms resembling those of white diarrhea. Aspergillosis is a disease that affects the pulmonary system and a typical pneumonia is present.

In the adult, the disease may be limited to one bird or several may show symptoms, at the same time. Accelerated breathing, a slight catarrh, and a rattling or croupy sound on expiration are characteristic of the disease. The birds also stray from the flock and are often found in a sitting position. If an attempt is made to pick up a sick fowl, it will show signs of pain. Fever, choking, diarrhea, sagging wings, sleepiness, and finally suffocation, precedes death. In some cases, where only the air sacs are involved, loss of flesh and weakness are the only symptoms noticed, though at times lameness and swollen joints are prevalent.

Treatment and Prevention.—Aspergillosis is difficult to cure. Coal tar or turpentine inhalations are made by stirring two tablespoonfuls of one of these in a quart of hot water and letting it stand for an hour or two. The affected birds should then be shut up in a small room and the solution poured on a hot brick until the room is filled with the vapor.

Dry well-ventilated brooder houses should be provided and the temperature in these should be regulated as much by the way the chicks act as by the thermometer. Crowding and huddling indicate lack of heat and the stove or lamp should be regulated accordingly.

Only dry, clean litter should be used and dusty grain must be avoided. Isolation and disinfection methods previously outlined should also be followed.

GAPES.

Gapes is a disease of young chickens caused by a small reddish worm, *Syngamus trachealis*, which attaches itself to the mucosa (inner lining) of the trachea (wind pipe). It is often called a forked worm because the male and female are firmly attached to each other at an angle that gives them the appearance of a single worm. The presence of the worms may be demonstrated by passing an extractor (a loop of fine wire or a horse hair) down the trachea for a short distance and turning it to loosen the worms. They may then be drawn out if present in considerable numbers.

Symptoms.—The worms cause a severe inflammation, suck blood, and may cause asphyxia if present in large numbers. The affected chick gapes, sneezes, and becomes pale and weak. Loss of appetite followed by emaciation is noticed. Spontaneous recovery is rare, and heavy mortality results where treatment is lacking.

Treatment.—Stripping a feather of all its web, except a small tuft on the end, moistening this in kerosene and inserting it into the

windpipe where the worms are attached, will often cause them to loosen their hold. They can then be withdrawn or coughed up. However, this method is not reliable in all cases, for some of the worms may be out of reach. Reliance must be placed in prevention. In badly infested pens kill and burn all stock, clean buildings, runs, and premises. Allow the ground to rest for six months. Under conditions where land is not available the following methods of treating the soil have been advised: (1) Treat ground with air-slacked lime; and (2) spade carefully. The spading is the more effective method of control.



FIG. 18.—Roundworm parasites (*Ascaridia perspicillum*) from small intestines of a chicken. (Courtesy J. E. Ackert.)

Rotation of runs will do much in preventing gapes. Chicks should not be kept on land where turkeys have been running during the previous year.

ROUNDWORMS.

Two species of roundworms are common in Kansas chickens. The large roundworm, *Ascaridia perspicillum*, (fig. 18) is the one most often found in the small intestines from the duodenum to the ceca (blind pouches.) It is a white or yellowish worm attaining a length of one to four inches in the adult stage and may be found at times in such large numbers as to block the lumen of the intestine.

The other roundworm is that commonly known as the cecum worm, *Heterakis papillosa*. It is a very small white worm, and is found in the ceca (blind pouches). It may be present in numbers

large enough to cause severe irritation to the lining of these organs. One investigator considers its presence in turkeys a factor in blackhead.

Symptoms. — Chickens may be heavily infested with roundworms before any abnormality is noticed. Young birds are most commonly infested and show general unthriftiness, drooping or sagging of the wings, paleness of the head, and emaciation, but loss of appetite only in advanced stages. Birds kept in crowded quarters or in damp, poorly drained runs seem more susceptible to roundworms. Diarrhea or the other extreme, constipation, may be present. Careful post-mortem examination of the intestines of a bird dead with the infestation will reveal the presence of the worms.

Treatment. — The California Agricultural Experiment Station recommends the following treatment for roundworms: Mix two pounds of tobacco dust, containing not less than 1.5 per cent nor more than 2.5 per cent nicotine, with 100 pounds of dry mash. Feed this daily for three weeks, and after discontinuing for three weeks repeat the treatment for a similar period. Epsom salts should be given at the rate of one pound per one hundred full-grown birds after the first week and at the end of each period.

Another method of giving tobacco is as follows: Steep one pound of finely chopped tobacco stems for two hours. Mix the stems and liquid with one-half the usual ration of ground feed and give to the birds after a fast of 18 hours. Epsom salts at the rate of one pound per one hundred adult birds should be given in one-fourth the usual feed of wet mash within a few hours after the feed of mash treated with tobacco. The dose can be regulated according to the size of the birds. Treatment should be repeated in 10 days to remove the large roundworms, but must be repeated at intervals of every three or four weeks to insure success in the removal of the cecum worm. When possible, the birds should be shut in the coops during the treatment and for at least 24 hours following the giving of Epsom salts. All droppings should then be cleaned up and burned in order to destroy the eggs. Yards should likewise be thoroughly cleaned and the refuse burned or hauled to areas not traversed by the flock. These precautions are necessary, since reinfestation can easily occur by the birds picking up the worm eggs from the droppings. Where the tobacco dust treatment is given over a period of three weeks or more it is not advisable to shut the fowls up during treatment, but the runs can be kept clean and the coops cleaned often, thus minimizing the danger of reinfestation.

Maurice C. Hall, of the Zoological Division of the Bureau of Animal Industry, United States Department of Agriculture, recommends oil of chenopodium and olive oil injected into the ceca, via the rectum, to control cecum worms, *Heterakis papillosa*. This treatment will remove about 90 per cent of the worms, and if repeated occasionally will aid greatly as a control measure if sanitary precautions are practiced at the same time. He advises the use of one dram of oil of chenopodium (1 teaspoonful) to six fluid ounces of olive oil or cottonseed oil given at the rate of one-third of an ounce to a bird weighing three pounds or more, regulating the dose according to the weight of the bird. The two drugs should be thoroughly mixed and given with a small hand rubber enema syringe. The syringe should be inserted into the vent, and by following the lower floor of the cloaca (the common passage into which the rectum and egg tube open) the rectum can be reached and then the tip of the syringe should be passed into this organ and the solution slowly injected. This procedure is as easy as giving treatment by mouth, and can be given just as quickly.¹⁸

Many other treatments have been recommended, but the above seem to be giving the best results at the present time. It must be remembered, however, that no treatment will be successful if given without heeding proper sanitary precautions. Frequent cleaning of runs, and houses, burning of all refuse insure death of larvæ and destruction of worm eggs, and keeping stagnant pools well drained are as important as giving of anthelmintics to rid the flock of worms. When possible, frequent changing of runs will aid in controlling roundworm infestation.

TAPEWORMS.

Tapeworms are white flat worms made up of a number of segments that give them a jointed appearance. Many species are found, and more than one may be present in the same bird. One of these, *Davainea echinobothrida*, causes a nodular condition of the intestines that resembles tuberculosis. In the adult stage it can be readily recognized with the naked eye. (Fig. 19.) In contrast to this species is another, *Amæbotæmia sphenoides*, which is often overlooked upon a post-mortem examination because of its semimicroscopic size.

The tapeworms of fowls require an intermediate host for the development of their larval stage. When this host animal is swal-

18. For additional details see U. S. Dept. of Agr., Farmers' Bul. 1337, Diseases of Poultry. Pages 81-82. 1923.



FIG. 19.—Intestines of chicken showing nodular teniasis due to the action of *Davainea echinobothrida* (a certain kind of tapeworm). (A) the ceca (blind pouches). (B) Pancreas. (C) Nodules on small intestines.

lowed by the chicken the larval tapeworm is set free in the chicken's intestines where it grows rapidly into an adult tapeworm. Thus one tapeworm is transmitted from one chicken to another by snail, another by the biting stable fly, and three other chicken tapeworms are transmitted by the common house fly.

Symptoms.—The symptoms of tapeworm in birds (fig. 20) resemble those shown by birds infected with roundworms, and in addition many nervous conditions are often noticed. Wry neck is common, and the bird in this condition often continually holds its



FIG. 20.—(A) A chick three months old heavily infested with tapeworms. (B) A portion of the intestines of chick "A." (Courtesy J. E. Ackert.)

head to one side, or straight back over the body. A twitching of the head may be noticed and a loss of equilibrium will often be seen. In this latter condition the bird will attempt to walk and will fall forward on its head as if to take a somersault. Duck-like attitudes are common, and one bird sent to this laboratory assumed a typical penguin-like posture. Lameness is also characteristic in severe outbreaks.



FIG. 21.—A bird being given medical treatment by means of a pipette made from glass tubing.

Treatment.—Very little is know about specific remedies for tapeworms in poultry. Unlike the case of roundworms, preventing the birds from picking up eggs from the droppings will not stop them from becoming infested, for the egg has to be taken up by flies or other forms of animal life before it can be a source of danger to the fowl. It is impractical to prevent birds from eating insects, so preventive measures must be taken against the flies or snails (intermediate hosts) getting the eggs. By careful attention to destruction of droppings and refuse in the houses and runs, control measures will be greatly aided. At least the droppings should be hauled to a remote area of the farm that is not frequented by the chickens. Other measures given for control of roundworms should be practiced.

For treatment, turpentine and olive or cottonseed oil in equal parts is recommended as being 69 per cent efficient for removal of tapeworms. The birds should be shut up at night and given from one-half to one teaspoonful of the mixture the following morning. Food in the form of a mash may be given the birds within three hours after feeding and to this should be added one-half pound of Epsom salts per one hundred adult birds. Regular feeding can be continued at night, but the flock should be kept enclosed until the following morning. The houses should then be cleaned as described under treatment of roundworms.

A convenient way of giving birds individual medical treatment is to use a piece of $\frac{3}{8}$ -inch glass tubing that has been drawn out on either end in the form of a pipette. By being careful this can be inserted directly into the crop. A piece of glass tubing 15 inches long and three-eighths of an inch in diameter will hold about three teaspoonfuls, and by carefully sucking it full three birds may be treated by one filling. The quantity can be guided by placing the forefinger over the free end of the tube and letting the liquid pass gradually down the esophagus and into the crop. (Fig. 21.) Care must be taken not to get any of the liquid into the trachea (wind-pipe) and to have the end of the tubing well rounded off with a file so as not to injure the mouth or œsophagus while inserting it.

A flock treatment that is being used by some with success is the lye treatment recommended by Dr. James E. Ackert, parasitologist of Kansas Agricultural Experiment Station, and is as follows:

- Wheat 1 pint.
- Oats 1 pint.
- Concentrated lye 1 teaspoonful,
- Water Enough to cover.

Cook this mixture for two hours and allow to cool. Chickens that are suspected of having tapeworms should be put in an enclosure at night, and on the following morning fed all of the mixture they will eat, giving them plenty of water to drink at the same time. In three hours Epsom salts (one-half pound per one hundred adult birds) should be given in a mash.

This is a perfectly safe method and all of the flock can be treated without harm if care is taken not to make the lye stronger than called for in the directions. Since chickens may become reinfested it is necessary to give this treatment every two months from May to December. This is especially advisable in the case of a young flock.

If tapeworms are present it is recommended that each bird in the breeding flock be given a treatment early in the winter to remove the worms. Such birds will not then become infested until the intermediate hosts (flies, etc.) are again present the following spring. This will allow the birds to pass the winter in much better physical condition and thus avoid many cases of colds, roup, etc., to which infested birds are susceptible.

The same precautions in regard to cleaning up, etc., should be observed when this treatment is used as is described under the turpentine treatment. Since this treatment is given to the flock care should be taken to see that each bird gets some of the mixture. It is well to separate those birds that seem to be most seriously affected and give them some of the mixture in a pen separate from those that have a keener appetite. Success will depend on the thoroughness of the application, and a badly infested bird that does not get any of the treatment may be a source of reinfestation of the entire flock.

Arecoline hydrobromide, given in 0.1 grain doses, has been giving good results at this station. The method used is to dissolve 0.1 grain of the drug in 4 c. c. (one teaspoonful) of water and administer to each bird as described under the turpentine treatment. The dose should be repeated in ten days or two weeks. Great care should be taken in administering this drug since it is very toxic and enough research work has not been done with it to determine the lethal dose for fowls.

GIZZARD WORMS.

A number of cases of gizzard-worm infestations have been called to attention of the authors recently. These worms, *Dispharagus hamulosus*, infest the muscular tissue of the gizzard and cause a

nodular condition of the external surface. It is within these nodules that the worms are found. They are round, vary from one-fourth of an inch to one inch in length, and are usually found coiled in a small pocket within the nodule. Several worms may be found in one area, which may become enlarged to a sac-like appendage. (Fig. 22.)

Symptoms.—The symptoms do not differ from those seen in other roundworm infestations, emaciation being the most noted symptom.



FIG. 22.—The gizzard of a chicken showing sac-like formation on the left, due to the action of gizzard worms.

Treatment.—Treatment is without avail, since it is impossible to get drugs to the affected portion of the gizzard. Turpentine and olive oil, as described for tapeworms, have been suggested by Kaupp.¹⁹ He advises that the treatment be repeated three or four times within an interval of one week. Preventive measures such as described for tapeworms should be practiced, and all affected birds should be destroyed.

MITES (COMMON CHICKEN MITES).

There are few poultrymen who do not know the ravages caused by the common chicken mite, *Dermanyssus gallinæ*. It is very common all over the United States and especially in the South and

19. Kaupp, B. F. Poultry Diseases. Third edition. Published by Alexander Eger. Chicago. 342 pp. Figs. 184. 1922. (See p. 114.)

Southwest. It is more prevalent in midsummer, but as it lives from four to five months, infestations are common in the fall and winter. Although dampness seems to increase the length of life of the mite, hot, dry weather is essential for its maximum development.

This mite is just visible to the naked eye, is grayish in color except when engorged with blood. It is a blood sucker that remains on the body of the host until engorged and then returns to its hiding place—in cracks of roosts and floors, refuse, and other obscure places.

Symptoms.—Mites cause severe irritation to the host, but seldom leave any mark. Unthriftiness and decrease in egg production are results of their action. Setting hens often leave the nests as a result of a severe infestation. Very few mites remain on the birds during the day, for mites are essentially night workers and hunt their hiding places in the daytime. Careful examination of cracks, dropping boards, and nests will often reveal large numbers of them.

Treatment.—Removal of all interior fixtures and thorough disinfection, with a strong dip applied with a force pump is recommended. All rubbish should be removed and burned. Care must be taken to get the spray into all crevices. Kerosene emulsion, crude petroleum, and wood preservatives may be used for spraying, followed by whitewash. Whitewash aids mechanically in filling up many crevices. Spraying should be repeated after one week to get any mites that escape; and it may be well to give a third treatment. Roosts should be painted frequently with wood preservative or crude petroleum. A treatment of roosts, nests, boxes, etc., each spring with undiluted crude carbolic acid or sheep dip is usually sufficient to reduce the action of mites to a minimum. The fact should be kept in mind that mites are bloodsucking parasites and do not remain on the bird as do lice. Mites are much more harmful to poultry than lice and in treatment it is necessary to treat the house and not the bird as in the case of lice.

Construction of roosts and nesting places so as to reduce hiding places to a minimum is an excellent control measure. Proper construction and the use of sprays will keep down this pest.

New birds brought to the farm, or birds moved to new quarters, should be isolated for a few days in a pen separate from the permanent quarters, so that all mites will leave them, thus preventing infestation of the new quarters. If the birds are moved during the day rather than at night mites will not be carried with them.

Other precautions to bear in mind are the possibilities of persons

carrying the pests to noninfested flocks, and of pigeons or wild birds carrying the mites to clean quarters. By being careful to guard against these sources of infestation the chance of mites invading the houses will be minimized.



FIG. 23.—The leg of a chicken as it commonly appears in scaly leg.

SCALY LEG.

Scaly leg is caused by a small mite, *Cnemidocoptes mutans*, which burrows into the skin of the feet and legs, causing an injury from which an exudate oozes. This exudate dries and causes the scaly condition that gives the disease its name. It generally appears between the toes and works upward, finally involving the unfeathered parts of the leg. (Fig. 23.) In bad cases, the leg may appear many times its normal size.

Treatment.—Combine the “clean-up” measures with local applications of an ointment consisting of oil of caraway, 1 part, and vaseline, 5 parts. Equal parts of kerosene and olive oil well rubbed in is also very good. Apply on several successive days. Local applications without general cleaning is of no avail because the mites often leave the affected bird and will attack other birds if not destroyed.

AIR SAC MITES.

The air sac mite, *Cyrtolichus nudus*, is found to some extent in this state and is important in that an infestation may be confused with tuberculosis. The mite is small, yellow, and soft bodied, barely visible to the naked eye. It may be found in any of the air passages, but most often on the linings of the air sacs. It has also been reported in the liver, heart, and kidneys.

Symptoms.—Unless present in very large numbers, air sac mites do not seem to affect the bird. In bad infestations, symptoms resembling those of tuberculosis are noticed—unthriftiness, “going light,” paleness of the head, dryness of feathers, etc.

Treatment.—Treatment is useless, owing to the fact that the mites are located in areas that cannot be reached with drugs. The affected birds should be killed and burned, and sanitary measures practiced to aid in prevention of an infestation of other birds.

CHIGGERS.

Chiggers, or harvest mites, affect young birds especially, but may be found on older ones. Chickens on free range are most susceptible. The same mite that attacks man is responsible for this infestation. Chiggers are the first stage in the life history of a red mite, genus *Trombidium*, that is harmless when mature.

Symptoms.—Chiggers attack the body of the chick, under the wing, on the breast, and on the neck, causing a suppurative abscess similar to that found when man is infested. These abscesses are reddish in nature and may attain a diameter of one-third of an inch. The affected bird becomes droopy and emaciated, and intense itching of the part where the chiggers are feeding is noticeable, as indicated by the nervous action of the infested bird.

Treatment.—Prevention consists in keeping the birds away from infested ranges, and raising early spring chicks that will be beyond the stage of susceptibility before the chiggers reach the stage at which they infest the birds. Occasional dusting with flowers of sulfur will also tend to keep the mite from infesting the chicks.

Fenced-in ranges may also be dusted with flowers of sulfur with a dust blower at the rate of 50 pounds per acre. Treatment of affected birds consists in removing the scab and washing out the suppurated area with a 5 per cent carbolic acid solution or a 2 per cent solution of silver nitrate. Tincture of iodine should then be applied to each abscess.

OTHER MITES.

Several other mites of lesser importance infest chickens. The depluming mite, *Cnemidocoptes gallinæ*, burrows beneath the skin at the base of the feathers. It causes severe itching and is often the cause of feather pulling in birds.

Another mite, *Rivoltasia bifurcata*, feeds directly on the feathers but causes little injury.

A connective tissue mite, *Laminosioptes cysticola*, burrows just beneath the skin where it causes small yellowish nodules to form.

Of interest to turkey raisers is a small mite, *Freyana chanayi*, that has not yet been reported in Kansas, but which is prevalent in Texas and Louisiana. It locates itself along the grooves on the under side of the shaft of the wing feathers.

Cleanliness combined with local treatment with sulfur ointment will usually aid in controlling outbreaks of mites.

LICE.

Lice are a more important factor in poultry raising than is often supposed, for a bad infestation may so lower the resistance of a flock that serious losses will result. They are also an important factor to be considered when treating other diseases, for a bird with a lowered resistance, due to lice, will not respond readily to control measures being used for other diseases. However, lice are much less harmful than mites, since the latter are blood-sucking parasites, while the former are of importance more because of their constant irritating action. They act somewhat as scavengers, living on the dead portions of the skin and feathers.

Lice may be found on almost any part of the body and are named after the part affected—neck lice, wing lice, body lice, etc. Seven species are commonly found on chickens of the United States, and a single bird may be infested with two or three of these at the same time.

Treatment and Control.—Lice will not trouble the poultryman who practices the “clean-up measures” previously outlined. At the present time sodium fluoride seems to be the best general remedy.

Bishopp and Wood²⁰ recommend dipping the birds in a solution of sodium fluoride as follows: The dip is made in a tub in the proportion of one ounce of the commercial, or two-thirds of an ounce of chemically pure sodium fluoride to each gallon of water. The bird is held by the wings with one hand and submerged in the solution; the other hand is used to ruffle the feathers and wet the body. Finally, duck the head of the bird a few times, drain for a few seconds, and release. One pound of sodium fluoride will be enough to treat 300 hens when using the dip method.

As it is unsafe, to practice the dipping method except in warm weather, the "pinch" system of treatment with sodium fluoride is also used and gives excellent results. A pinch of sodium fluoride is taken between the thumb and forefinger and placed on all affected parts—under the wings, on the head, etc. The feathers are then ruffled through the fingers to spread the powder. The fowl may be placed in a shallow pan so that all surplus powder that may fall off in applying can be recovered. If many birds are to be treated one's eyes and nostrils should be protected for the drug is somewhat irritating. One pound of sodium fluoride will treat 100 birds when the pinch method is used.

Sodium fluoride may be diluted by mixing one part of the drug with four parts of talc, road dust, or other finely divided material. When so diluted it can be applied with a sifter-top can similar to one used as a salt shaker.

THE FOWL TICK.

The fowl tick, *Argas miniatus*, is not found in Kansas, since it is essentially a native of hot, arid or semiarid areas that have mild winters. In the United States its distribution is limited to an area from southwestern Texas, westward along the southern part of New Mexico, Arizona, and California. Occasionally it finds its way to more northern areas and may live for a short time, but seldom long enough to cause severe damages.

This tick passes part of its life on the fowl, feeding mainly at night when in the nymph stage, and living in crevices and cracks during the day. Unlike most other ticks, the adult female does not die after depositing its eggs, often laying as many as seven different deposits before death.

The fowl tick is most difficult to combat, and usually complete destruction of infested hen houses by burning is necessary to con-

20. Bishopp, F. C., and Wood, H. P. Mites and lice on poultry. U. S. Dept. of Agr. Farmers' Bull. 801: 1-26. Fig. 14. 1917.

trol an infestation.²¹ Birds should be moved to new places during the daytime, since the ticks are on the birds only at night.

POISONING.

Probably the most common form of poisoning in fowls is that due to common salt. Brines, salty dish water, or foods thrown away because they contain an excessive amount of salt, will often be the source of salt poisoning. Various sprays (Paris green, Bordeaux mixture, etc.) rat poisons, and rose chafers²² are other examples of poisoning materials often accessible to fowls. The use of metal drinking fountains for containers of medicated drinking water is always a source of danger, since many drugs have a chemical action on metals which results in the formation of poisonous compounds. Sour milk or buttermilk may have the same action if left for any length of time in tin or galvanized vessels.

Symptoms.—The sudden appearance of a large number of sick birds showing darkened combs, prostration, and wry neck, should lead one to think of poisoning. On post-mortem examination, erosions, a parboiled appearance of the inner surface of the crop, and a severe catarrhal or hemorrhagic enteritis are usually present. These findings, however, are not diagnostic since many diseases show similar lesions. In case poisoning results from rose chafers, these insects may be found in the intestinal tract, and, if death is caused by sprays some of the material may be found.

Treatment.—Treatment is seldom of any avail. Milk, lard, and other demulcent liquids are indicated, following a tablespoonful of castor oil. The birds should be enclosed in a small area until the source of the trouble is located and removed.

PARALYSIS OF DOMESTIC FOWLS.

This disease, of unknown origin, is prevalent in some parts of the country, but is fortunately not common in Kansas. During outbreaks there may be heavy losses. The disease is always fatal. The appearance may be sudden and the disease may appear year after year in the same flock. In other cases but few birds are affected. In some cases the disease follows the introduction of new birds into the flock while in others no apparent reason can be given for its appearance. Birds of all ages may be affected but the heaviest losses occur in birds of four to six months of age.

21. For further information on the control of the fowl tick consult: Bishop, F. C. The fowl tick. U. S. Dept. of Agri. Bureau of Entomology, Cir. 170: 1-14. Figs. 5. 1918.

22. Lamson, G. H., Jr. The poisonous effects of the rose chafer upon chickens. Science n. s., 48: 188-189. 1918.

Symptoms.—Paralysis of one or both legs is the most common symptom, although loss of use of the neck or wings may be noted'. The symptoms are sudden in their onset. The birds appear healthy, then suddenly become lame in one or both legs or lose control of the wings or neck. This is followed by complete loss of use of the legs and the bird becomes rapidly emaciated, following loss of appetite and diarrhea. Sometimes the bird loses control of the neck and there is sometimes paralysis of the eyes followed by blindness. The duration of the disease varies from a few days or a week or two to many weeks.

There are no characteristic post-mortem findings. In some cases the internal organs and digestive tract appear to be congested; in others the liver and kidneys appear pale and slightly enlarged. In the more acute cases the organs appear normal.

Treatment.—Treatment is useless. If the disease is causing losses the entire flock should be placed on the market and no new birds introduced into the old runs or buildings for at least a year. This necessitates abandoning the raising of poultry on the runs, and use of the buildings for poultry for that length of time. There must also be thorough cultivation of the ground and disinfection of all houses and utensils.

HEAT STROKE.

Overheating will often cause birds to fall over or walk with a staggering gait. Birds suffering from indigestion or other disturbances are more prone to the condition than are healthy individuals. Recovery generally occurs if the affected bird is removed to cool, comfortable quarters.

SOD DISEASE.²⁸

Sod disease, vesicular dermatitis, is commonly found in young chicks that have free range of heavy sod lands. It is characterized by a severe swelling of the feet, resembling bumblefoot to a certain extent, but usually spreading over the entire foot. It is thought to be caused by irritation of the part by the stiff sod, which paves the way for secondary infection by pus-producing organisms.

Treatment.—Remove the chicks from the sod runs until a few weeks old and treat each bird by removing any exudate present and applying tincture of iodine to the wound. Keeping chicks off heavy sod pastures until they are a few weeks old will do much in the way of prevention.

²⁸. Newson, I. E., and Feldman, W. H. Sod disease of chickens. Colo. Agr. Expt. Sta. Bul. 262: 1-12. Figs. 5. 1920.

LAMENESS (RHEUMATISM).

Lameness is a condition which is often associated with such diseases as tuberculosis and tapeworm infestation and may be considered a symptom and not a disease in itself. Poor housing and inadequate diet may cause lameness and swollen joints, and if a large number of birds become so affected, the ration and housing conditions should receive immediate attention in order to stop the condition as soon as possible. Lameness, resulting from infections or worms, is corrected by the elimination of the primary disturbance. Birds sometimes suffer from an infection of the joints or nerve sheaths and show symptoms similar to rheumatism in higher animals. Occasional infection of the joints by *Pasteurella avicida* (the organism causing cholera) will result in rheumatism. Birds suffering from rheumatism show signs of severe pain when handled. Proper housing conditions will do much to control this disease. Birds should not be subjected to sudden changes in temperature as will exist in drafty or poorly ventilated houses.

BUMBLEFOOT.

This is a suppurative disease of the foot of all domestic fowls, but found most often in the heavier breeds. It is characterized by a slow swelling of the foot that finally results in the formation of an abscess or a hard, tumor-like growth.

The common causes of the condition are jumping from high perches to hard cement floors; roosting on too narrow perches; continuous walking on bare cement floors; and any injury that will bruise the bottom of the foot.

Symptoms.—The condition is seldom seen in more than one or two birds at a time and then the first sign of the disease is a severe lameness. When the fowl is picked up, a hot, painful swelling is noticed on the ball of the foot and between the toes. Usually this is an abscess with a core-like center, although at times only a hard tumor-like growth is to be seen.

Treatment and Prevention.—Treatment usually involves surgery, and if the bird is worth the expense of an operation it should be taken to a veterinarian to be treated. Often, after the foot is lanced, it requires some time to heal the wound and the market is the best place to take an injured bird unless it is a valuable one.

Prevention consists in seeing that the roosts are not too high from the floor; that the perches are not too narrow; that plenty of

litter is kept on the floor; and that injuries from splinters, sharp stones, etc., are promptly cared for.

TUMORS.

Tumors in fowls are not common and usually do not cause any economic loss. Old birds are most liable to be so affected. Treatment of external tumors is surgical, while treatment of internal ones is generally impossible, since they are not discovered until the death of the bird.

VENT GLEET (INFLAMMATION OF CLOACA).

Vent gleet is thought to be an infectious venereal disease of fowls, but no definite causative organism has been found. It is thought that it is spread by coition, and is characterized by a congestion of the membrane of the posterior part of the cloaca and interior portion of the vent. The inflammation may extend into the oviduct and rectum.

Symptoms.— Severe irritation, frequent voiding of small stools, a watery discharge that soon becomes foul smelling, and a swollen and reddened area around the vent are diagnostic symptoms. The fowl will pick at the irritated surface, and other birds attracted by the discharge and reddened area will peck at the swollen area and cause ulceration. Death often results from the wounds thus caused. Egg production in a flock suffering from vent gleet falls off materially, and the fertility of the eggs is lessened.

Treatment.— Isolate the affected birds, clean the external parts affected, clip the feathers around the vent, and break away all scabs. Then smear zinc oxide or mercurial ointment both on the external and internal surfaces. The cloaca can easily be reached by passing the finger through the vent. Male birds should be isolated as soon as vent gleet appears in the flock to prevent spreading of the disease by coition. Thorough disinfection should also be practiced.

CROP BOUND (IMPACTION OF THE CROP).

Continued feeding of dry grains, paralysis by irritating drugs, or the presence of foreign bodies often cause fowls to become crop bound. The first symptom noticed is an enlargement of the crop, which upon examination, will be found to be filled with a hard mass of food. If the condition is not relieved, pressure on the trachea (wind pipe) may cut off the air supply and cause suffocation. After passing water into the impacted crop (fig. 21), massage toward the head. This will often relieve the condition by forcing the food out

of the mouth. If this does not suffice, the crop should be opened by making an incision in the upper part of the organ. The contents may then be removed, and the wound sutured with ordinary linen thread which has been dipped in tincture of iodine. The walls of the crop should be sutured separately from the skin, and extreme care taken to use disinfected instruments in performing this operation. If a veterinarian is available and the bird is a valuable one it will pay to take it to him for treatment.

EGG BOUND.

This condition is often seen in pullets, but also is found in old hens due to attempts at passing malformed and double yolked eggs. In young birds, inflammation of the oviduct or production of too large eggs, tends to cause the retention of eggs in the oviduct.

Symptoms.—Listlessness, frequent attempts to lay, and often a prolapse of the cloaca and oviduct characterize the disease. In extreme cases the bird may assume a penguin-like posture. Symptoms described under prolapse of the oviduct follow the eversion of the organ. Often the cannibalistic habits of the other birds described under vent gleet develop, and in such cases the affected bird may die from injuries sustained.

Treatment.—Ward and Gallagher²⁴ prescribe the following procedure to remove a retained egg: Have an assistant hold the bird with her back downward while operator passes his forefinger through the vent and into the oviduct until the egg is felt. With the fingers of his other hand, pressing on the external wall of the abdomen the egg is forced outward, being guided by the inserted forefinger. When the shell is visible it should be punctured with a sharp-pointed knife and broken into pieces with a pair of forceps or the hands, and the pieces removed. The patient should be isolated and injections of cold water forced into the inflamed areas two or three times daily. Greasing or oiling the parts previous to treatment will aid in the removing of the egg.

PROLAPSE OF OVIDUCT.

Following "egg bound" conditions, the oviduct often becomes highly congested and, along with the cloaca, is everted through the vent. Often, if the affected fowl is not rescued as soon as the abnormality results, other birds will pick at the prolapsed portion and even pull it away and devour it.

24. Ward, R. A., and Gallagher, B. A. Diseases of domesticated birds. 338 pp. Fig. 69. The Macmillan Company, New York. 1922. (Reference, page 165.)

Treatment. — Isolate the bird, grease the oviduct with a bland oil, and explore it to determine if possible the cause. If a retained egg is present it should be removed. The prolapsed organ should then be returned carefully through the vent, and when in place cold water should be injected to relieve the congestion and cause the walls to contract. Treatment may have to be repeated several times before the bird is cured.

FROZEN COMB AND WATTLES.

When these appendages of the head become frozen, they should be thawed out by smearing with vaseline and rubbing with the fingers. If the injury is too bad, removal of the wattles and comb may be necessary.

WOUNDS AND FRACTURES.

Wounds result from ravages by dogs, by beasts of prey, by fighting, and by intentional abuse by the owner or assistants. Treatment consists in clipping the feathers from the injured area, washing with a 2 per cent solution of compound cresol and applying a dusting powder. Hemorrhages can usually be stopped by packing the wound with pledgets of cotton, since a fowl's blood clots very quickly. Wind puffs resulting from caponizing can be corrected to some extent by pricking the skin to allow air to escape. It may be necessary to repeat this two or three times.

Unless the bird is a valuable one a broken bone should not be treated, but the bird butchered. Fractures heal readily and if a leg bone of a valuable bird is broken it will pay to set it. Splints should be made to fit the leg, and these should be left in place for a week.

VICIOUS HABITS.

Toe Pecking. — Toe pecking is most commonly seen in brooder chicks and is a habit acquired by the chicks pecking at the feet of their mates, often resulting in blood being drawn. Once the chicks get the taste of blood the habit is strengthened and the weakling of the flock usually suffers most. Often the rest of the chicks will suffer the same abuse and large losses may result.

The correction of this habit is brought about by isolation of the offenders and the removal of injured birds until they are cured. Food hung above the chicks' heads gives them something to divert their attention, and will help to keep them from picking at objects on the ground.

Egg Eating. — Egg eating is a habit that is started by the birds' getting a taste of eggs that have been broken. The offenders can

usually be picked out by their yolk-stained beaks and should be killed or at least isolated from the flock.

Oyster shells should be kept before the birds continually so that they will not have a chance to get a craving for lime. Darkened nests that have plenty of straw in them aid in controlling this habit, both by making broken eggs hard to be seen and decreasing the chance of breaking the eggs.

Feather Pulling.—Birds do not mind having their feathers pulled and even seem to like the sensation. Consequently a bird that gets such a habit is not induced to stop by the actions of the offended, and once an offender gets the taste of blood that is on a pulled feather the habit becomes a vicious one. Parasites of the skin may cause itching which will lead the bird to become a feather puller. Itching following molting, and monotonous diets are other factors leading to the feather-pulling habit.

If the cause of feather pulling is a result of an infestation or a faulty diet, these factors should be corrected. If it is simply a habit with a few individual birds, the offenders should be got rid of. Plenty of exercise and green feed may help to correct the habit. Klee²⁵ reports that blood in a cooked form mixed with bran and curd aids in satisfying the craving for blood which is often the cause of birds pulling feathers.

SOME THINGS WHICH KILL YOUNG CHICKS.

1. **Filthy Runs.**—Runs that are muddy and foul will weaken chicks. Such runs are also likely to harbor eggs of worms and other internal parasites and disease-producing bacteria. All runs should be well drained, cleaned frequently, limed, and seeded thickly to oats. Chicks should be kept away from stagnant ponds, pig pens, and old manure heaps.

2. **Lice and Mites.**—These vermin should be removed as previously described.

3. **Lack of Ventilation.**—Impure and moist air is very dangerous to chicks. Runs, brooders, and houses should be well ventilated and exposed to the sunshine.

4. **Drafts.**—Proper ventilation without drafts is absolutely essential to the successful raising of young chicks.

5. **Dampness.**—There are several sources of dampness in runs and brooders. The dampness may be due to improper construction

25. Ward and Gallagher (loc. cit.), p. 177.

and drainage of the floors, moisture from the breath and excrement of the chicks, leaking and upset drinking fountains, etc.

6. **Lack of Sunlight.**—Sunlight has been found to be of great value as a disinfectant. It is also of value in preventing the development of leg weakness in chicks. However, chicks should not be exposed to the direct rays of the summer sun, but should be furnished shade to seek as they desire.

7. **Overcrowding.**—Chicks grow very rapidly and thus must be given floor space according to size and age. Overcrowding makes chicks unthrifty and some of the weaker ones obtain very little to eat in crowded runs. Close contact also makes the spreading of disease, lice, and worms an easy matter.

8. **Variation in Temperature.**—Chicks require a steady, even heat in the brooder; but they also require a cooler place to which they can move if they desire.

9. **Lack of Pure Water.**—The body of the chick is 55 per cent water, this being lost constantly through the droppings and through the respiratory tract. For this reason birds require large amounts of drinking water. They will not drink the necessary amount, however, if it is filthy. Water should be offered in such a manner that the chicks cannot get into the fountain with their feet and thus contaminate it with intestinal contents.

10. **Spoiled Feed.**—No moldy or tainted feed of any kind should be fed to chickens. Many cases of brooder pneumonia, limberneck, and bowel trouble are traced to spoiled feeds. Feed only clean, pure feeds.

11. **Improper and Inadequate Feeding.**—Aside from the troubles due to feeding spoiled feeds there may arise diseases due to lack of certain elements in the feed. The feed not only must be balanced, as to the proper amounts of protein, carbohydrates, fats, and ash but must also contain certain vitamins. The most important of these for young chicks appears to be the Vitamin D. The lack of this vitamin leads to leg weakness. This may be controlled by the introduction of cod liver oil or by proper exposure to the sun's rays.

Chicks should not be fed too soon after hatching. About the 19th day of incubation the chick takes into its body the residue of the egg. This supplies sufficient food for the first two or three days after hatching. Chicks should not be fed for the first two days after hatching and then in small amounts. Young chicks should be fed

sparingly but often throughout the day, and enough to fill the crop before roosting time. However, it should be kept in mind that the chick grows very rapidly and the amount of feed given should be increased from day to day. Too heavy feeding of cracked corn or corn meal will cause bowel trouble due to fermentation. Wilted or spoiled green feed should never be given. Sour milk contains lactic acid, that seems to control intestinal fermentation, and is an excellent feed for young chicks.

12. **Suffocation.**—Chicks raised in brooder houses that are cold and damp, crowd together and have a general tendency to pile up, each one trying to get to the center of the pile. It is usually the strongest chicks that succeed in getting to the center and then the owner wonders why the most vigorous chicks suffocate. It is simply because they are the strongest and can fight their way to the warmest place and then have not the strength to get out. Sometimes a similar condition results when only a small spot of the brooder house is flooded with sunlight. The chicks all try to crowd in this small area, which will often result in one or two chicks becoming smothered. Evenly heated brooder houses and the training of chicks to go to the hover when cold, will do much to correct losses from suffocation.

13. **Diarrhea Other than Bacillary White Diarrhea.**—Young chicks often suffer from diarrheas that are not of an infectious nature. Among the causes of such diarrheas are: (1) Overheated or underheated brooder houses, (2) very fine sand (sand scours), (3) sudden chilling, and (4) improper diet. Correction of the condition causing the diarrhea will usually prevent a spread of the disease.

APPENDIX.

USEFUL INFORMATION.

Approximate Equivalents.

- 60 grains = 1 dram = 4 grams = $\frac{1}{8}$ ounce.
- 8 drams = 1 ounce = 30 grams.
- 12 ounces = 1 pound (apothecaries') = 372 grams.
- 16 ounces = 1 pound (avoirdupois) = 453 grams.
- 1 level teaspoonful of copper sulphate = 9 grams.
- 1 level teaspoonful of crude catechu = 3 grams.
- 1 level teaspoonful of copperas = 8 grams.
- 1 level teaspoonful of nux vomica = 2.5 grams.
- 1 level teaspoonful of potassium permanganate = 11 grams.
- 1 level teaspoonful of Epsom salts = 8 grams.
- 1 gram of potassium permanganate = Amount that will stay on a five-cent piece.

-
- 60 minims = 60 drops = 1 fluid dram, = 4 c. c.
 - 8 fluid drams = 1 fluid ounce = 30 c. c.
 - 16 fluid ounces = 1 pint = 500 c. c.
 - 8 pints = 1 gallon = 4,000 c. c.

-
- 1 teaspoonful = 1 fluid dram = 4 c. c.
 - 1 dessertspoonful = $2\frac{1}{2}$ fluid drams = 10 c. c.
 - 1 tablespoonful = 4 fluid drams = 16 c. c.
 - 1 teacupful = 4 fluid ounces = 120 c. c.

Percentage Solutions.

To estimate the weight of a drug required to make a solution of a definite percentage multiply the weight of the solvent by the per cent desired.

Table of Solutions.

1 fluid ounce of water.....	30 grams.
To make 1 fluid ounce of a 1 to 1,000 (0.1 per cent) solution add..	.03 grams.
To make 1 fluid ounce of a 1 to 500 (0.2 per cent) solution add..	.06 grams.
To make 1 fluid ounce of a 1 to 250 (0.4 per cent) solution add..	0.12 grams.
To make 1 fluid ounce of a 1 to 200 (0.5 per cent) solution add..	0.15 grams.
To make 1 fluid ounce of a 1 to 100 (1 per cent) solution add..	0.3 grams.
To make 1 fluid ounce of a 1 to 50 (2 per cent) solution add..	0.6 grams.
To make 1 fluid ounce of a 1 to 20 (5 per cent) solution add..	1.5 grams.
To make 1 fluid ounce of a 1 to 10 (10 per cent) solution add..	3.0 grams.

To make one quart of any of the above percentage solutions, multiply the amount required for one fluid ounce by 32.

To make one gallon of any of the above percentage solutions, multiply the amount required for one fluid ounce by 128.

To make one gallon of wine-colored potassium permanganate solution add one gram (the amount which will stay on a five-cent piece conveniently).

A Disinfectant Whitewash.

The following formula is one that is recommended for preparing a white-wash that has a disinfectant value in addition to its other properties:

- (1) Hydrated lime²⁶..... 1½ pecks.
- (2) Salt 2 pounds.
- (3) Commercial lime-sulphur dip..... 4 gallons.
- (4) Water 40 gallons.

Equivalent amounts for a small quantity of the above whitewash are approximately as follows:

- (1) Hydrated lime 1 heaping quart.
- (2) Salt 3 tablespoonfuls.
- (3) Commercial lime-sulphur..... 1½ quarts.
- (4) Water 4 gallons.

Alum added to a lime whitewash lends adhesiveness. An ounce to the gallon is sufficient. A pound of cheap bar soap dissolved in a gallon of boiling water, then added to about five gallons of boiling water, and it in turn added to about five gallons of thick whitewash will give it a gloss like oil paint. Two applications should be made each year, one each in the fall and spring. To insure penetration in cracks and crevices, the operation is preferably done with a high-pressure spray pump.

Kerosene Emulsion.

Shave one-half pound of hard laundry soap into one-half gallon of soft water and boil the mixture until all the soap is dissolved. Remove it to a safe distance from the fire and stir into it, while still hot, two gallons of kerosene. This makes a thick creamy emulsion which may be used as a stock solution. When used for killing mites it should be mixed as follows: To one quart of this emulsion add nine quarts of water.

The emulsion can readily be converted into a disinfectant by stirring well and adding one pint of crude cresol or crude carbolic acid to the total amount of stock mixture. This should then be stirred until it is well mixed.

Tonics Suggested for Prevention of Blackhead in Turkeys.

The following tonics have been suggested for use during the critical period of the life of the bird "shooting the red," or for any period of the life of the bird when it shows bowel trouble or sluggishness:

- 1 pound ginger.
- ¼ pound salicylate of soda.
- ¼ pound powdered gum camphor.
- 1 teaspoonful turpentine.
- ½ pound sulphate of iron (powdered).

Moisten with water and roll into pills about the size of a small marble. For mature birds give three pills daily and to poults in proportion to size. This tonic may be added to sweet milk and fed in that way.

Another tonic that has been highly recommended is as follows:

- 3 ounces powdered cassia bark.
- 1 ounce powdered gentian.
- 10 ounces powdered ginger.
- 1 ounce powdered aniseed.
- 5 ounces carbonate of iron.

Mix ingredients well, and for six birds, four weeks of age, mix one level tea-spoonful in water and use to moisten the mash. Distribute the mash as evenly as possible for feeding.

The above tonics may also be used to advantage in outbreaks of other diseases. In such cases they should be given to the healthy birds during an outbreak to aid in stimulating the appetite.

26. The carbide waste from acetylene tanks can, if available, be substituted for the hydrated lime.

Medicated Vaseline.

Vaseline 2 ounces.
Crude carbolic acid..... 1 teaspoonful.

Mix well before applying and use for wounds, etc.

Dosage Table for Adult Fowls.

<i>Drug.</i>	<i>Therapeutic Dose.</i>	<i>Nontoxic Dose.</i>	<i>Toxic Dose.</i>
Ammonium carbonate.....	10 to 15 gr.	20 gr.	
Areca nut (powdered).....	3 to 4 gr.	5 to 10 gr.	
Arecoline hydrobromide.....	0.1 gr.		
Calomel.....	5.0 gr.	30 gr.	
Capsicum.....	1 to 4 gr.	5 gr.	
Carbolic acid.....	0.5 gr.	2 gr. in sol.	5 gr. in sol.
Calcium phosphate, ppt.....	15 gr.	30 gr.	1.25 dr.
Castor oil.....	1 dr.	6½ dr.	
Charcoal.....	5 gr.	10 gr.	
Chenopodium (oil of).....	5 minims.		
Cod liver oil.....	1 per cent of ration.	5 per cent of ration.	
Cottonseed oil.....	1 dr.	143 c.c. of 1 to 500 sol.	
Catechu (powdered).....	2 to 5 gr.		
Catechu (tincture of).....	2 to 5 minims.		
Copper sulfate.....	1 to 2 gr.	3 to 10 gr.	15 gr.
Copperas.....	10 to 20 gr.	30 gr.	
Digitalis (fluid extract).....	10 to 20 minims.	20 minims.	
Epsom salts.....	1 dram.		
Gentian.....	10 gr.	2 dr.	1 ounce.
Ginger.....	15 gr.	5 dr.	
Ipecac (powdered).....	0.5 dr.	0.75 dr.	1 dr.
Ipecac (fluid extract).....	0.5 dr.	0.75 dr.	1 dr.
Linseed oil (raw).....	1 dr.		
Mustard.....	5 to 7 gr.	10 gr.	
Nux vomica (powdered).....	10 to 15 gr.	2 dr.	1 ounce.
Potassium permanganate.....	2 to 6 gr.	15 gr.	30 gr.
Quinine sulfate.....	2 to 3 gr.		
Salicylic acid.....	1 to 5 gr.	5 to 15 gr.	30 gr.
Santonin.....	0.5 to 2 gr.	5 to 15 gr.	
Sodium chloride (common salt).....	5 gr.	¼ to 1¼ dr.	2½ dr.
Strychnine sulfate.....	0.25 to 0.5 gr.	2 gr.	3 gr.
Sulphocarbonate of calcium.....	¼ to ½ gr.		
Sulphocarbonate of sodium.....	¼ to ½ gr.		
Sulphocarbonate of zinc.....	¼ to ½ gr.		
Turpentine.....	0.5 dr.	2½ dr.	
Thymol.....	1 gr.	3 gr.	

NOTE.—The figures in this tabulation are for the average adult fowl, and should be varied according to age and size.

Normal Temperatures of Poultry.

Hen	104.0 to 107.6° F.
Turkey	104.0 to 106.7° F.
Duck	105.8 to 109.4° F.
Goose	104.0 to 105.8° F.

**QUESTIONNAIRE ON INFORMATION DESIRED WHEN WRITING ABOUT
POULTRY DISEASES.**

Below are listed some questions that should be answered when writing to the Department of Bacteriology for information regarding poultry diseases. Not all of these need be answered in every letter, but they should be looked over carefully to see which ones fit the case in question.

1. How many chickens have you in your flock? How many are affected? How many have died?
2. When was the disease first noticed?
3. Of what age are the fowls affected?
4. Have you ever had disease in your flock?
5. If so, was it of the same nature?

6. What are the symptoms? See "Scheme to Aid in the Diagnosis of Poultry Diseases," page 18.
7. Do all the birds seem to be suffering from the same disease?
8. Do the birds have lice? Mites?
9. Have you ever had worms in your flock?
10. Are the birds too fat? Do they get plenty of exercise.
11. When you autopsied a bird did you find anything abnormal? See, "Post-mortem Examination," page 24, chart on page 18.
12. Were there any worms in the intestinal tract? If so were they flat (tapes) or round, and in what part of the intestinal tract were they found?
13. How have you been feeding the flock?
14. Are they getting plenty of green feed?
15. Have you thrown any spoiled food into the chicken lots?
16. Do the birds have access to the dish water and waste from the kitchen? To spraying materials? Paints?
17. Do these waste products contain an excess of salt or soap?
18. Have you fed the birds spoiled ensilage?
19. Are there any dead carcasses on the range?
20. Do you keep fresh water before the birds?
21. Do you use metal, wooden, or crockery drinking fountains?
22. When were the water containers last cleaned and disinfected?
23. Do you put any antiseptic in the drinking water during an outbreak of disease?
24. Do the birds have free range?
25. What is the nature of the runs?
26. Are there any undrained pools or stagnant bodies of water near the poultry houses?
27. Are the houses well ventilated, dry, and without drafts?
28. Have they been cleaned and disinfected since the disease started?

INFORMATION CONCERNING THE AGGLUTINATION TEST FOR CARRIERS OF SALMONELLA PULLORA (THE MICROORGANISM CAUSING BACILLARY WHITE DIARRHEA).

All breeders interested in this test should write to the laboratory for information about the proper time to ship blood for testing. It is necessary to do this to avoid congestion, due to limited facilities for making the test. When writing to the laboratory for such information the following questions should be answered: (1) Number of birds to be tested. Breed? (2) What success did you have with your hatching the past season? (3) Did any of your chicks develop white diarrhea after hatching? (4) When will you want the test made?

The flock should be tested as early as possible after the laying season and before the breeding season so as to avoid the reduction of the egg production due to bleeding. Below are given directions for bleeding chickens for the agglutination test. Whenever possible a veterinarian should be obtained to take the samples. It is very essential that every precaution be followed very carefully. Unless blood reaches the laboratory in a good condition it will be impossible to use it for making the test.

Equipment.

The following special articles of equipment (fig. 24) are necessary for drawing blood for the tests:

1. Small sharp-pointed scalpel (D) or knife.
2. Legbands (B) for each fowl to be tested.
3. One dram homeopathic, or shell vials (C and E), for collecting samples.
4. Corks to fit, and labels (A) for marking.
5. Clean towel or piece of cloth for cleaning instruments, before proceeding with the next bird.

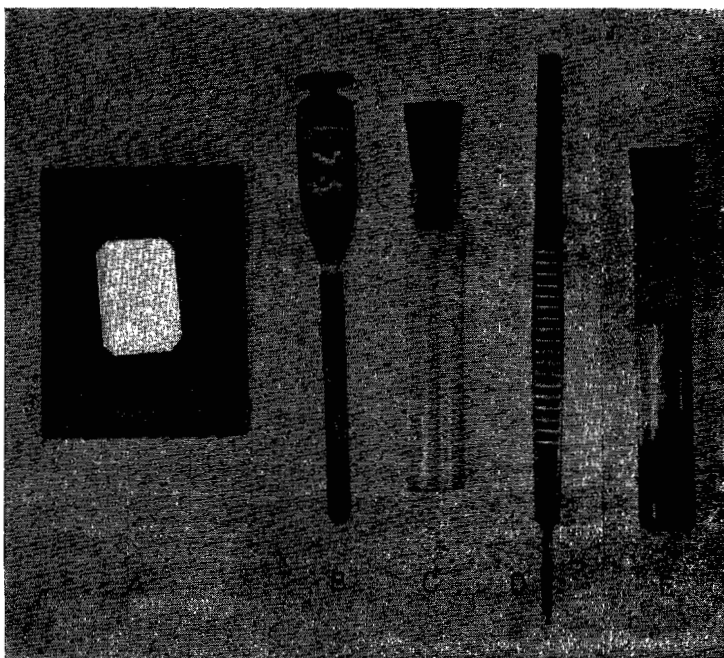


FIG. 24.—Equipment necessary for drawing blood for white diarrhea tests. (A) Gummed labels. (B) Legband. (C) Vial for receiving blood. (D) Scalpel for puncturing wing vein. (E) Vial ready for shipment.

Procedure.

1. Catch each bird and mark with a legband bearing a number.
2. Hold the fowl in a convenient position to permit spreading of one wing and exposure of the wing veins. A good way to do this is to hold the bird against the left side of the body (fig. 25 A) and use the left hand to spread the right wing full width and in a vertical position as indicated in figure 25 B and C.
3. Pull a few feathers in the region of the first wing joint to expose the skin over the vein. (It is not necessary to disinfect the area.)
4. Puncture the vein with a quick movement of some sharp instrument. (Fig. 25 B.) (The cut should be lengthwise and not across the vein.)

POULTRY DISEASES.



FIG. 25.—Pictures illustrating method of bleeding birds for white diarrhea test. (A) Method of holding bird. (B) Method of puncturing wing vein. (C) Method of collecting blood in vial.

5. Collect the blood, immediately in the vial. (Fig. 25 C.) *Fill at least one-half full.* Cork tightly and label with the legband number. (Fig. 24 E.) An indelible pencil is more efficient for this than a fountain pen, since ink may blur. *Be sure to write figures plainly and correctly.*

6. Place the vial flat on its side and allow the blood to clot. (Fig. 24 E.)

7. Press the vein tightly with the fingers or pull a few of the downy feathers and pack them over the wound if bleeding does not stop immediately.

8. Store the vials in a cool place such as a refrigerator, *but do not allow the blood to freeze.*

Precautions.

1. Withhold food for 18 to 36 hours before bleeding.

2. Use clean *dry* sterile vials for collecting blood. (Sterilize by placing both corks and vials in boiling water for 10 minutes. Dry in a hot oven.)

3. Have the skin dry at the time of taking the blood.

4. Wipe the scapel knife thoroughly after each sample is taken.

5. Do not place blood samples in the sun. They must be kept cool to prevent spoilage.

6. Do not allow blood to freeze. It is better not to bleed in freezing weather. Frozen blood hemolyzes and cannot be used for the test.

7. Do not let water come in contact with the blood. It has the same effect as freezing.

8. Avoid the use of disinfectants for preservation of the blood.

9. Collect plenty of blood.

10. Ship samples immediately after collection.

Delivery to Laboratory.

1. Pack samples securely; and ship *immediately* after bleeding. Ship by parcel post, *special delivery*. Blood frozen en route, or delayed for any length of time in warm weather, cannot be used for testing.

2. Address plainly to Department of Bacteriology, Kansas State Agricultural College, Manhattan, Kansas. Mark your own address on the package.

3. At the same time address a letter in the same way, stating the number and character of samples and the test desired.

