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# POULTRY DISEASES, THEIR PREVENTION AND CONTROL

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# POULTRY DISEASES, THEIR PREVENTION AND CONTROL[1]

L. D. BUSHNELL AND C. A. BRANDLY

## 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.

Although there is great individual variation among the 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 ten 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.

Forcing birds for increased production lowers their resistance to attacks of parasites of all kinds. Ease of transportation and the common practice in these days of transporting large numbers of birds in the regular avenues of the poultry industry are also important factors in the dissemination of disease. The fight against

**Acknowledgements**—This bulletin is a revision of Circular 106 of the Agricultural Experiment Station, "The Prevention and Control of Poultry Diseases." The authors take pleasure in acknowledging the assistance of Drs. J. G. Jackley, F. R. Beaudette, and W. R. Hinshaw in collecting some of the information. Special credit is due Dr. W. R. Hinshaw for his exhaustive studies on bacillary white diarrhea.

1. Contribution No. 104 from the Department of Bacteriology.

parasites must be carried on more vigorously and successfully if poultry diseases do not greatly handicap poultry husbandry as a profitable industry.

Kansas ranks seventh in number of fowls raised, and ninth in poultry products sold. In 1927, $25,989,400 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 six 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 bulletin 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. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May. | Jun. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Total. |
| 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 1.

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.

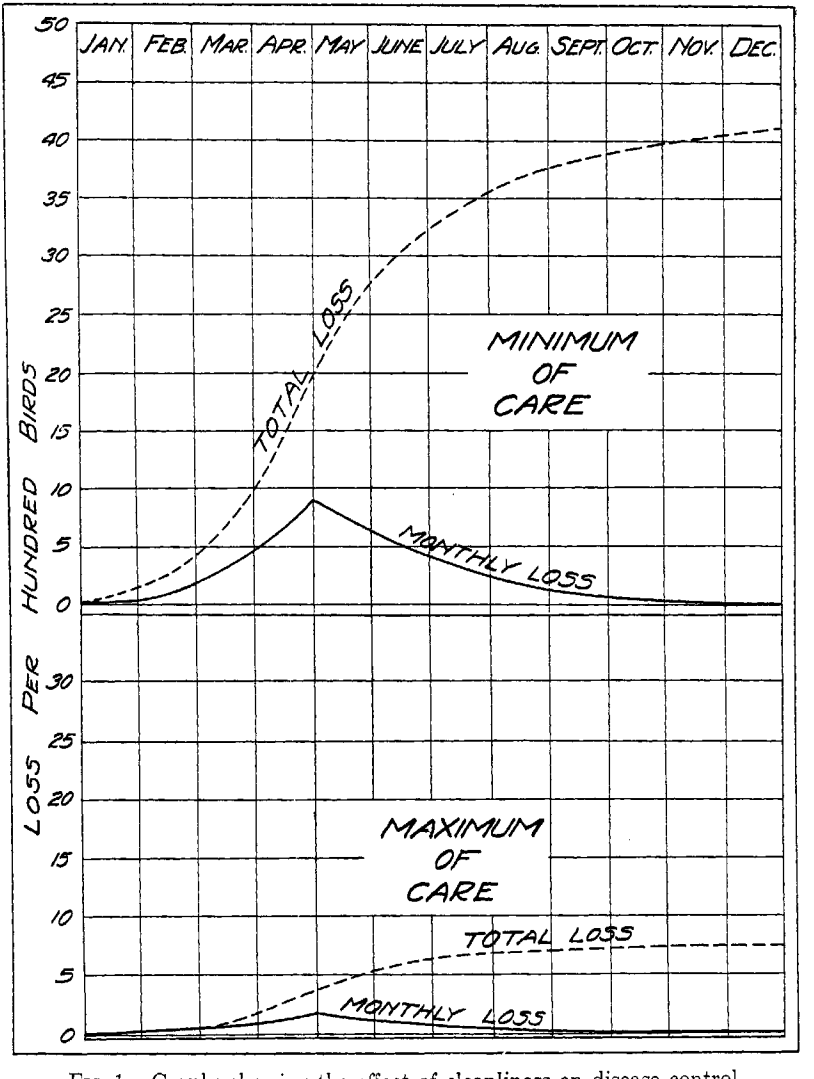


FIG. 1.—Graphs showing the effect of cleanliness on disease control.

## 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 will adhere to the point of a pin will 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 often 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.[2] 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 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

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.

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 deeply. It should never be thrown on the manure heap.

## DISINFECTANTS AND INSECTICIDES[3]

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 and because it loses strength very quickly in contact, with organic matter. Formalin in a 2 per cent solution is very good but is 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.

In poultry feeding and packing plants the hypochlorites are superior to other disinfectants because the odors do not taint the flesh of

3. Dorset M. Some common disinfectants. U.S. Dept. of Agr. Farmers' Bul. 926:1-1!2. 1918.

the birds as do the coal tar products. These products are sometimes loosely termed "chloride of lime" and should contain 30 per cent available chlorine. Such material should be used in proportion of 1 pound to 3 gallons of water.

At this laboratory many of the trade-preparation disinfectants have been tested and usually the phenol coefficient (value compared with carbolic acid) as given by the manufacturers is not far from correct. A disinfectant with a phenol 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 higher coefficient is the more 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.[4]

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 immediately burn or bury deeply. This is not only cheaper, but it often removes a serious source of infection from the premises.

Isolation means complete separation of the sick from the well

4. See appendix, page 100.

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

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 outbreaks of disease 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 bacillary white diarrhea. If eggs are purchased, the chicks hatching from these should be kept by themselves for several days to avoid introducing bacillary 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,[7] but a few of the important essentials

6. For reliable and detailed information on any phase of poultrymanagement the reader is referred to W. A. Lippincott's textbook on "Poultry Production." Fourth edition. 602 pages. 205 illustrations. 2 color plates. Published by Lea and Febiger, Philadelphia, 1927.

7. Klein, G. T., and Ward, Walter G. Poultry houses and equipment for Kansas. K. S. A. C. Extension Bul. 60:1-24. figs. 24. 1929.

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.**—On the farm 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 to 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 toward which to work 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.

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8. King, F. H. Physics of agriculture. (Second edition.) 1901. p. 353.

Where it is impossible to rotate runs and cement runs are too expensive, a layer of three inches of coarse gravel should cover the entire yard and great care should be exercised to avoid mud holes and wet spots where coccidia and worm eggs remain viable for long periods of time.

**Utensils.** — The essentials of good feed and water utensils, when 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 utensils 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, feed and air, 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, undersized, 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 inclosed 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.

Kansas poultrymen interested in poultry improvement should write the Department of Poultry Husbandry of the Agricultural Experiment Station for the program of improvement recommended by the Kansas Poultry Improvement Association.

## 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 has been had but a short time.

## 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.

## ANALYSIS OF CASES OF POULTRY DISEASES AS DETERMINED BY LABORATORY DIAGNOSIS

Table II gives the laboratory diagnosis on birds sent to this laboratory from various parts of the state. The period covered in collecting the data was nine years and nine months and the total number of birds examined, 16,322 from 7,886 distinct outbreaks. The distribution of the most common outbreaks is shown in figure 2.

The common diseases have been listed and under "miscellaneous" are included those cases which could not be diagnosed, and many which are not common, such as injuries, abscesses, obesity, scabies, pneumonia, vent gleet, and miscellaneous chick troubles, many of which were probably not of an infectious nature. In this table ophthalmia includes such diseases as are commonly diagnosed as roup. The disease bacillary white diarrhea has been considered under two heads, that of chicks and that of adult birds found to be infected. The term rickets is limited to the trouble in chicks due to deficiency of vitamin D.

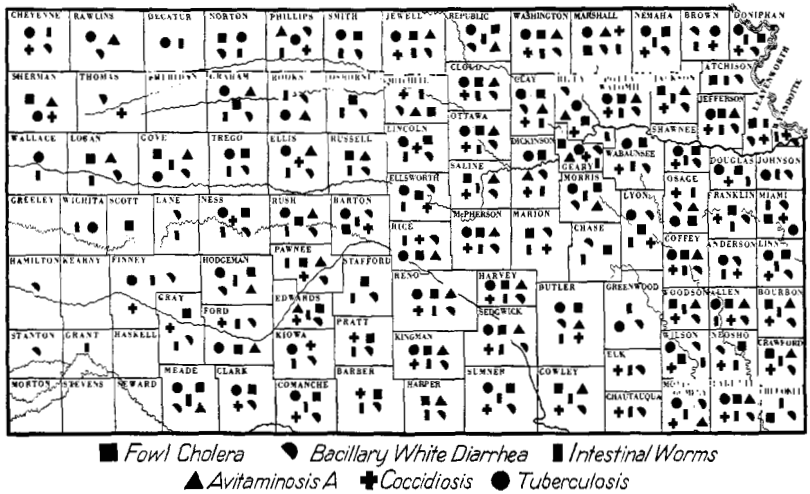


FIG. 2.—Map of Kansas showing the distribution of outbreaks of fowl cholera, bacillary white diarrhea, intestinal worms, avitaminosis A, coccidiosis, and tuberculosis.

TABLE II.—LABORATORY DIAGNOSIS ON COMMON DISEASES OF THE FOWL.

July 1, 1919, to March 31, 1920.

| DISEASE. | Number of outbreaks. |
|---|---|
| Worms (intestinal): | |
| Small round (*Heterakis papillosa*) | 837 |
| Large round (*Ascaridia infiera*) | 872 |
| Tapeworms (all kinds) | 693 |
| Gizzard worms | 81 |
| Bacillary white diarrhea of chicks | 821 |
| Bacillary white diarrhea of adults | 118 |
| Fowl cholera | 469 |
| Fowl typhoid | 257 |
| Coccidiosis | 419 |
| Tuberculosis | 238 |
| Opthalmia | 281 |
| Nutritional disease (avitaminosis A) | 270 |
| Ruptured ova | 248 |
| Diphtheria | 167 |
| Tracheitis ("roup") | 158 |
| Botulism | 108 |
| Tumors | 126 |
| Contagious epithelioma (pox) | 74 |
| Paralysis | 89 |
| Avitaminosis D (rickets) | 53 |
| Blackhead | 43 |
| Air sac mites | 36 |
| Scaly leg | 19 |
| Sod disease | 13 |
| Miscellaneous | 1,366 |
| Total number of outbreaks | 7,886 |
| Total number of birds examined | 16,322 |

Table III shows the seasonal distribution of some of the more common diseases of poultry. By a careful study of such figures it is sometimes possible to come to a much more accurate diagnosis than otherwise. This is especially valuable in the field where microscopic and cultural methods are not available. The data from which this table was compiled have been collected over a period of several years at this station. The graphs in figure 3 were plotted from the figures in Table III.

TABLE III.—MONTHLY SUMMARY OF 4,091 OUTBREAKS OF POULTRY DISEASES IN KANSAS.

| Disease. | Number of— | | | Distribution by months. | | | | | | | | | | | | Totals. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Counties (a). | Years. | | Jan. | Feb. | Mar. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | |
| Fowl Cholera | 78 | 6½ | Number | 54 | 61 | 51 | 20 | 20 | 7 | 21 | 16 | 16 | 21 | 32 | 36 | 355 |
| | | | Per cent. | 14.6 | 17.1 | 14.3 | 5.6 | 5.6 | 1.9 | 5.9 | 4.5 | 4.5 | 5.9 | 9.0 | 10.0 | |
| Fowl Typhoid | 53 | 8½ | Number | 11 | 8 | 16 | 11 | 19 | 25 | 26 | 28 | 21 | 22 | 15 | 5 | 237 |
| | | | Per cent. | 5.3 | 3.8 | 7.7 | 5.3 | 9.1 | 12.0 | 12.5 | 13.5 | 10.1 | 10.6 | 7.2 | 2.4 | |
| Botulism | 28 | 6½ | Number | 0 | 0 | 0 | 2 | 3 | 15 | 25 | 21 | 16 | 5 | 4 | 0 | 91 |
| | | | Per cent. | 0 | 0 | 0 | 2.2 | 3.3 | 16.4 | 27.4 | 23.0 | 17.5 | 5.5 | 4.4 | 0 | |
| Blackhead | 19 | 14½ | Number | 2 | 1 | 0 | 4 | 6 | 8 | 12 | 1 | 7 | 19 | 7 | 2 | 69 |
| | | | Per cent. | 2.8 | 1.4 | 0 | 5.8 | 8.7 | 11.5 | 17.4 | 1.4 | 10.1 | 27.3 | 10.1 | 2.9 | |
| Avitaminosis A | 50 | 6½ | Number | 7 | 18 | 36 | 38 | 30 | 14 | 14 | 5 | 1 | 2 | 2 | 3 | 170 |
| | | | Per cent. | 4.1 | 10.5 | 21.1 | 22.3 | 17.6 | 8.2 | 8.2 | 2.9 | 0.5 | 1.1 | 1.1 | 1.7 | |
| Tuberculosis | 66 | 14½ | Number | 19 | 19 | 24 | 25 | 27 | 20 | 13 | 12 | 11 | 11 | 18 | 17 | 216 |
| | | | Per cent. | 8.8 | 8.8 | 11.1 | 11.5 | 12.5 | 9.2 | 6.0 | 5.5 | 5.0 | 5.0 | 8.3 | 7.8 | |
| Worm infestations | 87 | 14½ | Number | 105 | 74 | 78 | 57 | 117 | 147 | 230 | 238 | 257 | 216 | 166 | 152 | 1,837 |
| | | | Per cent. | 5.7 | 4.0 | 4.2 | 3.1 | 6.3 | 7.4 | 12.5 | 12.9 | 13.6 | 11.2 | 9.0 | 8.2 | |
| Bacillary White Diarrhea | 92 | 14½ | Number | 3 | 51 | 190 | 232 | 225 | 54 | 14 | 7 | 2 | 1 | 1 | 2 | 782 |
| | | | Per cent. | 0.3 | 6.6 | 24.3 | 29.6 | 28.7 | 6.9 | 1.9 | 0.9 | 0.2 | 0.1 | 0.1 | 0.2 | |
| Coccidiosis | 75 | 6½ | Number | 2 | 5 | 25 | 65 | 117 | 88 | 38 | 17 | 5 | 0 | 1 | 1 | 364 |
| | | | Per cent. | 0.5 | 1.3 | 6.8 | 17.8 | 32.1 | 24.1 | 10.4 | 4.6 | 1.3 | 0 | 0.2 | 0.2 | |

(a) There are 105 counties in Kansas.

**Note.**—See figures 2 and 3 for a graphic representation of these data.

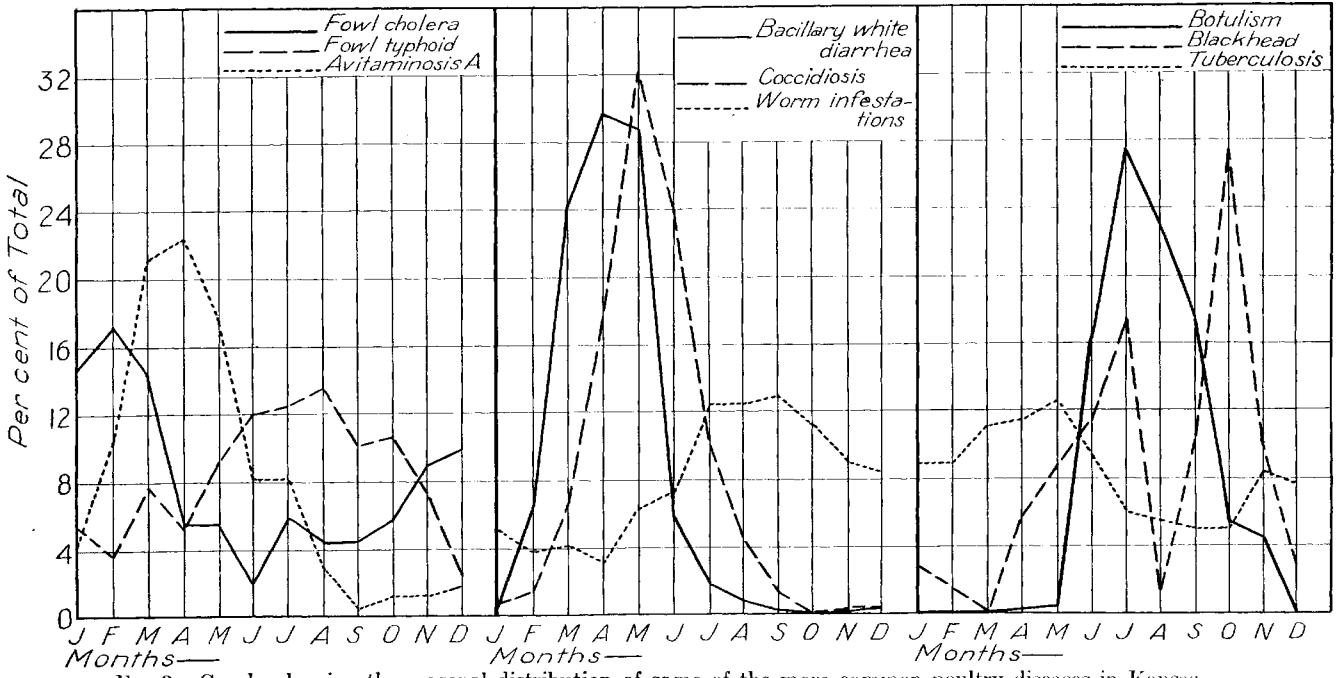


FIG. 3.—Graphs showing the seasonal distribution of some of the more common poultry diseases in Kansas.

## GENERAL DISCUSSION OF POULTRY DISEASES

The term disease in its broadest sense means any deviation from the normal. Consequently, any factor that interferes 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 may 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 may 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.

### WHAT TO DO IN CASE OF AN OUTBREAK

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 cannot 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 prepaid express to the Department of Bacteriology, Kansas State Agricultural College, Manhattan, Kan. A letter giving the following information should be mailed at the time the birds are shipped: [9] (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 cannot 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 permanganate[10] 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 and see that the birds are getting a balanced ration and plenty of green feed. Also see that the birds have

9. See appendis, page 100, for further details regarding information desired.

10. See appendis, page 100. for instructions regarding the preparation of drinking water.

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.

## SCHEME TO AID IN DIAGNOSIS OF POULTRY DISEASES

| *External symptoms.* | | *Diseases.* |
|---|---|---|
| Comb | Congested (deep red) | Cholera (early).<br>Botulism. |
| | Cyanotic (purple) | Cholera (late).<br>Blackhead. |
| | Anæmic (pale) | Tuberculosis.<br>Air sac mites.<br>Intestinal parasites (worms).<br>Fowl typhoid.<br>Avitaminosis A.[11]<br>Lice and mites.<br>Cholera (chronic).<br>Leukemia.<br>Fowl pox. |
| | Tumors | Contagious epithelioma (Bird pox).<br>Nonspecific. |
| Eyes and nostrils (exudate in) | | Colds.<br>Ophthalmia (ocular roup).<br>Coccidiosis.<br>Avitaminosis A.<br>Sod disease. |
| Mouth and throat (ulcers in) | | Injuries.<br>Avian diphtheria (roup). |
| Feathers | Unthrifty appearance | Worms.<br>Lice.<br>Avitaminosis A.<br>Scurvy?<br>Tracheitis (flu). |
| | Falling out | Depluming mites.<br>Feather pulling.<br>Botulism. |
| Wings (drooping) | | Intestinal parasites (late stages).<br>Lice and mites.<br>White diarrhea.<br>Avitaminosis A.<br>Coccidiosis.<br>All acute diseases. |

11. Avitaminosis A was formerly called nutritional disease or nutritional roup.

| *External symptoms.* | | *Diseases.* |
|---|---|---|
| Lameness | | Scaly leg.<br>Avitaminosis B[12].<br>Bumble foot.<br>Tuberculosis.<br>Sod disease.<br>Rheumatism.<br>Injury.<br>Gout. |
| Paralysis | | Avitaminosis B.<br>Coccidiosis.<br>Tapeworms.<br>Avitaminosis D[13].<br>Tumors.<br>Range paralysis.<br>Unbalanced ration. |
| Legs and feet | Rickets (Avitaminosis D).<br>Dry and rough—Scaly leg.<br>Blisters—Sod disease.<br>Foot swollen—Bumblefoot. | |
| | Joints swolen | Tuberculosis.<br>*P. avicida* infection.<br>Gout.<br>Rheumatism.<br>Rickets (weak legs). |
| Neck | Limberneck | Cholera (late).<br>Botulism. |
| | Wry neck | Poisoning.<br>Worms.<br>Ocular roup. |
| Vent (inflamed and protruding) | | Prolapse of oviduct.<br>Inflammation of cloaca.<br>Vent gleet. |
| Emaciation (loss of flesh) | | Tuberculosis.<br>Air sac mites.<br>Intestinal parasites.<br>Avitaminosis A.<br>Blackhead.<br>Intestinal coccidiosis.<br>Cholera (chronic type). |
| Diarrhea | Green | Fowl typhoid. |
| | White | Tuberculosis (late).<br>Worms.<br>Bacillary white diarrhea.<br>Cholera.<br>Botulism.<br>Avitaminosis A.<br>Coccidiosis. |
| | Yellow | Cholera.<br>Blackhead (sulphur droppings). |
| | Bloody | Coccidiosis.<br>Cholera. |

12. Avitaminosis B was formerly called beriberi or polyneuritis.
13. Avitaminosis D was formerly called rickets or leg weakness.

| *External symptoms.* | | *Diseases.* |
|---|---|---|
| Temperature | Elevated | Cholera.<br>Fowl typhoid.<br>Blackhead.<br>Bacillary white diarrhea.<br>Tuberculosis (late stages).<br>Tracheitis. |
| | Subnormal | Botulism.<br>Avitaminosis A. |
| Difficult respiration | | Tracheitis and bronchitis.<br>Avian diphtheria.<br>Gapes.<br>Aspergillosis.<br>Pneumonia. |
| Esophagus (nodules in) | | Nutritional disease. |
| Liver | Enlarged | Fowl typhoid.<br>Leukemia.<br>Blackhead.<br>Apoplectiform septicemia. |
| | White spots | Blackhead.<br>Coccidiosis.<br>Tuberculosis.<br>Fowl typhoid (white or gray). |
| | Yellow | Chilling.<br>Overheating.<br>Sand scours. |
| Intestinal tract | Congestion | Cholera.<br>Worms.<br>Coccidosis.<br>Poisoning.<br>Avitaminosis B.<br>Apoplectiform septicemia. |
| | Thickened wall or ulcers | Worms.<br>Coccidiosis.<br>Tuberculosis.<br>Blackhead. |
| | Nodules on | Tuberculosis.<br>Tapeworms (*Davainea echinobothrida*). |
| Kidneys | Ureters distended with urates | Avitaminosis A.<br>Cholera (late). |
| | Enlarged | Fowl typhoid.<br>Avitaminosis A. |
| Ovaries | Hard, shrunken, angular, dark brown, or greenish | Bacillary white diarrhea of adult hens. |

| *External symptoms.* | | *Diseases.* |
|---|---|---|
| Heart | Petechiæ (small hemorrhages) | Cholera. |
| | Grayish spots | Fowl typhoid. |
| Lungs | Congestion (filled with blood) | Cholera. |
| | Dark, gray, firm, pus in | Pneumonia. |
| Trachea and bronchi | Congestion, Blood in, Pus in | Tracheitis (flu). |
| | Worms in | Gapes. |
| Crop | Distended with food | Crop bound. |
| | Filled with feathers | Depraved appetite. |
| | Putrid odor | Botulism. |
| Fat | White | Avitaminosis A. |
| 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 THE 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 anaemic 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.

**How 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. 4) in

such a way that, the back or side of the head rests in the palm of 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 vertebrae are pulled apart. If this is carefully done the skin will not be broken and blood will not be lost to contaminate the soil.

FIG. 4.—A bird being held in position ready to break the neck.

**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. 5.) 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 coracoid and clavicle (wishbone) 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. 6.) 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

FIG. 5.—Stage of work in the autopsy of a bird showing skin properly pulled back and surface exposed.

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

FIG. 6.—Stage of work in the autopsy of a bird showing viscera exposed.

have a sour odor, but in some cases, as in botulinus poisoning, they may have a putrid odor. The esophagus and trachea should be dissected out and split open for examination. In some cases of canker, fowl pox, and tracheitis the upper end of the trachea may be plugged

with a yellowish exudate, while in nutritional disease the upper third of the esophagus may be 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.

## DISEASES OF POULTRY DUE TO DEFICIENT DIET

### AVITAMINOSIS A (NUTRITIONAL DISEASE)

Vitamin A is soluble in fat and is called "fat soluble A" (antixerophthalmic). 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 avitaminosis A 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. 7), 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 rouplike 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 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. 8.) These may be few or many in number and may be located near the upper end of the esophagus or scattered over the entire surface. The borders of the nodules are

regular in outline, a condition which distinguishes them from those seen in the diphtheritic roup. In some cases, however, birds may be suffering from both these diseases at the same time.

FIG. 7.—A typical case of avitaminosis A due to lack of vitamin A in the feed. Note white exudate in eye similar to beginning of ocular roup.

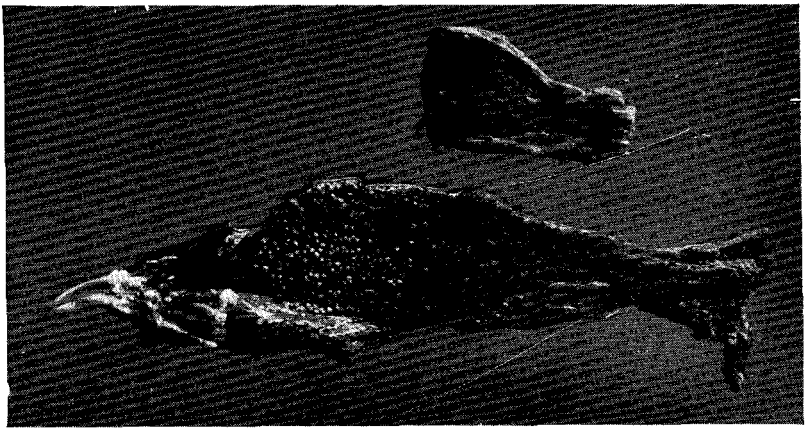

FIG. 8.—Characteristic nodular lesions as seen in the lining of the esophagus of a bird having died from avitaminosis A.

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 network 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.

### AVITAMINOSIS B (BERIBERI OR POLYNEURITIS)

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

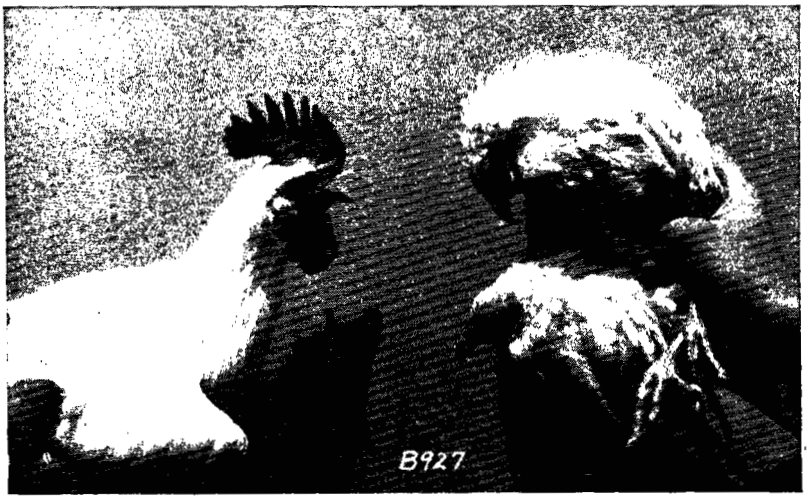


FIG. 9.—Three cockerels of the same age. The one on the left received adequate diet and sunlight. The others received an adequate diet but no exposure to the sun.

much cheaper sources of this substance. 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 fifty-four days.

### AVITAMINOSIS C (SCURVY)

Vitamin C is of recent discovery (1918). It has been given the name of antiscorbutic vitamin. 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.

### AVITAMINOSIS D (RICKETS)

Vitamin D is a late discovery in the field of vitamins. It has been found to prevent rickets when present in proper amounts in the feed, This vitamin has been given the name antirachitic vitamin for this reason. It is present to some extent in 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 9 and 10 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[14]

Table IV shows the influence of lack of vitamins by death in young adult birds at the Kansas Agricultural Experiment Station. Each pen contained ten 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

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

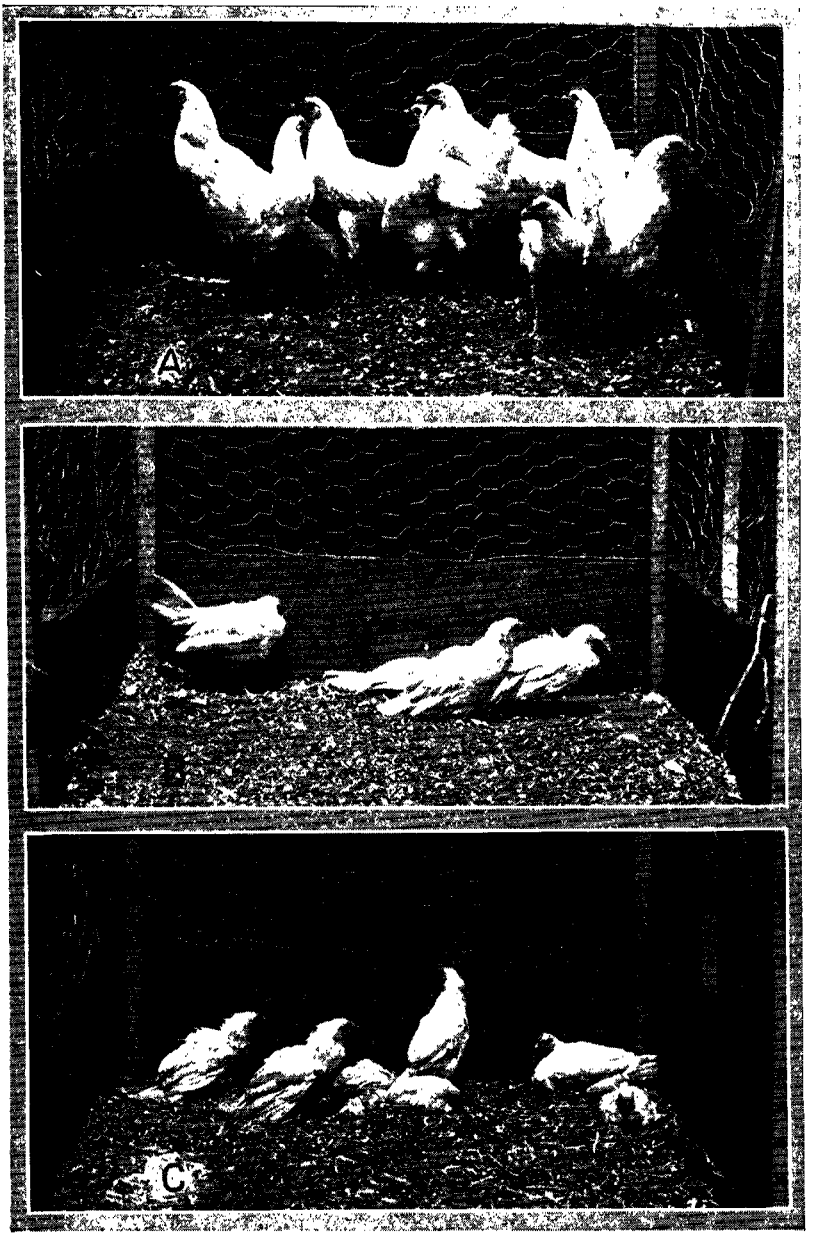


FIG. 10.—Groups of birds of the same age. Group A was given adequate diet and exposed to sunlight six hours per day. Group B was given adequate diet but not exposed to sunlight. Group C was given adequate diet and exposed to sunlight which had passed through window glass. (Window glass removes most of the ultra-violet rays.)

D. Pens 6 and 7 were outside and received sunlight according to weather conditions.

TABLE IV.—INFLUENCE OF LACK OF VITAMINS ON ADULT BIRDS.

| PEN NO. | Number of birds. | Vitamins lacking in diet. | Per cent of birds dying. |
|---|---|---|---|
| 1 | 10 | D | 10 |
| 2 | 10 | CD | 40 |
| 3 | 10 | ACD | (a) 100 |
| 4 | 10 | BDC | 100 |
| 5 | 10 | ABCD | 100 |
| 6 | 10 | None | 0 |
| 7 | 10 | ABC | 40 |

(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 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.

## SOURCES OF IMPORTANT VITAMINS

A statement summarizing the source of vitamins may be of value. The only available and cheap sources of vitamin A for poultry are yellow corn and green leaves, either dry or fresh. Supplementary

sources of vitamin A are high-grade cod-liver oil, and whole milk and butter from cows and egg yolks from hens fed vitamin A.

Vitamin B is carried in the outer covering of all grains. Since whole grains make up a large bulk of most poultry feeds little attention need be given to this deficiency in poultry rations.

It has been quite clearly demonstrated that vitamin C is not necessary to maintain birds in a state of health. The feathers probably appear somewhat brighter and smoother in birds receiving this vitamin, and it should be included in the feed of show birds. Since it is present only in succulent fresh feeds, the required amount is usually received in this manner by all birds.

Vitamin D has not been found in any natural poultry feeds in sufficient quantity to prevent rickets or leg weakness in growing chicks, except whole milk from cows and egg yolks from hens which have been exposed to direct rays of the sun. The usual method of supplying vitamin D is to expose the chicks to sunshine, in which case the vitamin D is manufactured in the body. If sunshine is not available a high grade cod-liver oil will supply this necessary vitamin.

## DISEASES OF POULTRY NOT DUE TO DEFICIENT DIET

Some of the more important diseases of poultry are not due to deficient diet but to the action of microorganisms, higher parasites, or to some other factor. In the following discussion of diseases those due to similar factors have been classed together. The first group is those due to bacteria and of an etiology which is fairly well known. Following this are discussed troubles due to higher forms of life, such as molds, protozoa, worms, lice and mites, etc. The group last discussed consists of miscellaneous diseases and troubles which are of unknown etiology or not due to parasites.

### DISEASES DUE TO BACTERIA

#### 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 ophthalmia or diphtheria if not controlled. Usually but a few of the individuals of the flock suffer from this trouble.

**Symptoms.—** The first symptom noticed 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 winds 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. It is essential 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 birds must be made to work vigorously for their feed. This may be accomplished by compelling them to scratch for the feed in deep litter. This exercise will keep up their temperature, increase their vigor, and prevent overeating 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 a 2 per cent potassium permanganate solution, or a 10 per cent watery solution of baking soda.[15] 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 green fed 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. However, if a bird is very valuable it may be returned several weeks after it has recovered.

### 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 a 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

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

"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 healthy birds must be freed from worms, 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 of the chicken. The disease appears to develop rapidly in virulence when once introduced into the flock. 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 avicida,* 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 nasal 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. Some cases may be treated successfully by removing the membrane from the surface of the lesions with a bent wire or hairpin 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.

### FOWL POX (CONTAGIOUS EPITHELIOMA)

Fowl pox is very common in many parts 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. Fowl pox is also called ‘‘contagious

epithelioma" and is probably closely related to canker. The cause 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 "fowl pox" or "bird pox" from the appearance of the peculiar wartlike 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 blisterlike 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 tumorlike 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 tumorlike 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 fowl 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 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 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 fowl pox. (See appendix.)

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

A virus has been prepared that seems to be of considerable value in certain localities for immunizing birds against this disease. It is best to obtain the virus from a local flock for use in any locality. Persons wishing to try this treatment may write the Department of

Bacteriology, Agricultural Experiment Station, Manhattan, Kan., for further particulars. The virus is made by using the tumorlike growths from the skin. It should be used soon after preparation as it does not long retain its potency. One dose is sufficient.

Since the immunizing material is an active virus it cannot be used by anyone except a licensed veterinarian. This treatment should not be used on birds less than eight weeks of age or on those already in production. Birds of eight to ten weeks of age are treated by

—*Courtesy J. R. Beach.*

FIG. 11.—Head of cockerel showing typical fowl-pox eruptions (natural infection).

removing three or four green feathers and introducing the virus into the areas by means of a small stiff brush. Weak, sick birds or those suffering from worms should not be treated by this method. The birds may be off feed and out of production for about four weeks, but are strongly resistant to later exposure of the disease. A typical example of fowl pox (natural infection) is shown in figure 11.

### 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 and surrounding tissues. As in case of the other affections of

the head of the bird, the cause is unknown. Certain types of ophthalmia may be merely another manifestation of pox or canker, but this is not definitely known. Some of the most severe outbreaks of the disease appear to be closely associated with the organism causing fowl cholera. In other cases the cause is an eye worm or perhaps injury. In chicks of about one month of age it is mostly due to coccidiosis.

Symptoms.— Ophthalmia is characterized by its chronic course, rather light losses, the characteristics bulging of the eye, and the

—(B) Courtesy J. R. Beach.

FIG. 12.—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.

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 conjunctiva or the sinuses should be treated with hydrogen peroxide to cleanse 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. 12) are usually of little value and should be fattened for the market as soon as possible after recovery.

### TRACHEITIS

This disease has been given different names such as "Canadian flu," "tracheolaryngitis," "infectious bronchitis," etc., and is often confused with fowl pest. The name "tracheitis" has been applied to the disease because the more characteristic symptoms seem to be a severe inflammation of the trachea (windpipe). The disease is most severe in feeding stations and markets.

**Symptoms.**— The first symptoms noticed will be stretching of the neck and gaping, showing difficulty in breathing. The nostrils are usually partly filled with dried mucus. There is usually no swelling of the sinuses of the head and no diphtheritic patches in the mouth. The temperature is usually raised.

Autopsy shows few lesions except a slight enteritis and a severe tracheitis. The trachea is partly filled with pus, sometimes mixed with blood. The wall of the trachea may show intense inflammation and hemorrhage. In many cases death appears to be due to a plugging of the trachea with a mass of cheesy material. The lungs may be normal or show areas of congestion. In some cases the lining of the proventriculus show intense hemorrhage as described for fowl pest.

Young birds appear to be most susceptible and those most heavily parasitized with worms suffer heaviest losses.

The cause of the disease is unknown and several organisms have been considered as the cause. From many cases at this station the organism of fowl cholera has been isolated and other workers consider other organisms as significant.

**Treatment.**— There is no treatment which is very effective in curing the sick birds. The spread of the disease may be prevented

by carefully culling all birds before they are placed in feeding pens; careful sanitation and daily removal of droppings; removal of intestinal worms; protecting birds from cold and drafts; and killing the birds as soon as they begin to show signs of disease. Birds which have been killed and dressed while suffering from the disease often show a bluish discoloration of the skin. Such birds should not be sold for food.

As death is often due to stoppage or occlusion of the windpipe or bronchi, any measures that will tend to prevent this condition will decrease losses. The State Institute of Applied Agriculture (N. Y.) recommends "Fifteen grains of equal parts of ammonium chloride and ammonium carbonate given in capsule once or twice daily as an expectorant to assist in the elimination of the exudate. . . . Though not so satisfactory, the ammonium compounds may be given in a small amount of wet mash at the rate of 1 ounce to 25 or 30 birds as a flock treatment. Spraying the upper respiratory passage with a hypochlorite solution by means of an atomizer is also beneficial in individual treatment of valuable birds."[16]

### 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 tisues 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, although in chronic cases death may be delayed for several weeks,

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.

16. Horton, D. Hart. Everyday problems of the poultryman. State Inst. of Applied Agr. Bul. 188 pages. Illus. 1927. (Farmingdale, Long Island, N. Y.) Ref. Section IX, Diseases and parasites, P. 111.

**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 identify it definitely until a bacteriological examination is made. The post-mortem lesions found in this disease are given in the outline, page 21, "Scheme to Aid in Diagnosis of Poultry Diseases."

**Treatment.—** The object of treatment after the disease has a start is to try to 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. 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 6, should be carefully followed and the general control measures given under "What to Do in Case of an Outbreak," page 19, practiced. The very fat birds and those in heavy production are the most susceptible to the disease. For this reason the amount of feed should be reduced and about half the grain should be replaced with dry bran.

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.

### APOPLECTIFORM SEPTICEMIA

This is a highly infectious disease of fowls and pigeons caused by a streptococcus *(Streptococcus gallinarum)*. The disease is very similar to that of sleeping sickness described by European workers, which is also due to a streptococcus.

**Symptoms.—** The disease is rapid in its course. The bird appears listless, remains by itself, will not eat, and gait is staggering, and in time shows great prostration. Death may be rapid and some birds are likely to be found dead under the roosts. Diarrhea is usually present if death is not too rapid. The skin of the breast and neck may show areas of discoloration and redness.

When the bird is opened the liver and spleen are found greatly enlarged and paler than normal in color. The surface is usually covered with an exudate. There is considerable fluid in the peritoneum and the intestines contain blood-stained mucus. There is a profuse exudate and an abnormal amount of fluid around the brain and spinal cord.

**Treatment.**— Vaccines and an immune serum have been used with good results, but the authors have had no experience with them. The sanitary methods recommended for the control of fowl cholera should be applied in outbreaks of this disease.

### BACILLARY WHITE DIARRHEA (PULLORUM DISEASE)

Bacillary white diarrhea is a highly acute fatal infectious disease of young chicks. It usually affects the chicks within four to twenty days after hatching. The development of the disease is due to the presence of a specific bacterium, *Salmonella pullorum,*[17] 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. In many cases small white points, or areas of necrosis, may be found on or near the surface or on a cross section of the lung.

**Treatment and Control.**— Treatment of sick birds is unsatisfactory, and only control measures can be practiced. For several years the following method has been used with success in reducing the losses 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 the practice.) Allow the chicks to partake of

17. 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. A bacteriological examination will determine the cases that are caused by bacillary white diarrhea. (See "Some Things Which Kill Young Chicks," page 97.)

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. Keep everything scrupulously clean and dry.

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.

It has been found that the disease may be spread from diseased to healthy chicks in certain types of incubators. The practice of custom hatching may offset the good results from testing unless all eggs hatched at a time are from flocks which have been tested and carefully culled of all reactors. Heavy losses may result from the eggs of but one or two diseased hens hatched with the eggs of large numbers of healthy hens.

Infertile eggs, dead embryos, and egg shells from the incubators should be boiled thoroughly, to destroy disease germs which may be present, before they are fed to either chicks or adult birds.

### The Agglutination Test

In the case of heavily 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 sending samples of blood to a laboratory for agglutination tests.[18] By this method it is possible to eliminate the infected birds.[19]

The "pullorin" or "wattle" test has not been perfected to a point where it can be recommended in place of the agglutination test.

A more detailed description of bacillary white diarrhea will be

18. For further information see appendix, page 103, "Information Concerning the Agglutination Test for Carriers of *Salmonella* ***pullorum.***"

19. 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.

found in Technical Bulletin 21 of the Agricultural Experiment Station.[20]

Figure 13 shows some of the losses due to bacillary white diarrhea, such as decreased fertility, hatchability, and livability of the chicks. Since it has been determined that the disease may be transmitted from diseased chicks to normal chicks through incubators, all flocks used to supply eggs for custom hatching must be tested to reduce the spread from diseased to free flocks.

**Losses Due to Bacillary White Diarrhea**

The following data have been estimated on the basis of five years' study of this disease in Kansas. The figures may not be applicable to other states and there will be very great variation in individual flocks, but in general the figures are a fair average for Kansas conditions:

Average per cent fertility for nonreactors ..... 90
Average per cent fertility for reactors ..... 70
Average per cent hatchability of fertile eggs for nonreactors ..... 70
Average per cent hatchability of fertile eggs for reactors ..... 58
Average per cent livability of chicks from nonreactors ..... 90
Average per cent livability of chicks from reactors ..... 50
Average per cent infection in Kansas flocks ..... 25
Average per cent of Kansas flocks infected ..... 75

Calculating on the basis of the above figures, Kansas losses have been considered from the standpoint of the hatcheryman who sells day-old chicks and the farmers who purchase these chicks. Losses to the farmer who may hatch chicks on his own farm have not been considered because of lack of data on this point. When the disease is present, however, the losses are probably as great as stated above.

LOSSES TO THE HATCHERYMAN

For each 100 eggs incubated from nonreactors the hatch would be 70 per cent of 90 eggs, or 63 chicks. For each 100 eggs from reactors the hatch would be 58 per cent of 70 eggs, or 40.6 chicks. This gives a difference of 22.4 chicks. If 25 per cent of the birds in the flock are reactors, the difference in loss between reactors and nonreactors would be 5.6 chicks per 100 eggs incubated,

At 15 cents per day-old chick this loss would amount to 84 cents. On this basis the hatcheryman can afford to pay 84 cents per hundred more for eggs from nonreactors than from the average farm

20. Bushnell L D. Hinshaw, W. R., and Payne, L. F. Bacillary White Diarrhea in Fowl. Kan. Agr. Expt. Sta. Tech. Bul. 21:1-85. Figs. 4. 1926

flock not tested. This is on the basis of saving in losses due to infertility and poor hatchability alone.

LOSSES TO THE PURCHASER OF DAY-OLD CHICKS

If 100 day-old chicks are purchased at 15 cents each the cost is $15. The normal loss is 10 per cent, leaving 90 chicks. If these chicks are affected with bacillary white diarrhea there is an average loss of 40 per cent, or 40 per cent of 90 chicks, or 36 chicks.

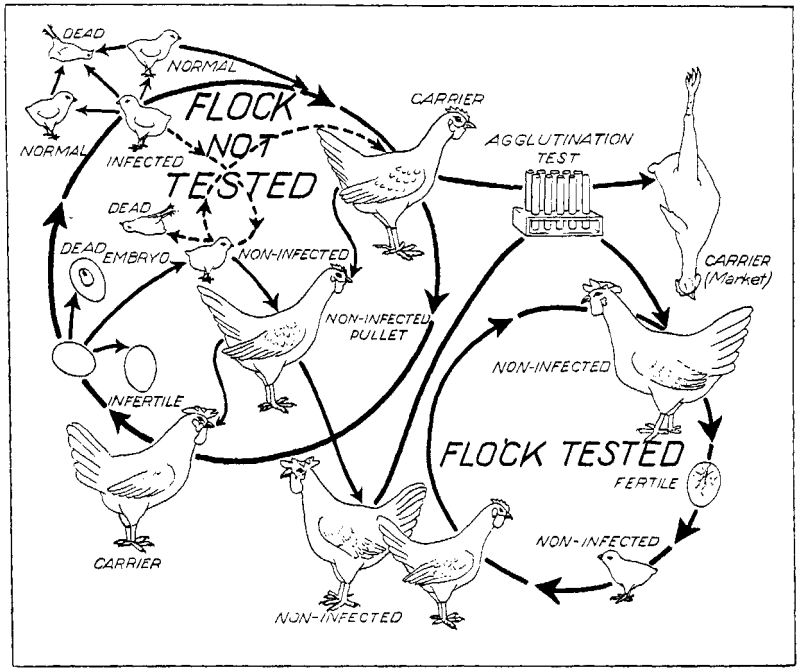


FIG. 13.—Chart showing the possibilities of the agglutination test in controlling bacillary white diarrhea in poultry flocks.

The remaining 54 chicks cost $15, or a total of 28 cents per chick. In reality the 90 chicks cost 17 cents each. This makes a difference in cost per chick of 11 cents. The loss of one chick would be enough to pay for the laboratory charge for the testing of an adult bird.

Considering relative losses between reactors and nonreactors startling results are obtained.

*Normal Losses per 100 Eggs Incubated*

Losses in fertility, 10 per cent, or 10 eggs, leaves 90 eggs.
Losses in hatchability, 30 per cent, or 27 chicks, leaves 63 chicks.
Losses by death, 10 per cent, or 6.3 chicks, leaves 56.7 chicks.

*Normal Losses per 100 Eggs plus Those Due to Bacillary White Diarrhea*

Losses in fertility, 30 per cent, or 30 eggs, leaves 70 eggs.

Losses in hatchability, 42 per cent, or 29.4 chicks, leaves 40.6 chicks.

Losses by death, 50 per cent, or 20.3 chicks, leaves 20.3 chicks.

The difference due to bacillary white diarrhea is 36.4 chicks. At 14.1 cents each this amounts to $5.13 per 100 eggs incubated.

Note.— The figure 14.1 cents was obtained as follows: Cost of eggs, per 100, $3; cost of incubation, $5; total cost, $8. The 56.7 chicks obtained under normal conditions will cost $8, or 14.1 cents each.

In case of 100 per cent reactors in the flock, approximately 20.3 chicks are obtained from each 100 eggs incubated at a cost of $8 or at a cost of 39.4 cents per chick. From a flock of nonreactors held under similar conditions 56.7 chicks may be obtained at a cost of $8, or at a cost of 14.1 cents per chick. The difference in cost per chick in this particular case is 25.3 cents.

It may be concluded that it is easily worth while to test for this disease and eliminate the reactors. The estimated losses have been very conservative and based upon quite extensive investigations.

### Fumigation of Incubators

Recent experimental work has shown that proper sanitation and incubation practices are of great value in keeping down dissemination of disease in the hatchery and in the incubator. As bacillary white diarrhea may be transmitted from infected to healthy chicks in the incubator, the observation of certain measures is important and essential if this infection as well as others are to be controlled.

In addition to scrupulous cleanliness in the hatchery the two most important factors to be considered are: A proper relative humidity in the incubator and regular fumigation of the incubators with formaldehyde gas.

A high relative humidity serves the double purpose of reducing the circulation of down from infected chicks and of increasing the effectiveness of formaldehyde fumigation. A wet bulb thermometer reading of 85° to 90° F. is desirable at the time of fumigation,

For fumigation formaldehyde gas is generated by mixing 40 per cent commercial formalin and potassium permanganate. These substances are mixed together in an enamelware vessel and placed about three feet from the floor in the middle compartment of the incubator. Thirty-five c. c. of commercial formalin and 17.5 grams of potassium permanganate are recommended for each 100 cubic feet of incubator space. For an incubator 8 by 10 by 5 feet, which would have a volume of 400 cubic feet, there would be required for each fumigation four times the amounts of ingredients given above. Equip-

ment for generating and introducing the gas through the intake ports of certain forced air-draft incubators can be obtained from the manufacturers.

To prevent the mixture from foaming over, the container used should be large enough to hold five to six times the amount of mixture employed. The vessel containing the mixture should be placed in a larger vessel to prevent the hot mixture from reaching the floor in case it does boil over.

Most of the gas is liberated within five minutes after mixing the formalin and potassium permanganate, but the incubator should not be opened for ten minutes. It is unnecessary to close the ports during incubation.

Still-air incubators may be fumigated by opening them and treating the entire room in which they are housed.

Fumigation between hatches is often desirable, but to obtain the maximum effect from fumigation the procedure may be carried out three times at eight-hour intervals during the time the hatch is coming off. By removing all dry chicks before the second and third fumigations practically all chicks are exposed to one fumigation. Neither the very young chicks nor the eggs seem to be injured if the formaldehyde fumigation is carried out as recommended.

Fumigation may not reach disease germs that are covered by dirt or down. It is, therefore, essential to clean the incubator thoroughly and carefully at regular intervals, preferably after each hatch.

Although fumigation with formaldehyde kills the disease germs in the incubator and thus prevents spread of infection from one end of the incubator to the other, it cannot and will not destroy germs such as those of bacillary white diarrhea which are in the body of infected chicks or inside the egg. It, therefore, merely destroys infection in the air and on the incubator trays, but does not keep the diseased chicks from infecting others in very close contact with them. For these reasons FUMIGATION OF THE INCUBATOR CANNOT BE CONSIDERED AS A SUBSTITUTE FOR TESTING AGAINST BACILLARY WHITE DIARRHEA or as an insurance against losses due to other causes.

### FOWL TYPHOID

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

**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. Birds stand about the yards with drooping head and wings.

**Post-mortem Findings.**—Upon opening a fowl that has died, an enlarged darkened greenish or mahogany 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 or fatty 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. Bacterial vaccines have also been used with success in controlling the disease.

### 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 very 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. Swine get avian tuberculosis by association with affected birds. Thus diseased birds are often a serious source of tuberculosis, especially for hogs, since they are very susceptible to this type of infection. 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. The rate of spread is in direct relation to crowding.

**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. 14.) The bird will eat well until death and only one or two in the flock may be noticed with the disease at one time, although it is usually widespread in an affected flock. Birds may die a few at a time or singly over a considerable period of time. Paralysis and lameness are quite common in the more chronic cases.

**Post-mortem Findings.—** The surest method of diagnosis is to kill an infected 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

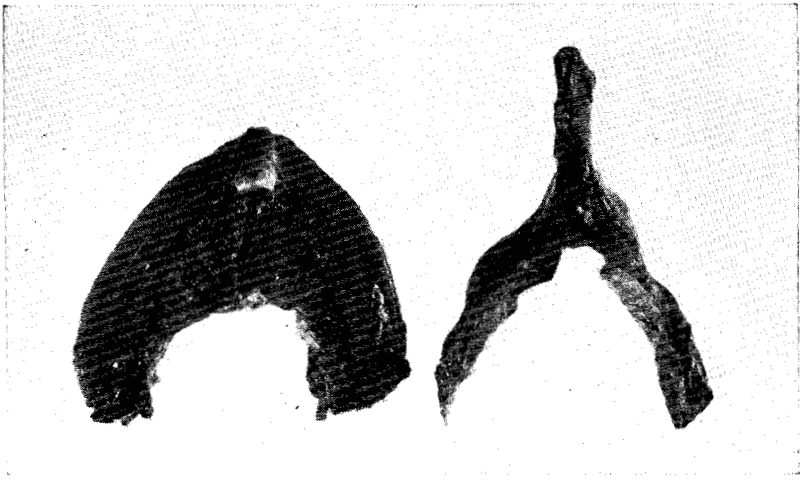

FIG. 14.—Picture of the breast bone and muscle of a normal bird and of a bird suffering from a well-advanced case of tuberculosis.

commonly seen are white to yellow tubercles of various sizes, few to many in number, on the surface of the liver, and on the surface of an enlarged spleen. These tubercles may or may not be found along the intestinal tract. (Fig. 15) When lesions are present in the walls of the intestines they are firm to the touch, irregular in outline, and yellowish in color. They generally are of cheesylike 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 flock. A third and much better method is to have a veterinarian apply the tuberculin test on each bird at least twice a Year and

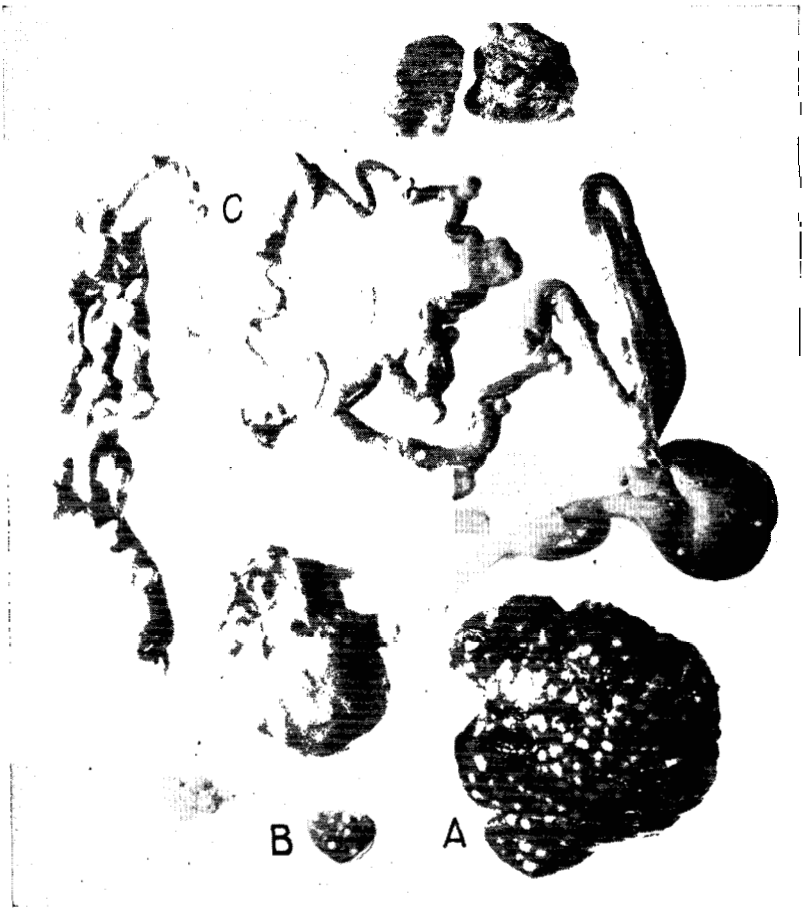


FIG. 15.—Viscera of a tuberculous bird. (A) Liver, (B) spleen, and (C) intestines.

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 removed, but the premises must be carefully cleaned and disinfected. Especially should all

runs under old sheds and barns be closed so that new birds cannot get in these places. The tubercle bacillus will live in dark places and in refuse for long periods of time. The organisms have been found to remain alive and virulent after one year in moist soil. Schalk, in North Dakota, found that healthy birds fed carcasses of tuberculous birds which had been exposed to weather conditions for the winter showed a severe outbreak of the disease. 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 and those that show no signs of the disease may be sold to the butcher. All affected fowls should be burned.

#### BOTULISM (LIMBERNECK)

Botulism (limberneck) is a disease caused by the toxins of a microorganism that is common wherever spoiled food or grain is found. The organism, *Clostridum botulinum* types A and 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 wryneck found in worm troubles, or disease of the ear 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 or feathers and bones that have carried the poisonous material.

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

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

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 caster 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.

### COLIBACILLOSIS OF CHICKS

This disease, although not very common, has been found to cause heavy losses in broods of chicks from two to eight weeks of age. Certain bacteria, chiefly *E. coli,* which are normally present in the intestines and which do not cause disease when confined to the

intestines, may gain entrance to the blood and body organs and tissues and thus cause colibacillosis. Unfavorable conditions of feeding, brooding, or sanitation may weaken the chicks to the extent that general infection readily occurs. The symptoms may cause one to suspect bacillary white diarrhea, but the losses can be more readily controlled than in bacillary white diarrhea. Affected chicks may become droopy and show signs of difficult breathing, others may die rather suddenly with only mild symptoms.

Dirty floors and overcrowding are factors that must be corrected. In broods of chicks that are not overcrowded it has been found that providing several times as much floor space as is ordinarily desirable is helpful in controlling the losses. All sick chicks should be removed as soon as they are noticed and care should be taken to prevent contamination of the feed and water with the droppings,

## DISEASES DUE TO HIGHER FUNGI (MOLDS)

### FAVUS (WHITE COMB)

Favus is caused by a fungus, *Achorion gallinarum (Lophophyton gallince),* 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)

A cause of brooder pneumonia in young chicks is 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. This type of pneumonia should not be confused with that due to infection with bacillary white diarrhea, which is very common in chicks.

**Symptoms.**—The brooder chick, when affected, shows symptoms resembling those of bacillary 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 foul, 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.

## DISEASES DUE TO PROTOZOA

### 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 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.

Coccidiosis of poultry is commonly caused by two species or types of coccidia, while several harmless types have been recognized. The coccidia cannot be seen with the naked eye, a microscope being

necessary to detect their presence and to differentiate between the various types. Large numbers of coccidia are voided in the droppings of infested birds early in the disease, and while the parasites (oocysts) in fresh droppings are incapable of producing disease they develop to the infective stage under favorable conditions of moisture and temperature in from forty-eight hours to several days. At this stage the coccidia on being taken into the body of the fowl

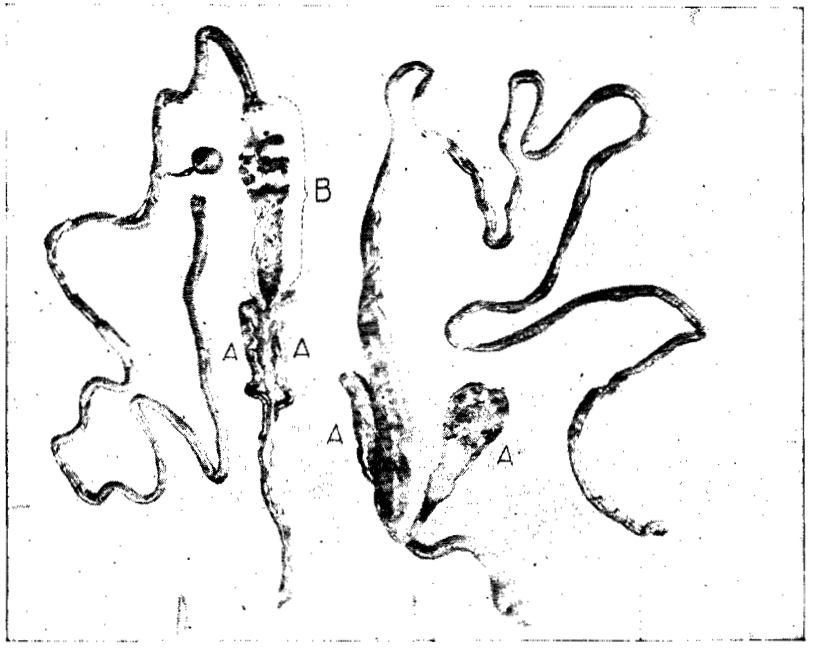


FIG. 17.—Lower portions of the intestines of two young chicks showing lesions of coccidiosis. Note the ceca (A), one of which is cut open showing ulcerations on the inner wall. Note, also, a portion of one intestine (B) split open and showing ulcerations on the inner wall.

with contaminated feed and water attack the mucous membrane of the intestines. In younger birds the ceca (blind gut) are most often affected, and in older birds the small intestine just below the gizzard is usually involved. Five or six days after becoming infested the fowl voids large numbers of coccidia in the droppings, thus providing a source for infesting other individuals and for reinfestation. There is also some evidence that the organism may be transmitted through the egg, but this has not been definitely proved. Outside of the body the coccidial cysts are very resistant to disinfectants and they may remain alive in the soil for several seasons.

**Symptoms.**—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 harmful species of coccidia. The first symptoms noticed are that the affected bird becomes droopy, the wings sag (fig. 18), and the bird lags behind the rest of

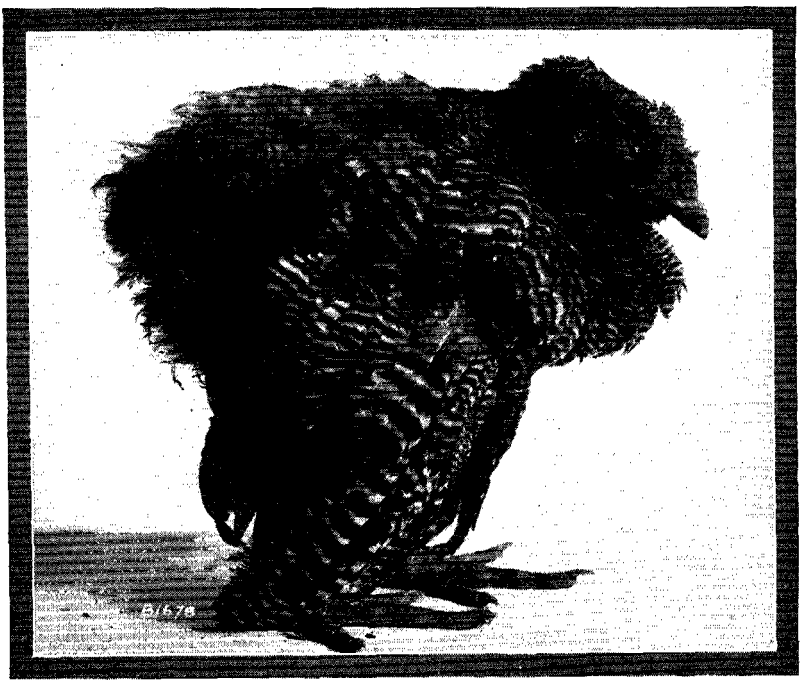

FIG. 18.—A chick six weeks of age suffering from coccidiosis.

the flock. In severe infestations the droppings may consist of almost pure blood. 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. If the local veterinarian is not in a position to make an examination for coccidiosis, one or two of the birds should be shipped to this laboratory for diagnosis.

**Treatment and Prevention.—** Treatment is very unsatisfactory in most cases and control measures must, therefore, be directed toward preventing the disease from getting a start on the premises. Care should be exercised to prevent introducing coccidiosis with chicks from infested flocks while other means of infecting premises (contaminated litter, coops, vehicles, etc.; pigeons and other wild birds) must be guarded against. Movable brooder houses and rotation of runs will help to prevent an outbreak.

Since old birds are commonly carriers of the coccidia, the chicks which are incubator hatched should not be allowed to use runs previously occupied by adult birds. If new premises cannot be provided concrete or gravel runs are important aids in preventing the spread of coccidiosis. Properly constructed gravel runs drain well and consequently do not provide the moisture necessary for the development of the coccidia outside of the body of the fowl. Concrete runs can also be kept dry by cleaning at least three times a week and preferably each day.

If the disease appears care must be taken to prevent its spread by removing the affected individuals from the flock. The healthy chicks should be moved to new, clean premises or they may be kept on gravel or concrete runs under sanitary conditions.

Powdered crude catechu at the rate of one-third teaspoonful per gallon of drinking water has given good results when kept before the birds continually. Epsom salts at the rate of one pound for 100 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.

Beach and Davis, of the California Agricultural Experiment Station, recommend a feed containing 40 per cent dry skim milk or buttermilk for the control of coccidiosis. The following mixture is fed as the entire ration for a period of time not longer than three weeks.

| | |
|---|---|
| Dry skim milk or dry buttermilk | 40 pounds |
| Yellow corn meal | 30 pounds |
| Ground barley or shorts | 20 pounds |
| Wheat bran | 10 pounds |

The composition of the mash is not important as long as it contains 40 per cent of dry milk and is suitable for feeding young chickens. If the chicks do not eat a sufficient amount of the milk mash, a daily feed of grain (not more than one-half to one-third the weight of mash consumed) should be given about the middle of the day. The amount of milk in the mash should be reduced gradually and the ration thus changed in two to three weeks to the same one in use when the disease appeared. A plentiful supply of fresh water must be provided. Catechu in the drinking water is not necessary with the milk treatment. Regardless of the method of control followed, the sanitary measures must be considered of first importance.

### 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, the "black" head is not a constant symptom and may even indicate some other disease. As the disease progresses the feathers become ruffled, the wings droop and general debility is noticed. (Fig. 19.) 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. 20) in most cases, but some do not show these. The ceca (fig. 21) 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 lying 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 burned. A treatment that is now being used by some is as follow: For each twenty birds give two tea-

FIG. 19.—Typical position of a turkey affected with blackhead disease. (The position and the sulphur-colored droppings are usually diagnostic of blackhead.)

spoonfuls 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 one each ten 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 and one-half pounds per one hun-

dred 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 thirty 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

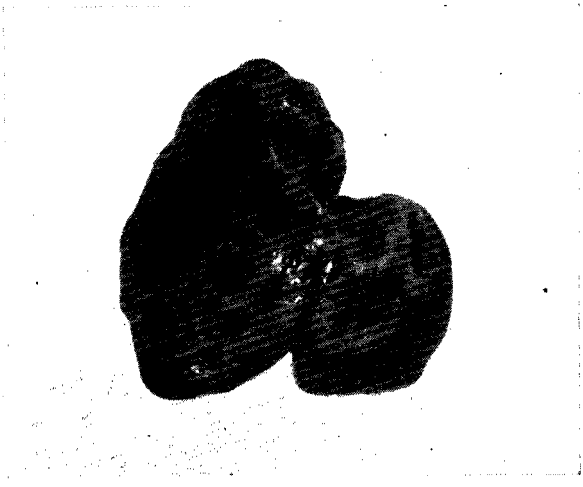

FIG. 20.—Liver from turkey affected with blackhead showing irregular yellowish areas on the surface.

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 caecum worm, *Heterakis papillosa,* may be an intermediate host or carrier 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

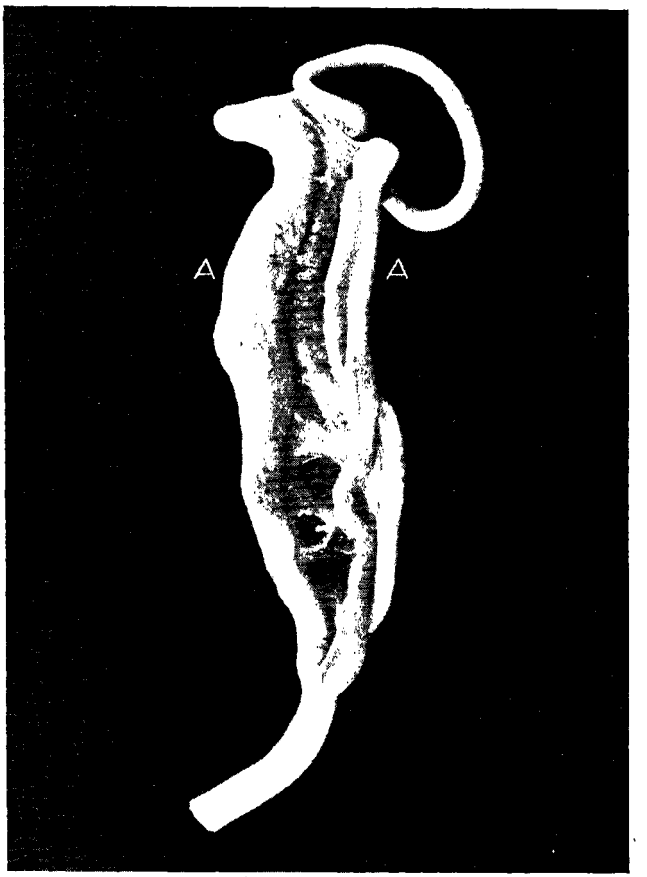


FIG. 21.—A portion of the intestines showing swollen and ulcerated ceca (A) (blind pouches) characteristic of blackhead. Note the large areas of ulceration on the left cecum.

they are not known to be specific for blackhead. 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.

### Management of Poults to Prevent Blackhead

Concerning the management and feeding of poults for the prevention of blackhead, Prof. H. M. Scott, of the Department of Poultry Husbandry, outlines the following system:

The most successful methods of preventing blackhead consist of artificial hatching and brooding and then rearing the young poults either in confinement or by practicing a definite rotation program. In confinement the poults are brooded in a house with a concrete or wooden floor that has been previously cleaned and thoroughly disinfected. The poults should be kept inside this brooder house until twelve or fifteen weeks old, at which time they are moved to a range that has not been frequented by chickens or sick turkeys. This brooder house must be cleaned and disinfected at least once each week. One pint of cod-liver oil must be fed with each 100 pounds of mash to prevent rickets. Some modify this complete confinement by furnishing a small run in front of the brooder house. To use successfully this modification it is necessary to place an eight-inch layer of clean river gravel over the entire ground area of the run. Where such a run is used it is not necessary to feed cod-liver oil except during long periods of continued cloudy weather.

In the rotation method the brooder house is equipped with four separate and distinct pens. The young poults occupy one pen for one week only and are then ranged in a different pen. A definite order is followed so that all pens are ranged one week and remain free from turkeys for three weeks before being used again. Some turkey raisers move the brooder house each week to a new range instead of using the four-pen system. The underlying principle is to keep the young poults on clean, fresh ground all the time. These pens or ranges need not be large. Turkeys do not need a large area over which to roam if the ground is clean. Green alfalfa can be cut and brought to them, and poults will not eat much more grain and mash in confinement than when allowed free range. The small additional feed cost can be considered insurance against loss from blackhead.

Martin, of Kentucky agricultural extension service, makes the following statement concerning the feeding of turkey poults.[21]

21. Martin, J. Holmes. Raising turkeys. Ky. Ext. Circ. No. 217. 16 pp. Illus. 1927.

"Probably there are as many different methods of feeding poults as there are turkey raisers. Most of these methods have proved at least fairly satisfactory where certain precautions are taken. Some of the most common causes of losses in young poults are chilling, feeding sooner than forty-eight hours, overfeeding, and using wet, sloppy, or spoiled feed." From this, then, it may be seen that there is considerable leeway in the feeding of poults if the above precautions are followed, and it seems only logical that the most simple and easy method should be recommended.

The Department of Poultry Husbandry of the Kansas Agricultural Experiment Station has secured good results in feeding young poults in exactly the same manner as they feed baby chicks. The poults are brooded under a brooder stove in confinement. The following directions present briefly the system used:

1. Do not feed until forty-eight hours old.
2. Dip the beak of each poult in water as it is placed under the brooder stove.
3. During the first 12 weeks feed mash only. This should be before the poults at all times in open hoppers.
4. When 12 weeks old, a scratch grain should be hopper fed in addition to the mash.
5. Green feed, which should be fed after the first week or ten days, must be very tender. The feeding of stems and woody portions should be avoided to prevent impaction in the digestive tract.
6. Clean, coarse gravel should be supplied in a box to furnish grit.
7. Chick-size oyster shell should be accessible to the poults while young.
8. The poults should be continued on the mash and grain feed until ready for market. Be sure the corn and kafir is old and not from the new crop. Moldy or musty feeds should never be fed to turkeys at any time.

The grain and mash feeds used in this feeding method are as follows:

ALL-MASH FEED.

20 pounds yellow corn meal.
20 pounds ground wheat.
20 pounds ground oat groats *(a)*.
15 pounds meat scrap.
10 pounds dried buttermilk *(b)*.

SCRATCH FEED.

75 pounds cracked yellow corn.
25 pounds wheat.

(a) May be replaced by ground oats when poults are 12 weeks old.
*(b)* If skim milk or cottage cheese is available omit the dried buttermilk and increase the yellow corn meal from 20 to 40 pounds per hundredweight of the mixture.

## DISEASES DUE TO WORMS

### MANSON'S EYE WORM

Eye disease due to the parasite *(Oxyspirura mansoni)* is common in the southern portion of the country, but has not been reported in Kansas.

The worm is not transmitted by contact or by feeding the worm eggs, but appears to require residence in the body of a cockroach *(Pyenoscelus surinamensis* Linn.). Sanders[22] has found the larvae imbedded in the adipose tissue and free in the body cavity of those roaches. The worm larvae are freed in the crop of the bird and may reach the eye within twenty minutes after the roach is eaten. The larval worm migrates up the esophagus to the mouth and reaches the eye through the nasolachrymal duct. Here the worms reach sexual maturity and lay eggs which reach the intestines and pass out in the droppings. In this manner they reach the roaches which are common in poultry yards.

**Symptoms.**—The worms are located in the tear sac of the eye and under the nictitating membrane (thin membrane). Here they may set up an inflammation leading to excessive secretion of tears and irritation. The bird scratches the eye, thus leading to injury and severe ophthalmia. During this stage of the disease the worms leave the eye and conditions develop which cannot be distinguished from ordinary ocular roup.

**Treatment.**—Since the cockroach becomes infested with these worm larvae from consuming eggs in the droppings of birds which carry the adult worm, a daily removal of droppings will eliminate the most serious source of trouble. Runs that are clean, free from trash, loose boards, and mudholes, and exposed to the sun will drive the cockroaches to seek a more congenial location and thus take them out of the reach of the birds. The roaches live in trash, under boards in moist places, and feed at night. They do not, inhabit clean, well-lighted runs.

The birds may be freed of worms by carefully lifting the membrane covering the eyeball and introducing a drop or two of 2 per cent, cresol solution daily for a few days. A drop of 5 per cent creolin has been recommended to kill the worms immediately, but must be removed at once by irrigating the eye with water.

Since most common wild birds which frequent poultry yards are easily infested by the worms they may act as carriers and spread

22. Saunders D. A. Manson's eye worm of poultry. Jour. Amer. Vet. Med. Assoc. Vol. 25 (n.s.) No. 5: pp. 568-584. Feb., 1928.

the trouble from farm to farm. These birds should be kept out of poultry houses as much as possible. Sanitary premises and self-feeders will prevent their frequenting the runs in large numbers.

### GAPES

Gapes is a disease of young fowls caused by a small, reddish worm, *Syngamus trachealis,* which attaches itself to the mucosa, (inner lining) of the trachea (windpipe). 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,

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

### ROUNDWORMS

Two species of roundworms are common in Kansas chickens. The large roundworm, *Ascaridia lineata* (fig. 22), 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. Ackert has found that if the birds have reached the age of three months before the large roundworm of the intestine becomes fully established the worms do not cause such a severe disturbance as is due to early infestation.[23]

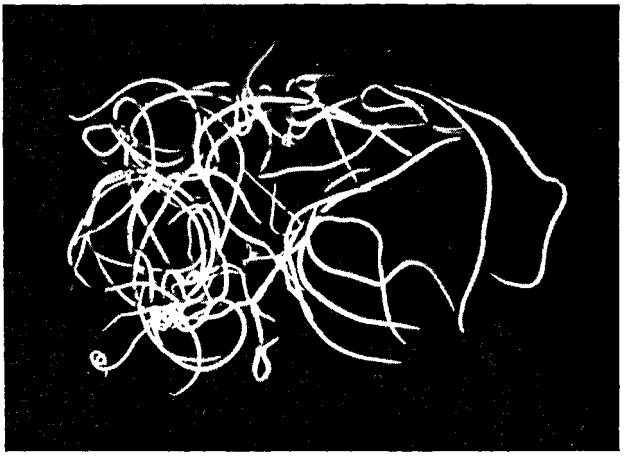

FIG. 22.—Roundworm parasites (*Ascaridia lineata*) from small intestines of a chicken. (*Courtesy J. E. Ackert.*)

**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

23. Ackert, J. E. Parasitologist, Kan. Agr. Expt. Sta. Personal communication.

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. Some practical feeders keep this before the birds continually. 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.

When possible the birds should be shut in the coops during the treatment and for at least twenty-four 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.

Note.—It has been estimated that tobacco dust will lose 14 per cent of its nicotine content each month it is exposed to the air. For this reason it should be sealed in air-tight containers until used. When mixed in mash and exposed to the air it rapidly deteriorates and soon becomes useless.

Graybill and Beach[24] have recommended the use of carbon tetrachloride for the cecum worm and large roundworms. It is most conveniently and safely administered in 1 c. c. gelatin capsules. The dose for an adult bird is 3 c. c. They found that the rectal injection of from 5 to 15 c. c. gave approximately 60 per cent efficiency in removal of cecum worms, with complete failure in some cases.

Freeborn[25] stated that nicotine sulphate mixed with fullers' earth (Lloyd's alkaloidal reagent) was effective and not poisonous since the nicotine is not liberated until it reaches the small intestines. The mixture of nicotine sulphate (40 per cent nicotine) at the rate of 6.6 c. c. (7.92 grams) to 16 grams of the earth placed in 55 No. 2 capsules and given at the rate of 1 capsule per bird has given good results. GREAT CARE MUST BE USED IN GIVING NICOTINE SULPHATE BECAUSE OF ITS HIGH TOXICITY.

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

24. Graybill, H. W., and Beach, J. R. Anthelmintic treatment for the removal of heterskids in fowls. The Cornell Vet. Vol. 15, No. 1, pp. 21-36, Jan., 1928.

25. Freeborn, S.B. Nicotine as a poultry vermifuge. Science. Vol. 57, No. 1485, p. 692 June 15, 1923.

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 chenopodiunm (1 teaspoonful) to six fluid ounces of olive oil or cotton seed 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.[26]

Another treatment which may be used with success is a mixture of equal parts of turpentine and cottonseed oil. Each bird should be given 4 c. c. of this mixture (by mouth) before the morning feed.

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 to insure death of larvae 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. 23) In contrast to this species is another, *Amoeboenia 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-

26. For additional details see U. S. Dept. of Agr. Farmers Bul. 1337, Diseases of poultry. Pages 31-32. 1923.

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 a snail, an-

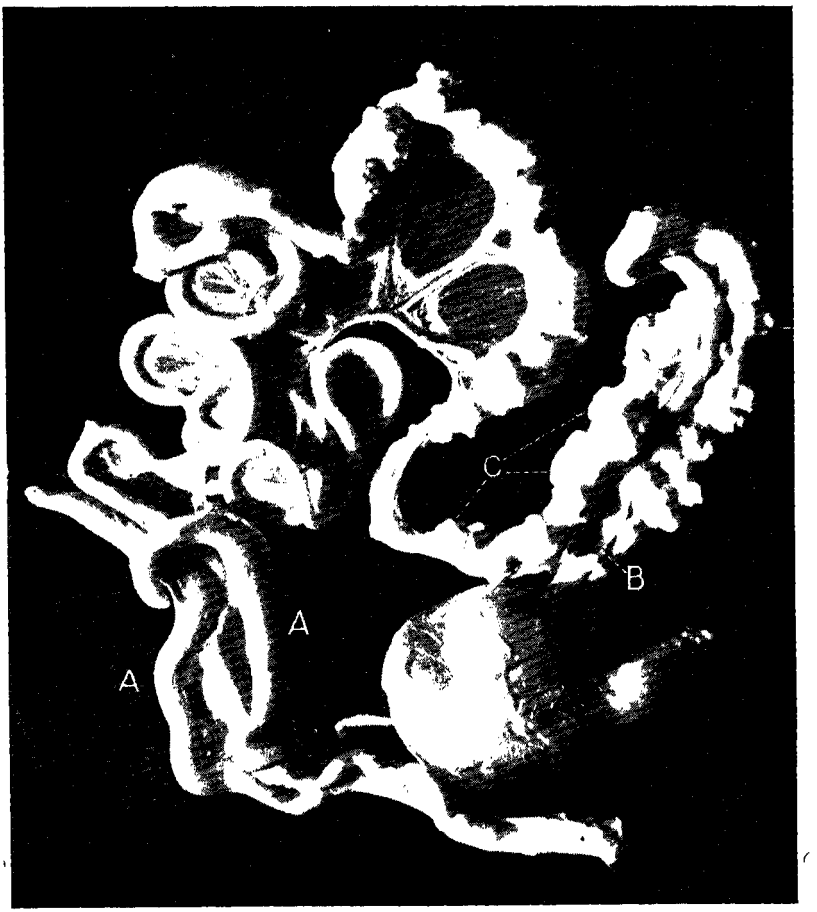


FIG. 23.—Intestines of chicken showing nodular tæniasis due to the action of *Davainea echinobothrida* (a certain kind of tapeworm). (A) The ceca (blind pouches). (B) Pancreas. (C) Nodules on small intestines.

other 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. 24) resemble those shown by birds infected with roundworms, and in addition nervous conditions are often noticed. Wryneck is common, and the bird in this condition often continually holds its 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. Ducklike attitudes are common, and one bird sent to this laboratory assumed a typical penguin-like posture. (Fig. 25.) Lameness and paralysis are also


FIG. 24.—(A) A chick three months old heavily infested with tapeworms. (B) A portion of the intestines of chick A. (*Courtesy J. E. Ackert.*)

characteristic in severe outbreaks. Young birds heavily infested with tapeworms do not develop feathers properly, and late chicks may be severely sunburned as a result.

**Treatment.**—Unlike the case of roundworms, preventing the birds from picking up eggs from the droppings will not prevent them from becoming infested, for the egg has to be taken up by flies or


FIG. 25.—Penguin-like posture assumed by a young bird heavily infested with tapeworms.

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 flies, etc. (intermediate hosts), getting the eggs. Control measures will be greatly aided by careful attention to destruction of droppings and refuse in houses and runs. 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.

At the present time kamala is being used successfully for the removal of tapeworms of poultry. Fifteen-grain tablets of crude kamala are given to vigorous, mature chickens, while for immature, weak birds and those heavily infested with worms, 7½-grain individual doses are recommended. For large, vigorous turkeys, 30 grains are recommended. The kamala tablets in the proper size for individual treatment of poultry may be obtained from a veterinarian or druggist. The tablets are readily swallowed if they are placed well back in the fowl's mouth.

For the best results the kamala treatment should be repeated in three or four weeks. Kamala may cause a considerable drop in egg production for a week or two following its use, while very weak or heavily infested birds may die. However, results tend to show that the drop in production after treatment of an infested flock may be more than compensated for by an increase within a short time and that ill results are not common.

Kamala cannot be given satisfactorily as a mass treatment in the feed because it becomes distasteful in a moist mash and the fowls do not consume it readily. This objection is partly overcome by placing it in dry mash, but individuals may receive too little or too much when it is given in this manner. It is unnecessary to keep feed from the birds previous to giving kamala or to give a physic following the treatment.

Another treatment consisting of equal parts of turpentine and olive oil has been found to be 69 per cent, efficient in removing tapeworms. The birds should be shut up at night and the following morning given one-half to one tablespoonful of the mixture. Food in the form of a mash may be given the birds within three hours after treatment and to this should be added one-half pound of Epsom salts for 100 adult birds. Regular feeding can then be continued, but the flock should be kept housed until the following morning. The houses should then be cleaned thoroughly as described under roundworms.

A convenient way of giving birds individual medical treatment is to use a piece of 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 3/8-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. 26.) 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 esophagus while inserting it.

FIG. 26.—A bird being given medical treatment by means of a pipette made from glass tubing.

Chandler[27] has recommended the use of iodine preparations for the control of intestinal worms in poultry. He states that a small amount of iodine applied in the proper form will destroy both the worm eggs and worms.

A product called iodine suspensoid has been developed which is claimed to destroy worms and eggs on floors and in soil. For cleaning floors the treatment is at the rate of one gallon per 100 square feet, and for soil three gallons per 100 square feet. The product has a commercial strength of about 4 per cent iodine and is diluted twenty times with water at the time of using.

There has also been developed an iodine vermicide which is recommended for treating the birds. The dosage of this product ranges from one-half ounce in case of young birds weighing from one to three pounds to one ounce for adult birds. It is administered directly into the gizzard by means of a flexible catheter. This product destroys large roundworms and cecum worms.

Arecoline hydrobromide, given in 0.1 grain doses, has given good results at the 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.

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. 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. This makes individual treatment preferable.

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27. Chandler, W. L. Iodine on the poultry farm. Poultry Sci. Vol. VI, No. 1, pp, 21-35. Oct.-Nov., 1926.

### GIZZARD WORMS

A number of cases of gizzard-worm infestation recently have been called to the attention of the authors. These worms, *Dispharagus hamulosus,* infest the muscular tissue of the gizzard and cause a nodular condition of the external surface and a loosening of the membrane lining the cavity of the gizzard. It is within these nodules that the worms are found. They are round, vary from one-fourth 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 saclike appendage. (Fig. 27)

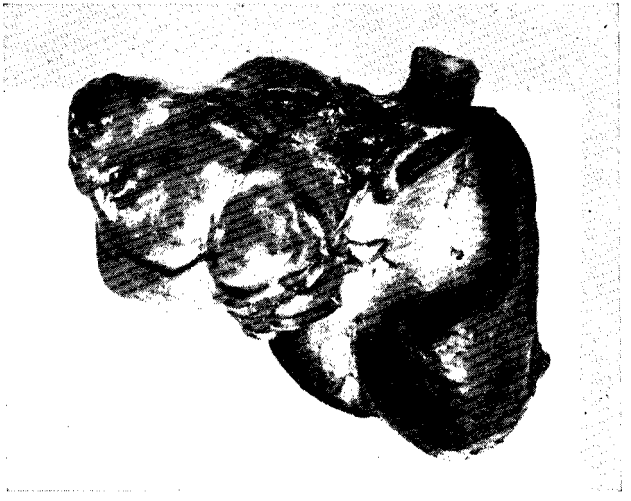

FIG. 27.—The gizzard of a chicken showing saclike formation on the left, due to the action of gizzard worms.

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

**Treatment.—** Treatment is without avail, since it is impossible to get drugs to the affected portion of the gizzard. Turpentine, 1 to 4 c. c. in some bland oil as described for tapeworms, has been suggested by Kaupp.[28] 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.

28. Kaupp, B. F. Poultry diseases. Fourth edition. Published by Alexander Eger. Chicago. 393 pp. Figs. 158. 192; (See p. 135.)

### SKIN FLUKES [29]

Chickens and turkeys as well as common wild birds, such as the sparrow, are sometimes infested by flukes of the genus *Collyriclum*. The life history of the fluke is unknown at present, but birds which frequent lake borders and swampy land suffer most.

**Symptoms.**—The most conspicuous lesions are small blisters about the vent and along the lower side of the body. These blisters sometimes develop as a berrylike mass on various portions of the body. The cysts are smooth and shiny, grayish-white in color and vary in size from 2 to 3 mm. up to 10 mm. in diameter. Frequently a mass of degenerating cysts may be removed, leaving an irregular yellowish-white area.

**Treatment.**— Adequate control measures cannot be devised until we have a better knowledge of the life history of the parasite. At present the only suggestion to be offered is to keep chicks and poults on dry, well-drained and sanitary runs.

## DISEASES DUE TO LICE AND MITES

### 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 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 bloodsucker 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.

Eggs are laid in cracks and hatch in about two days. The adult stage is reached in about eight days. The rate of development depends somewhat upon the temperature. The insect develops most rapidly in July and August.

**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

29 Riley W. A., and Kernkamp, H. C. H. Flukes of the genus Collyriclum as parasites of turkeys and chickens. Illus. Jour. Amer. Vet. Sci. Assoc., Vol. 17 (n. s.), No. 5, pp. 591-509. Feb., 1924.

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. An occasional treatment, of the roosts with Black Leaf 40 is also very effective. 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.

### 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 un-

feathered parts of the leg. (Fig. 28.) 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, one part, and Vaseline, five parts. Equal parts of kerosene and olive oil well rubbed in is also very good. Apply on several successive days.

FIG. 28.—The leg of a chicken as it commonly appears in scaly leg.

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, *Cytoleichus 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 infection. 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 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 sulphur will also tend to keep the mite from infesting the chicks. Fenced-in ranges may also be dusted with flowers of sulphur with a dust blower at the rate of fifty 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.

### TROPICAL MITES

The tropical mite *(Liponyssus bursa),* also called feather mite, is a serious pest of poultry and has recently become widely spread over this country. Poultry shows as well as poultry traffic in general

have been the most important factors in their spread. However, wild birds, animals, and man may carry these mites from infested to previously free premises or flocks. Unlike the red mite the tropical mite lays its eggs on the fowl and spends its entire life on the bird, although when present in large numbers they may be found in the nests and on the perches. The mites are often found on loose feathers on the floors and dropping boards.

These mites, like the red mite, are bloodsuckers and cause severe irritation and rapid loss of flesh. Production and growth are naturally very seriously impaired.

The following treatments have been recommended (Kaupp) as being very effective: Dip the birds in either of the following preparations, using a washtub:

1. 20 ounces sulphur.
   10 ounces soap.
   10 gallons water.
2. A solution containing 0.5 of 1 per cent zenoleum.

At this station better results have been obtained by use of the nicotine sulphate treatment recommended for lice and outlined in the section devoted to control of lice.

#### OTHER MITES

Several other mites of lesser importance infest chickens. The depluming mite, *Cnemiodocoptes 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 sulphur 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 bloodsucking 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 Wood[30] 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 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.

Another treatment against lice as well as tropical mites by the use

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

of Black Leaf 40 has recently been used with good success. This method eliminates the extra time and labor of handling each individual bird.

Nicotine sulphate in the form of Black Leaf 40 is applied to the perches in a very thin line by means of a small brush or by pouring out of a vessel with a very small opening. The material should be applied early enough that it may dry before the birds go to roost. The warmth of the body of the bird causes the nicotine to volatilize and as the vapor rises it reaches all the surfaces of the body of the bird, particularly the base of the feathers where the lice are most numerous. The lice are killed within a short time and drop to the floor.

One treatment may be sufficient, but if on an examination of a representative number of birds three days after treatment lice are still present the treatment may be repeated. Reinfestation with newly hatched lice may require a second treatment. Birds that do not reach the treated perches may be treated by placing them in a nest or small coop in which a small amount of Black Leaf 40 has been placed. For the tropical mite at least three treatments are necessary.

Great care must be exercised in using products containing nicotine sulphate because of the poisonous effects on animals and man. If any of the material reaches the clothing or skin of the operator it should be washed off at once to prevent absorption.

### 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 henhouses by burning is necessary to con-

trol an infestation.[31] Birds should be moved to new places during the daytime, since the ticks are on the birds only at night.

## MISCELLANEOUS DISEASES

### POISONING BY DEATH CAMAS

While this disease is rarely diagnosed it may be more common than is generally supposed. An outbreak of poisoning by this plant caused a short investigation to be made of the effect of the plant on adult birds.

The disease occurs in the early spring when there is little green feed or after a late frost when the other green plants have been killed. The plant somewhat resembles an onion but is without odor. It is widely distributed in Nebraska, Kansas, Oklahoma and Texas.

**Symptoms.—** A few hours after eating the tops of the plant the birds show signs of poisoning. There is weakness and excessive flow of saliva. Poisoned birds may remain in this condition for several days before death. There is a profuse putrid diarrhea and no appetite. There is staggering and difficulty in walking. On post-mortem examination there is inflammation of the intestines and congestion of the lungs. If the birds live several days there are ulcerated patches on the comb.

**Treatment.—** There is no satisfactory treatment for poultry poisoned by death camas. The best method of control is to keep the birds off the open range, where the plant is commonly found, Plants should be removed from all yards. When there is plenty of green feed birds will not eat the death camas.

### 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, etc., 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

31. For further information on the control of the fowl tick consult: Bishopp, F. C. The fowl tick. U. S. Dept. of Agr. Bur. of Ent. Circ. 170:1-14, Figs. 5, 1913.

in tin or galvanized vessels. Rose chafers, if eaten in considerable numbers, are also poisonous.[32]

**Symptoms.**—The sudden appearance of a large number of sick birds showing darkened combs, prostration, and wryneck, 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 inclosed 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 the eastern part of the country, but is not so common in Kansas, although increasing each year. 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.

Stafseth and Johnson[33] have found that coccidiosis may be the cause of a paralysis in chickens. At this station some evidence has been found which indicates that coccidia and tapeworms may be associated with this trouble.

**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

32. Lamson, G. H., Jr. The poisonous effects of the rose chafer upon chickens. Science, n. s., 43:138-139. 1916.

33. Stafseth, H. J., and Johnson, E. P. Range paralysis of poultry. Mich. Agr. Expt. Sta. Quar. Bul., Vol. 9, No. 3. Feb., 1927.

and there is sometimes paralysis of the eye muscles 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. The peripheral nerves leading to the paralyzed members may be enlarged and infiltrated with round cells. 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 equipment.

### HEAT STROKE AND SUNBURN

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.

Young birds or birds suffering from tapeworm infestation so that they develop feathers slowly may become badly sunburned. Such birds must be given adequate shade.

### SOD DISEASE [34]

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. In many cases the skin of the head about the eyes and beak is affected in much the same way. 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. (Fig. 29.)

**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

34. Newson, I. E., and Feldman, W. H. Sod disease of chickens. Color. Agr. Expt. Stat. Bul. 262:1-12. Figs. 6. 1920.

heavy sod pastures until they are a few weeks old will do much in the way of prevention.

### 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 or mash containing an improper mineral mixture may cause lameness and swollen joints, and if a large number of birds become so affected, the ration and housing should receive

FIG. 29.—Lesions on feet of a young chick, a typical case of sod disease.

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, tumorlike 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 corelike center, although at times only a hard tumorlike 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 uncommon, but usually do not cause much 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. Tumors may cause lameness or paralysis by pressure on a nerve.

### ULCERATIVE CLOACITIS (INFLAMMATION OF CLOACA)

This disease, commonly called "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.

In some cases a diet too high in protein, such as tankage, may cause this trouble. In such cases it will be necessary to change the feed to correct this condition.

Some practical poultrymen consider that heavy infestation of lice may predispose the membranes of the vent to infection. This is a factor which may be easily removed.

### CROP BOUND (IMPACTION OF THE CROP)

Continued feeding of dry grains and fibrous material, 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 (windpipe) may cut off the air supply and cause suffocation. After passing water into the impacted crop (fig. 26), 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. Follow the operation with soft feeds until the birds recover.

### 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 Gallagher 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.

**Treatment.**—Isolate the bird, grease the oviduct with zinc oxide ointment 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

35. Ward R. A., and Gallagher, B. A. Diseases of domesticated birds. 333 pp. Figs. 69. The Macmillan Co. New York. 1922. (Ref. P. 165.)

walls to contract. Treatment may have to be repeated several times before the bird is cured.

As the occurrence of one case of prolapsed oviduct, particularly in closely housed flocks, may result in vent picking of healthy as well as the affected birds, serious harm with heavy losses may result in a short time.

Birds that are particularly active and those that are the chief offenders may be controlled by removing the tip of the upper beak. A shallow cut is made on each side of the beak about one-eighth inch back of the point, the beak is then broken off at this point. It is not desirable that the point be entirely cut off as the "quick" is much more readily injured by using a knife to complete the procedure.

This simple operation will not prevent the bird from eating normally, nor will it decrease production or otherwise injure the bird. It takes about three weeks for the point of the beak to grow out again. After this length of time the bird seldom takes up the habit again.

### RUPTURE OF OVIDUCT

The oviduct may rupture due to severe inflammation or attempt to pass large eggs or masses of egg material. This allows the egg material to collect in the peritoneal cavity, where it causes peritonitis and occasionally coagulates into solid masses. These masses may become large enough to interfere with the function of the abdominal organs and cause a pendulous abdomen. This trouble is not common but may cause some loss where heavy birds are forced to fly from high perches to a hard floor.

**Symptoms.**—The bird ceases to lay, the abdomen becomes hard and sometimes pendulous and the bird will sit in an upright position (Fig. 30.) When forced to walk about, the tail may drag on the ground. Sometimes the birds die quickly, the comb showing bluish discoloration. (This condition resembles cholera.)

**Treatment.**—There is no treatment possible except to protect the birds from injury and feed and exercise them to avoid excessive development of fat.

### RUPTURED OVA

This is an important disease in Kansas. Table II shows that as a cause of death it is more important than botulism. Within the past eight and one-half years birds suffering from this disease have

been received at this laboratory from 137 flocks. The ova may rupture into the abdominal cavity or they may rupture within the oviduct. In some cases death follows rapidly while in others it does not appear to injure the bird to a great extent.

**Symptoms.**—When in the peritoneal cavity the yolk may be broken and be distributed over the organs and walls. Here it usually becomes thickened and somewhat dry. In the oviduct the

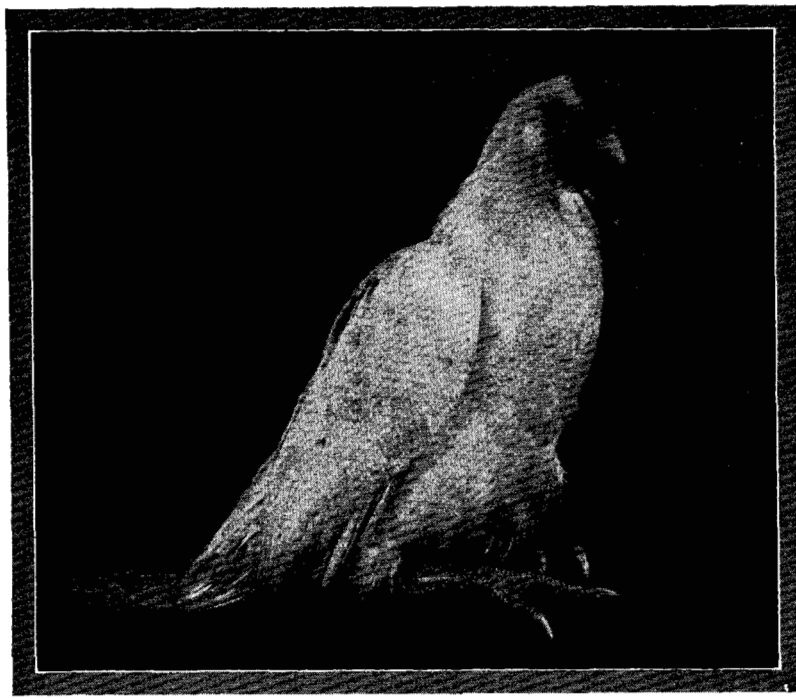

FIG. 30.—Posture commonly assumed following rupture of the oviduct.

ruptured ova are not passed out because the contracting muscles of the organ cannot act upon it. The presence of this material leads to severe catarrhal peritonitis with thickening of the membranes. The birds often die with symptoms of cholera and sometimes the cholera organism may be isolated from the internal organs.

**Treatment.**—Reduce the amount of protein and concentrates in the feed. Lower the high perches and cover cement floors with a thick layer of straw. Give the birds plenty of exercise and adjust the ration to avoid excessive fat. A dose of Epsom salts at the

rate of one pound per 100 adult birds is often effective in temporarily controlling the trouble.

### EDEMA OF THE WATTLES

This disease is especially common in a breeding flock containing several male birds. Birds of both sexes are affected, but it is primarily a disease of males. The cause of this trouble is unknown, but in some of the most severe outbreaks the organism of chicken cholera seems to be the primary factor. Several pus-forming organisms have been isolated and the disease probably is not specific.

**Symptoms.**—The wattles become swollen and hot. In most of the cases but one wattle is involved. The birds become listless and show loss of appetite. The swelling extends and may involve the head. The wattle is red at first but later becomes more yellow and grayish in color. In some cases the liquid within the wattle becomes caseated (cheeselike) and may be easily removed. The diseased wattle shrivels and in some cases becomes one-half the size of the unaffected wattle. The death rate is not high, but the birds lose flesh and become unthrifty and may be killed by the more vigorous birds.

**Treatment.**—This infection usually gains entrance to the wattle through wounds due to fighting. Davis[36] has recommended the practice of cropping the wattles and thus removing them from possibility of injury. Heavy clamps are placed on the wattles close to the lower mandible to reduce hemorrhage. The wattles are cut off by means of curved shears and the cut edges treated with chloride of iron solution or an astringent dusting powder. When the clamps are removed there is very little hemorrhage and infection is rare.

### 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 dust-

36. Davis, D. E. Edema of the wattles in cockerels. Jour. Amer. Vet. Med. Assoc., Vol. 19 (n. s.), No. 5, pp. 588-598. Feb., 1925.

ing 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 making an x-shaped cut in 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 weaklings of the flock usually suffer 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 removed. Plenty of exercise and green feed may help to correct the habit. Klee[37] 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, pigpens, 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 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. One per cent potent cod-liver oil added to the feed may be used as a substitute for sunshine.

**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.

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

**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.**—In addition to 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 are vitamins A and D. The lack of vitamin A lends to ophthalmia, loss of balance, and rapid death. Cod-liver oil, yellow corn, and alfalfa leaves provide vitamin A in large quantities. Lack of vitamin D causes leg weakness (rickets). Vitamin D is supplied by feeding cod-liver oil and by proper exposure to the sun's rays.

Chicks should not be fed too soon after hatching. About the nineteenth 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.

**14. Coccidiosis.**—This disease does not usually cause loss until the chicks are two or three weeks of age, but chicks less than one week of age have been known to be affected.

# APPENDIX

## USEFUL INFORMATION

### APPROXIMATE EQUIVALENTS

60 grains = 1 dram = 4 grams = ⅛ 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 = 2½ fluid drams = 10 c. c.
1 tablespoonful = 4 fluid drams = 16 c. c.
1 teacup = 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 whitewash that has a disinfectant value in addition to its other properties:

| | |
|---|---|
| (1) Hydrated lime[38] | 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 | 1 ½ 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.

### MEDICATED VASELINE

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

Mix well before applying and use for wounds, etc.

### 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. |

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

**DOSAGE TABLE FOR ADULT FOWLS**

| DRUG. | Therapeutic Dose. | Nontoxic Dose. | Toxic Dose. |
|---|---|---|---|
| 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. | 1¼ to 1¾ dr. | 2½ dr. |
| Strychnine sulfate | 0.25 to 0.5 gr. | 2 gr. | 3 gr. |
| Sulphocarbolate of calcium | ¼ to ½ gr. | | |
| Sulphocarbolate of sodium | ¼ to ½ gr. | | |
| Sulphocarbolate 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.

## 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 affected fowls?
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 21.
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 25, also chart on page 21.

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 spray 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 ON THE AGGLUTINATION TEST FOR 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. 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. 31) are necessary for drawing blood for the tests:

1. Small sharp-pointed scalpel (D) or knife.
2. Leg bands (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.

**PROCEDURE**

1. Catch each bird and mark with a leg band 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. 32A) and use the left hand to spread the right wing full width and in a vertical position as indicated in figure 32B and C.

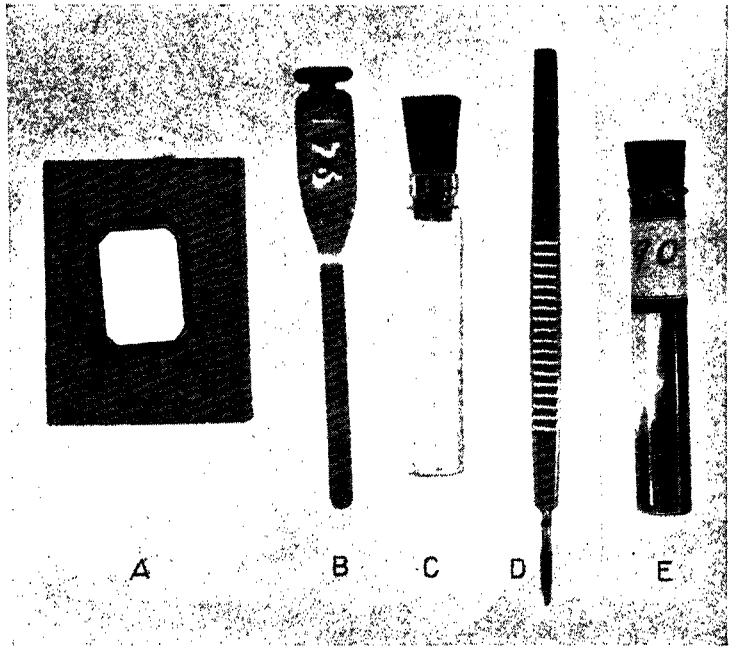


FIG. 31.—Equipment necessary for drawing blood for bacillary white diarrhea tests. (A) Gummed labels. (B) Leg band. (C) Vial for receiving blood. (D) Scalpel for puncturing wing vein. (E) Vial ready for shipment.

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. 31D.) The cut should be lengthwise and not across the vein if made with a scalpel. Scissors may be used instead of a scalpel. If scissors are used a small cut is made in the exposed surface of the vein. This cut is made across the vein and not lengthwise.

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


FIG. 32.—Pictures illustrating method of bleeding birds for bacillary white diarrhea test. (A) Method of holding bird. (B) Method of puncturing wing vein. (C) Method of collecting blood in vial.

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

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

2. If the blood is to be shipped it is necessary to dry two drops of 5 per cent solution of boracic acid on the sides and bottom of each vial as a preservative. (Vials shipped from this laboratory are ready to be used without further treatment.)

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

4. Thoroughly wipe the instrument used for cutting the vein 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 other than boracic acid for the 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. 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.