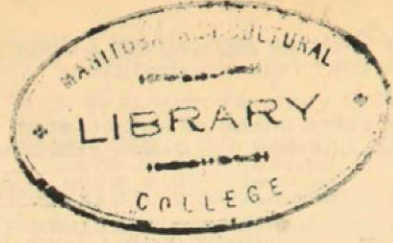


2

1) Colorado

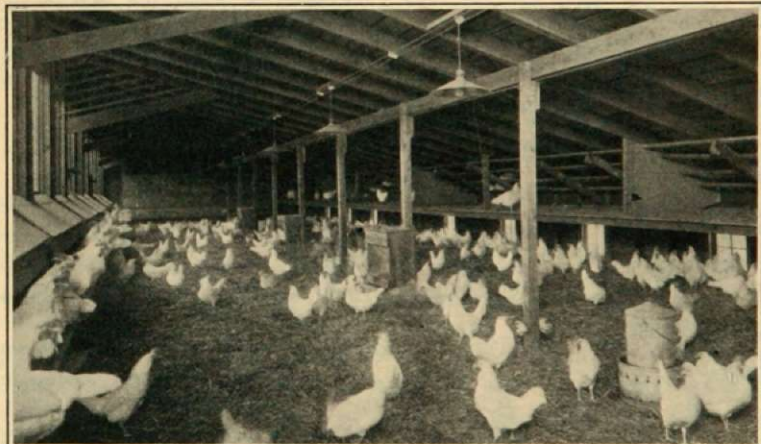
3) 4)
Bulletin 372

December, 1930



DISEASES OF POULTRY

By I. E. NEWSOM



2)
 COLORADO AGRICULTURAL COLLEGE
 COLORADO EXPERIMENT STATION
 FORT COLLINS

The Colorado Agricultural College
FORT COLLINS, COLORADO

THE STATE BOARD OF AGRICULTURE

E. R. BLISS, Pres.....Greeley	JAMES P. McKELVEY.....La Jara
MRS. MARY ISHAM.....Brighton	H. B. DYE.....Manzanola
J. C. BELL.....Montrose	O. E. WEBB.....Milliken
W. I. GIFFORD.....Hesperus	T. J. WARREN.....Fort Collins

Ex-Officio } GOVERNOR W. H. ADAMS
PRESIDENT CHAS. A. LORY

L. M. TAYLOR, Secretary VERNER U. WOLFE, Treasurer

OFFICERS OF THE EXPERIMENT STATION

CHAS. A. LORY, M.S., LL.D., D.Sc.....	President
C. P. GILLETTE, M.S., D.Sc.....	Director
L. D. CRAIN, B.M.E., M.M.E.....	Vice-Director
L. M. TAYLOR.....	Secretary
ANNA T. BAKER.....	Executive Clerk

EXPERIMENT STATION STAFF

<p style="text-align: center;">Agronomy</p> <p>Alvin Kezer, A.M., Chief Agronomist David W. Robertson, M.S., Ph.D., Associate J. W. Adams, B.S., Assistant G. W. Deming, B.S., Assistant Robert Gardner, B.S., M.S., Assistant Dwight Koonce, B.S., Assistant Roy D. Hockensmith, B.S., M.S., Associate Warren H. Leonard, B.S., M.S., Assistant</p> <p style="text-align: center;">Animal Investigations</p> <p>George E. Morton, B.S.A., M.S., in Charge E. J. Maynard, B.S.A., M.S., Associate B. W. Fairbanks, B.S., Associate H. B. Osland, B.S., M.S., Assistant</p> <p style="text-align: center;">Bacteriology</p> <p>W. G. Sackett, Ph.D., in Charge Laura Stewart, B.S., Assistant Sarah E. Stewart, B.S., M.S., Assistant</p> <p style="text-align: center;">Botany</p> <p>L. W. Durrell, Ph.D., in Charge Anna M. Lute, A.B., Ph.Sc., Seed Analyst E. C. Smith, A.B., M.A., M.S., Assistant Bruce J. Thornton, B.S., M.S., Assistant E. W. Bodine, B.S., M.S., Assistant Don Cation, B.S., M.S., Assistant Mary F. Howe, M.S., Ph.D., Assistant Melvin S. Morris, B. S., Assistant E. J. Starkey, B.S., M.S., Assistant</p> <p style="text-align: center;">Chemistry</p> <p>Wm. P. Headden, A.M., Ph.D., D.Sc., in Charge Earl Douglass, M.S., Associate J. W. Tobiska, B.S., M.A., Associate C. E. Vail, B.S., M.A., Associate</p> <p style="text-align: center;">Entomology</p> <p>C. P. Gillette, M.S., D.Sc., in Charge W. L. Burnett, Rodent Investigations J. L. Hoerner, B.S., M.S., Associate George M. List, B.S., M.S., Associate Chas. R. Jones, M.S., Ph.D., Associate Miriam A. Palmer, M.A., M.S., Associate Sam McCampbell, B.S., Assistant J. H. Newton, B.S., Assistant R. G. Richmond, B.S., Assistant Lestlie B. Daniels, B.S., Assistant</p>	<p style="text-align: center;">Home Economics</p> <p>Inga M. K. Allison, F.B., M.S., in Charge Florence N. Schott, B.S., M.S., Associate</p> <p style="text-align: center;">Horticulture</p> <p>E. P. Sandsten, Ph.D., in Charge A. M. Binkley, B.S., M.S., Associate Carl Metzger, B.S., M.S., Assistant Geo. A. Beach, B.S., Assistant</p> <p style="text-align: center;">Irrigation Investigations</p> <p>R. L. Parshall, B.S., in Charge Carl Rohwer, B.S., C.E., Associate W. E. Code, B.S., C.E., Associate R. E. Trimble, B.S., Meteorologist L. R. Brooks, B.S., Assistant</p> <p style="text-align: center;">Rural Economics and Sociology</p> <p>L. A. Moorhouse, B.S.A., M.S., in Charge R. T. Burdick, B.S., M.S., Associate B. F. Coen, B.L., A.M., Associate D. N. Donaldson, B.S., M.S., Associate G. S. Klemmedson, B.S., M.S., Associate H. B. Pingrey, B.S., M.S., Assistant</p> <p style="text-align: center;">Veterinary Pathology</p> <p>I. E. Newsom, B.S., D.V.M., in Charge Floyd Cross, B.S., D.V.M., Associate Bryce R. McCrory, M.S., D.V.M., Assistant</p> <p style="text-align: center;">Veterinary</p> <p>Geo. H. Glover, D.V.M., M.S., in Charge</p> <p style="text-align: center;">Editorial Service</p> <p>I. G. Kinghorn, Editor Arthur Robinson, Associate Editor Esther Horsley, Assistant Editor</p> <p style="text-align: center;">Engineering Division—Mechanical Engineering</p> <p>L. D. Crain, B.M.E., M.M.E., Head of Division, in charge of Mechanical Engineering F. E. Goetz, B.S., M.S., Associate</p> <p style="text-align: center;">Civil Engineering</p> <p>E. B. House, B.S., (E.E.), M.S., in Charge Carl Carpenter, B. S., Testing Engineer</p>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

DISEASES OF POULTRY

By I. E. NEWSOM, Veterinary Pathologist

HYGIENE AND SANITATION

While knowledge of the cause of disease and its control is essential to the poultryman, the ideal should always be kept in mind of a system of management that will keep the birds in a state of health. Theoretically at least this is a possible accomplishment and an outbreak of disease in a flock is evidence that the laws of hygiene have not been fully observed.

When poultry were raised mainly on farms and in small numbers, hygienic considerations were of little importance. The fowls ran widely over the farmyards and picked up a great variety of food which, for the most part, was adequate, thus protecting themselves against the inroads of disease. With the increase in size of the flocks the opportunities for spread of disease were greater and the difficulties of housing and feeding were much increased. With the modern poultry plant of today careful attention must be given to these details or the business cannot be maintained.

Housing

While it is not intended to give details for building poultry houses, which can be obtained from many other sources,* the general problem of housing in the prevention of disease is of the utmost importance. An adequate supply of air without drafts and sufficient warmth without accumulation of too much moisture are factors which must be taken into consideration. Improper or inadequate ventilation, drafty and cold houses are not infrequently responsible for the development of certain forms of roup. A special roosting floor built above that on which the feed is placed is not only valuable from the standpoint of ventilation but also prevents to a considerable degree the admixture of droppings with the feed. An adequate supply of sunlight is essential to healthy fowls and is best provided in our northern climates by facing the houses toward the south, with openings so arranged that the window coverings can be entirely removed during warm days. For ordinary purposes houses should be provided so that each mature hen will have 3 and one-half square feet of floor space. Any accumulation of moisture on the inside of the house is an indication that the ventilation is poor, while frozen combs are evidence of insufficient warmth. Between these two extremes, proper housing will result in the elimination of much disease.

*"An Improved Poultry House for Colorado Flocks." O. C. Ufford, Colorado Extension Bulletin 291-A.

Feeding

Not only must fowls have a ration* containing the organic nutrients in proper proportion but recent work indicates that minerals and vitamins are essential to the proper maintenance of health. Rickets is now known to be closely connected with vitamin D and sunlight, and a form of roup follows a deficiency in vitamin A. The close relationship between diet and infectious disease has been well worked out in the use of milk for the prevention of coccidiosis. There is a possibility that a similar relationship exists in other diseases but it is not so clearly established.

Since many diseases such as tuberculosis, blackhead, fowl typhoid, cholera, coccidiosis and intestinal parasites are commonly spread thru the droppings, it is essential that these shall not be mixed with the feed. Hoppers so arranged that the birds cannot stand in them will do much toward eliminating this possibility. The usual practice of throwing the scratch feed on the floor in order to give the birds exercise has the objection that worm eggs and disease-producing bacteria may be taken in with the feed. All efforts must be directed toward breaking this cycle if transmission of disease is to be stopped.

Water Supply

The ideal for a poultry establishment would be running water but since this cannot usually be provided, fountains of various types are used with the view of allowing the birds to get an adequate amount without getting their feet or droppings into the pan. Cleanliness of these utensils will pay large dividends. Cleaning should be carried out daily. Much stress has been laid upon disinfection of the water supply but this merely prevents the transmission of disease by that means and will not in itself control serious maladies. Most of the disinfectants added to water are valuable for only a short time after their addition. Polluted water is a fruitful source of disease-producing organisms.

Yards

The soil of runs, because it receives the droppings of the birds, is commonly infected with disease bacteria and with eggs of parasites of various kinds. The ordinary disinfectants are not particularly active in the soil and they do not injure worm eggs in the slightest. For this reason frequent change of yards with occasional cultivation is to be desired. Rotation of pens, even where the houses cannot be moved, will do much toward keeping fowls healthy.

*For definite rations refer to "Feeding Poultry from Chick to Hen," by O. C. Utford, Colorado Extension Bulletin 292-A.

Cleaning and Disinfection

Disinfection is of little value unless preceded by thoro cleaning and when cleaning is thoroly done, disinfection is often unnecessary. These operations have for their purpose the elimination of the droppings at such intervals as will prevent their contaminating the food and water supply of the fowls. This is the principle behind rotation of yards and maintaining fowls on hardware cloth. Intestinal parasites will never become a problem in a house or yard where regular cleaning is established. In houses the dropping boards should be cleaned daily and the floors should receive attention at least weekly with a constant addition of plenty of clean straw. Occasional scrubbing will be found necessary, altho in the winter dampness must be avoided. The best method of cleaning the yards is to spade or plow them up after all litter has been removed.

Sunlight is the best of all disinfectants but is only active when applied directly and cannot penetrate the soil. Chemical disinfectants are only valuable against bacterial agents and are not injurious to parasite eggs. They can be applied best with a spray. The standard for all disinfectants is carbolie acid (phenol) and all should be bought upon the guarantee of their phenol coefficient. Crude carbolie acid in itself makes a very good disinfectant when used in 5 percent solution. Compound creosol solution which is available at all drug stores is effective when used in 3 percent solution in water. Most of the coal-tar disinfectants owe their activity to the creosol content and most of them, while sold under a great variety of trade names, can be depended upon to actually possess the phenol coefficient which is published in connection with their advertising.

The disinfection of the water supply has usually been carried out by the addition of potassium permanganate. As long as the water has a slight purple color it is sufficiently strong for the purpose. Potassium permanganate, however, is readily used up by the organic matter in the water and this purple color soon fades. While this is a valuable procedure, it is probable that too much dependence has been placed upon disinfection of drinking water in times past.

Worm eggs are normally destroyed by putrefactive bacteria, consequently disinfectants, by destroying these bacteria, actually tend to preserve the eggs. Removal of the droppings at frequent intervals is the best way to prevent worm transmission.

To rid the house of mites, removal of the roosts and frequent spraying with kerosene or crankcase oil is effective.

It should be kept in mind that infection comes from the fowls themselves and that so long as disease-carrying birds remain in the

flock, disinfection of houses, yards, drinking fountains and hoppers is only of temporary value. Not infrequently the distributors of the infection are apparently healthy and for that reason cannot be removed.

Breeding

While diseases themselves are usually not inherited, susceptibility to them is a family characteristic. For that reason vigor and general healthfulness should be as much sought for in breeding fowls as egg or meat production. Without health the other qualities are sure to fail. Culling must be done vigorously in order to keep a flock in a state of health.

General Directions

Individual birds are seldom worth treatment and many poultrymen follow the practice of destroying and burning all diseased birds in the belief that the sick bird is a menace to the flock. If individual birds are to be treated they should be isolated to prevent the spread to others. Ordinarily flock treatment is the only type that is effective.

Accurate diagnosis must always precede rational treatment. As a rule poultrymen spend too much for remedies and too little on diagnosis. The department of veterinary pathology at the Colorado Agricultural College maintains a diagnostic service which is available to poultrymen of the state, but this service cannot fulfill all of the needs. There was a time when veterinarians were interested only in diseases of the horse. Now, however, every veterinary college in the United States gives a course in diseases of poultry. Many of the more recent graduates are well versed in this subject. A chicken is easily taken to the office of the nearest practitioner and much valuable time may be saved in the application of treatment.

NUTRITIONAL DISEASES

(Deficiency Diseases)

The deficiency diseases of poultry are largely of two kinds: Vitamin deficiency and mineral deficiency. Of the five commonly described vitamins, only two seem to have any importance in poultry feeding, A and D. Careful work seems to indicate that vitamin B is so commonly present in grains that, while under experimental conditions a deficiency in this vitamin will result in very marked symptoms, under natural conditions such deficiency is practically inconceivable. Vitamin C, the lack of which results in scurvy in man and guinea pigs, is either unnecessary for poultry or birds manufacture

their own. Vitamin E, the anti-sterility vitamin is also apparently of no importance in poultry feeding. This leaves us to consider only the antixerophthalmic vitamin A and the anti-rachitic vitamin D.

Vitamin A Deficiency

(Nutritional Roup)

This vitamin is present in practically all green leaves. Its deficiency is never noted in poultry during the summer time when the birds are running out on green feed. In the winter, however, this is a very common disease at the time the birds are shut up and are not receiving leafy vegetables. It is particularly important in turkeys.

The symptoms become quite pronounced and make the diagnosis of the condition quite positive. There is at first a watery discharge from the eyes and nose, simulating roup, followed by an accumulation of grayish deposit within the eye that can be easily removed as it is not adherent to the conjunctiva. In the mouth, the pharynx and the gullet, will be found little white spherical nodules projecting above the surface of the mucous membrane. These are diagnostic of the disease. Emaciation will develop and the bird will finally get weak, become paralysed and die.

This form of roup can be easily differentiated from the ocular variety by the fact that the deposit in the eye is more grayish in the nutritional disease, has no bad odor and can be easily removed. The presence of the nodules in the upper digestive tract will also separate it.

Treatment of the disease is comparatively simple, altho an adequate supply of green stuff is not always available. Cod liver oil, however, is a very satisfactory source of vitamin A as well as D and when added to the ration in the proportion of 2 percent (2 pounds to the 100) will prevent the development of this malady.



White nodules in the oesophagus show vitamin A deficiency.

Vitamin D Deficiency

(Rickets and Leg Weakness)

Vitamin D is present in most green stuff, in cod liver oil and in a variety of other foods. Apparently the ultra-violet rays of sunlight make vitamin D unnecessary and will increase its content in foods where it already exists.

This disease is most commonly seen in young chickens that are kept out of sunlight and not fed an adequate quantity of greens. It commonly goes under the name of leg weakness. Occasionally it is seen in older birds but only where they are kept indoors and are fed on dry food. The common fowl paralysis in mature birds is quite certainly not a vitamin D deficiency. Prevention of the disease is comparatively simple because mere exposure to sunlight, the addition to the ration of sprouted oats, lettuce leaves or other green stuff or codliver oil in the proportion of 2 percent, will be found effective.

Mineral Deficiency

While it is quite certain that a number of minerals are essential to an adequate poultry diet, the most common deficiency is found in calcium. Iron, copper and iodine are probably quite necessary but the ordinary poultry feeds will contain a sufficient quantity of these minerals to more than meet the nutritive requirements. There is an intimate relationship between the calcium metabolism and vitamin D so that rickets may be produced by the deficiency of either. Consequently leg weakness may develop in small chicks due to a deficiency in lime as well as by absence of sunlight or vitamin D deficiency. Crooked breasts and misshapen bones are also evidence of calcium deficiency.

In the laying hen a considerable supply of calcium is necessary in order to maintain the egg-shell production and it has been found wise to add calcium to most poultry diets. This has usually been done in the form of oyster shell, limestone or bonemeal. Bonemeal also contains phosphorous and in the proportion as used in development of bones, but for poultry most work has indicated that oyster shell and ground limestone will be about as effective as bonemeal. On the other hand, chemically pure calcium carbonate has not given as good results as the more impure forms to be found in limestone and oyster shell.

The question has recently arisen as to the possibility of adding too much mineral supplement and causing a lessened growth or egg production. Several investigators in the last few years have shown that the addition of even four parts per hundred of calcium car-

bonate might retard growth and that eight parts were quite certainly disastrous. When bonemeal was added in the same amount it gave similar results. This leads to the suggestion at least that mineral supplements might well be provided separately from the mash so that fowls can take them at will rather than forcing the birds to eat a particular amount by mixing them in the mash.

INFECTIOUS DISEASES

Fowl Cholera

This is a very acute, highly contagious disease affecting all domestic and many of the wild species of fowls. It usually affects adults, with young birds showing symptoms but rarely. This was one of the earliest diseases of fowls to be studied, the organism causing it having been isolated by Pasteur. It is also very wide spread and causes great losses among all classes of fowls in this state. In the early stages fowls are found dead, having succumbed on the nest or fallen from the roosts. Dozens of fowls may die in a single day. When seen sick, the birds appear dull, weak, refuse food and may show a yellow diarrhoea. In the acute form they seldom survive more than a few hours. After a few days the disease may assume a chronic form in which the fowls may live 2 or 3 days. Sometimes the mortality is very high after which the disease subsides as quickly as it began only to reappear the following year. At other times it takes only a few at a time but continues for weeks.

While the cause is well known, the factors that precipitate the outbreak remain unsolved. Apparently the disease arises spontaneously as it cannot be traced to the introduction of new birds, nor to a previous outbreak.

This disease is merely one of the hemorrhagic septicemias that are so destructive in cattle, sheep, swine and rabbits and doubtless is associated with some influence that lowers the vitality of the bird. Probably it is transmitted thru the droppings of infected birds.

Postmortem examination reveals little that is distinctive. A bacteriological examination is often necessary to determine accurately the cause of death.

Few birds recover and treatment is futile so that all sick birds should be destroyed immediately and the carcasses burned or buried deeply. Potassium permanganate should be added to the drinking water until the water is purple. The flock should be moved to new quarters where this is feasible. The pens and houses should be cleaned and disinfected at frequent intervals.

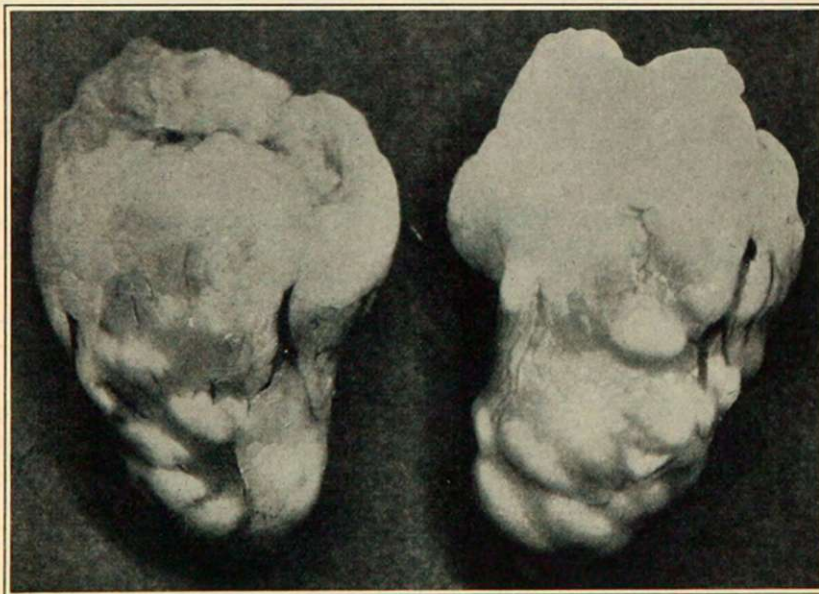
The first vaccine to be made by Pasteur was used for protection against this disease. Since that time many investigators have worked

with the problem but even now vaccination is not on a stable basis. It has been difficult to prove that any immunity could be obtained under experimental conditions. In spite of negative results in the experimental field many workers have not hesitated to advise vaccination as it is so frequently followed by a cessation of the trouble. The experience in Colorado seems to warrant us advising its use in outbreaks of the disease.

Fowl Typhoid

This disease is probably more prevalent in the state than cholera, and while it does not destroy large numbers of birds at one time it is very difficult to eliminate from a flock once it gains entrance. It is due to a germ that somewhat resembles the cholera organism and is spread in the same way. An affected bird will transmit the disease to others thru the droppings, thus infecting the food and water.

With cholera several birds will die in one day without preliminary signs of illness but with typhoid only an occasional loss will be suffered. This loss, however, may continue over a period of months. Birds are usually sick with typhoid for from 1 to 2 weeks previous to death. They will show a greenish diarrhoea, appear dull but do not lose flesh very rapidly.



A lumpy condition of the heart is associated with fowl typhoid.

On postmortem examination the tissues are all quite pale, the liver is usually enlarged and may show the presence of small grayish spots thruout. The heart may be lumpy with gray nodules or the pericardium (heart sac) may be adherent to the heart by means of a grayish exudate. The kidneys are very light in color being filled with urates.

Control consists in the destruction of diseased birds as fast as they are seen. At frequent intervals there should be a thoro clean-up of the premises followed by disinfection. Potassium permanganate may be put into the drinking water until the water is red but it should be remembered that this is not curative but only prevents the spread of the disease thru this channel.

Vaccination has been practiced with only fair results.

Sanitation and disinfection, if continuously and religiously practiced, will bring results. No medicinal treatment seems effective.

Bacillary White Diarrhea

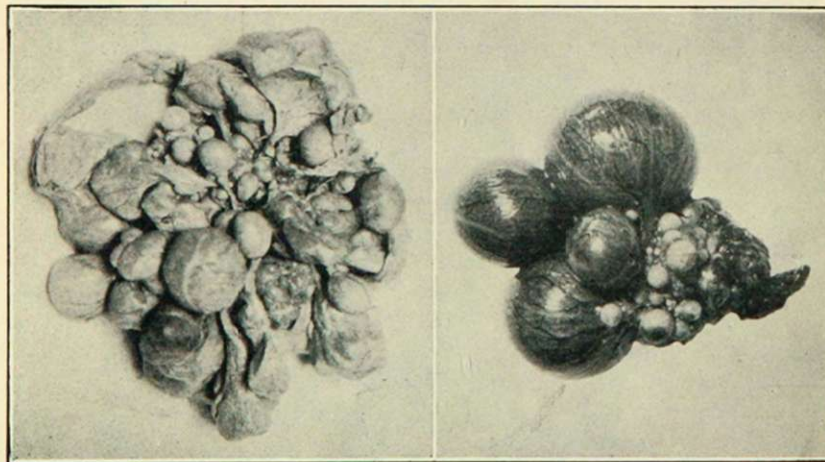
(Pullorum Disease)

This wide-spread disease was practically unrecognized until commercial hatching of chicks became prevalent. While the disease undoubtedly existed under the old system of hatching under hens, the losses were so small as to make them unimportant. It is now believed to be the most destructive disease of baby chicks and to cause a large percentage of the loss in these birds. It also has a considerable economic importance as a disease of mature fowls and is undoubtedly spread from one of these to another, altho the mortality is much lower in mature birds than it is in those a few days old.

In 1910, Rettger showed that this malady was due to a bacterial cause which now commonly goes under the name of *Salmonella pullorum*. Rettger also worked out the life cycle which has proved very interesting and furnishes the basis for control of the disease. It is now recognized that the organisms are to be found in the eggs coming from infected hens and that in a number of instances the chick is actually infected before it hatches. Presuming a single chick to be infected in a particular hatch, it is then possible to have all of the others become diseased thru contact. While the mortality is very high, a certain percentage of those that survive continue to carry the organism thruout life. In mature hens the organisms are usually found in the ovary and have been frequently cultured from the immature eggs found in that organ. While it is known that males are also sometimes reactors it is not so well determined where the organisms are to be found in the body or whether males can act as spreaders to other birds.

Baby chicks are most susceptible during the first 4 days of life and after that only slightly so, altho it must be admitted that the disease is spread even between mature fowls to some extent. Typically while the disease is spread during this early period the high mortality comes from the eighth to the twelfth day, after which it subsides and a certain, usually small percentage of the chicks survive. The mortality in many hatches may run up to 90 percent altho the average loss is probably around 50. The symptoms are not diagnostic but consist of dullness, weakness, sometimes but not always a white diarrhea and loss of appetite. Frequently the disease is a pure septicemia and may not show the symptom of diarrhea at all. Death takes place in from a few hours to several days after the first symptoms are evident.

There are no postmortem evidences that are any more accurate as a means of diagnosis than the symptoms. In a general way it may be said that the yolk remains unabsorbed and that the liver is of a yellow ochre color. The most diagnostic lesions are grayish necrotic areas in the lungs and small white areas in the heart muscle. This lung lesion has given rise to the name "brooder pneumonia" which in most instances is in reality white diarrhea. The only accurate diagnosis of this condition is made by cultures from the heart blood with determination of the organism recovered. Because of this fact, where the disease is suspected it is always best to send several of the dead chicks to the nearest laboratory for bacteriological determination.



Diseased

Normal

A cystic ovary from a hen affected with pullorum disease, compared with a normal ovary.

The ailment in older fowls usually assumes a more chronic character altho fairly acute septicemias have been described in rare instances even in these. Ordinarily, however, the organisms are confined to the ovary which shows gross evidence of their presence by becoming cystic with the ova misshapened, discolored and often solidified. Sometimes the ovary increases enormously in size and almost fills the abdomen with a cystic mass. Occasionally the liver is enlarged, mottled with whitish areas and sometimes covered with a false membrane. Occasionally, also, there may be a mass of exudate within the heart sac, causing that covering to be adherent to the heart muscle proper. This latter condition, however, is more commonly associated with fowl typhoid. As the ovary becomes diseased the number of eggs is lessened and the fertility is decreased. Finally no eggs at all are laid. Numerous statistics have shown that infected hens lay fewer eggs than normal ones and that the eggs that are laid are low in fertility and hatchability. Consequently an infected flock is economically unprofitable.

Treatment.—A great variety of dietetic and medicinal treatments has been suggested but under controlled conditions all have failed in their purpose. At one time it was thot that sour milk would keep down the mortality but careful work seems to indicate that it is of little value. Certainly no drug has been found that offers any hope. In the presence of an outbreak in baby chicks the destruction of the diseased birds as far as they can be picked out, with frequent cleaning and disinfection of the brooder floor, is about all that can be done. Some have put potassium permanganate in the drinking water but this is of little value. The treatment of mature birds is out of the question as they seem not to yield to any known measures. Their destruction will be the best for the future of the flock.

Prevention.—Undoubtedly special care in feeding, in shipping and in brooding baby chicks will go a long way toward preventing the serious development of this malady.* That care in this respect will eliminate this disease without further measures seems however entirely too optimistic.

When the organisms are present in the egg a certain percentage of chicks will often develop the disease regardless of care and management. It is now known that the disease is readily spread by means of the forced draft in the incubator. Consequently chicks hatched in certain compartments, even tho originally free from the disease, may contract it if there are any infected eggs in the machine. To prevent this spread, either eggs should be hatched only from disease-free hens or frequent disinfection of the machine should be practiced.

*"Care and Feeding of Baby Chicks." Colorado Extension Bulletin 272-A.

Since the spread occurs most frequently at the time of hatching, it is at that period that disinfection will do the most good. It has been demonstrated by Bushnell and his co-workers at the Kansas Experiment Station that 35 cubic centimeters of formalin added to 17½ grams of potassium permanganate will efficiently sterilize 100 cubic feet of incubator space without injuring eggs and without injury to the chicks if they receive only a single exposure for not more than 10 minutes. Their work seems to show that a relatively high humidity (85° to 90° F. wet bulb thermometer) makes the fumigation more effective. They recommend that during the time the chicks are hatching, three fumigations be given at 8-hour intervals with the removal of dry chicks previous to each fumigation in order to be assured that no chick is fumigated more than once. Since it has been shown that down from an infected chick is heavily loaded with the organisms, it is apparent that this method must be practiced thoroly in order to prevent the so-called "brooder pneumonia" that has caused such heavy losses in recent years. Later work at the Kansas station shows that a humidity of 95 degrees Fahrenheit, wet bulb thermometer, will prevent the down from being carried thru the incubator.

Testing.—In the final analysis, hatcheries must work toward the ideal of hatching only from disease-free hens. This is the most certain method of eliminating the disease. In order to attain this ideal it is essential that a method must be available of accurately finding the diseased birds. It is now recognized that a bird affected with white diarrhea will carry specific agglutinins in the blood which can be determined with a high degree of accuracy. As a consequence, much attention has been given to testing the mature fowls and eliminating the reactors prior to the hatching season. This can usually be done to the best advantage after the culling has been carried out in the fall but before it is time to save eggs for hatching.

Various methods of testing have been devised and while it is recognized that no one of them is 100 percent accurate, yet some quite certainly have advantages over others. The pullorin or wattle test has been used now sufficiently long so that we may say quite definitely in its present form it should not be recommended. As compared with other tests it is highly inaccurate. It does not follow from this statement that a pullorin may not be worked out in the future that will give an accurate indication of infection in a fowl, but it can be said that none is available now. The presence of agglutinins in the blood is a much better indication. This requires drawing a small sample of blood and applying it to suspensions of the causative organism of the disease. If the organisms are clumped together, it is evident that specific agglutinins are present.

The first method to be used was that known as the tube test in which a certain percentage of blood serum was added to a suspension of the organisms in a test tube. The whole was then allowed to set

from 24 to 48 hours and agglutination determined by the settling of the organisms to the bottom of the tube.

The proper dilution of the serum in the suspension has been the subject of much investigation. A few years ago the committee on poultry diseases of the United States Livestock Sanitary Association, reported that a 1 to 25 dilution should be taken as the standard.

Following the development of the tube method, the rapid slide method as used in testing cattle for contagious abortion was studied by Runnells. In



Method of bleeding birds when testing for bacillary white diarrhea.

many laboratories this has supplanted the older method as much time and material may be saved. More recently Bunyea and Hall of the United States Bureau of Animal Industry, have devised a method by which whole blood can be added to a suspension of the organisms on a slide in the poultry house and a reaction obtained while the hen is still held. This, of course, has the advantage that the chickens need be handled only once. Several laboratory workers, however, in the state experiment stations have found that this method does not have the accuracy of the Runnells' method. Consequently a survey of the state experiment station men seems to indicate that the newer method of Bunyea and Hall is still subject to investigation and should not be adopted in practice in its present form.

It ought to be stressed that this test in any form is a highly

delicate and complicated procedure, calling for the best skill obtainable and that it cannot be expected to be used with success by the average poultryman in his own henhouse. Errors are bound to creep in even in the best of hands and to place this procedure in the hands of unskilled operators is to condemn it.

Repeated testing will be found to be necessary to actually clean a flock of all reactors. The experience in states where the work has been done over a period of years indicates that free flocks may not be obtained short of 2 or 3 or even more years of continuous testing. In a wave of enthusiasm a great many owners have tested who did not cull out the reactors nor disinfect the premises and who would persist in buying infected baby chicks for replacement of their flocks. Under these conditions it is better that no testing should be done. Probably the ideal will be reached only by persistence on the part of a few people who really understand the problem, and from these as a basis, other disease-free flocks can be started in clean houses and on clean grounds.

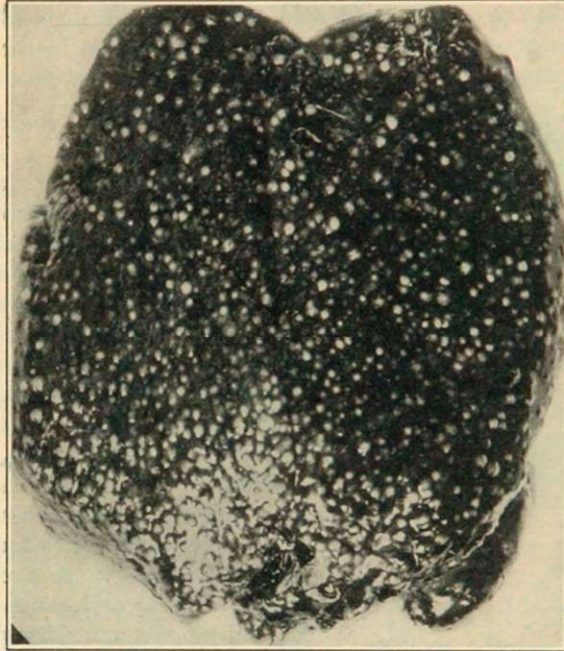
While many states have extensive programs for the development and maintenance of disease-free flocks, Massachusetts seems to have set the example for conservative management and successful progress. Fuller details for testing a flock may be had by writing to the nearest experiment station.

Tuberculosis

This is a chronic, wasting disease of all species of fowls which, on account of its insidious nature, becomes wide-spread in a flock before its presence is discovered. The disease, formerly quite rare in Colorado, is now wide-spread and has been reported from nearly all of the poultry districts in the state. Not only is it a menace to poultry but it is now well recognized that the disease is spread from fowls to hogs and that a fair percentage of tuberculosis of swine is of avian origin.

Birds affected with tuberculosis gradually waste away in spite of good feeding. They become lame, their combs and wattles turn pale and after weeks of these symptoms, they succumb. Postmortem examination reveals very characteristic changes. One or more joints may be swollen and contain yellow, cheesy pus. There are yellow nodules in the liver and spleen and frequently along the intestine. The disease is not likely to be confused with any other malady except blackhead in turkeys in which case it can be differentiated by the latter disease not showing in the spleen and the nodules being grayish in color and not protruding from the surface of the liver.

When tuberculosis has become widespread, it is usually best to slaughter the whole flock, selling such birds for food as are not diseased and after a thoro cleaning and disinfecting, leave the houses and pens empty for a year.



A turkey's liver affected with tuberculosis.

If the disease has gained little headway or the flock is especially valuable for breeding then the affected birds can be eliminated by applying the intradermal test. This should be applied by a veterinarian as it is improbable that the poultryman has sufficient skill and training to properly apply and interpret it. The tuberculin is injected into the wattle and the reaction is determined by a swelling. By the application of

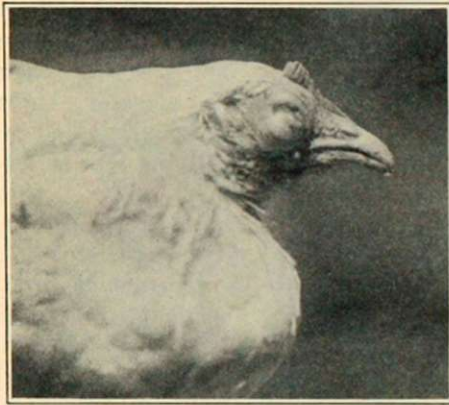
this test at frequent intervals it will be possible to clean up a flock providing that thoro cleaning and disinfecting is carried out.

Roup

It is customary in many writings on poultry diseases to discuss under this head all forms of catarrh of the head, including diphtheria or canker and chicken pox. Until the cause of each of these conditions is known it will be difficult to settle this question. Since it seems possible to separate them on the basis of very clear-cut symptoms they will be described as separate maladies. Roup is a highly contagious disease affecting especially the mucous membranes of the upper air passages and of the eyes. It usually affects mature birds or at least those that are half grown or over. It rarely attacks chicks under 2 months of age.

The cause is probably a filterable virus which is introduced in many cases by the purchase of new chickens or by bringing in birds

that have been sent to shows. There are also healthy birds that have passed thru a previous outbreak and are still carrying the virus. These, known as "carriers," continue the disease in a flock from year to year. Undoubtedly, the usual devitalizing influences are a considerable factor. These are exposure to cold, overcrowding, lack of ventilation, improper diet, etc. The disease is more prevalent in the winter than in the summer but may be seen at any time of year.



A chicken affected with ocular roup.

The early symptoms are watering from the eyes and nose accompanied by sneezing and coughing. Later the discharges become thicker and clog the nostrils and glue the eyelids together. The lids will now be swollen and as the nostrils are closed the bird breathes thru its mouth, thus drying the tongue. At this time the bird droops, may refuse food, the feathers are ruffled and diarrhoea may supervene. Still later

the cavity just below the eye fills with an exudate that then becomes cheesy and putrid and causes a swelling of the face at this point. This swelling is particularly characteristic of roup.

The birds may die at any time during the course of the disease, the younger ones dying early and the stronger or older keeping up at times for several days and even recovering in many instances. The disease may spread rapidly thru the flock with a high percentage of mortality.

The proper handling of a flock affected with roup requires decisive and energetic action. It is usually better to destroy all sick birds but if treatment is to be attempted, the sick should be isolated and as fast as others are taken sick they should be removed. If only the birds in one pen are affected, precautions should be taken to see that the disease does not spread to the rest of the flock. The houses and pens should be cleaned thoroly and disinfected at frequent intervals and special attention should be given to the drinking vessels. Potassium permanganate may be used in the drinking water or a pinch of chlorinated lime.

Housing is recognized as a large factor in the development of roup. Damp, ily ventilated, cold and overcrowded houses must re-

ceive attention. Correction of the housing conditions will often in itself stop this disease.

If treatment is to be attempted the heads of the affected chickens may be dipped into a warm solution of any of the following: Potassium permanganate—1 level teaspoonful to a pint of water. Chlorinated lime—a pinch of the powder to a pint of water. Hydrogen peroxide diluted 1 to 3. If there is a bulging of the face that has been present for some days it may be incised with a sharp knife, after which the cavity may be washed out with any of the above solutions.

Prevention of roup by vaccination has been tried by many investigators. Some have used the virus of chicken pox, others have made the vaccine from the bacterium that causes chicken cholera and still others from a miscellaneous group of organisms associated with roup. While some excellent results have been reported, all that can be said at this time is that vaccination against this disease is still in the experimental stage and if used at all should be used with this understanding.

Diphtheria

(Canker or Diphtheritic Roup)

Diphtheria or canker is a highly fatal contagious disease of birds manifesting itself by the formation of false membranes in the respiratory tract. Its cause is unknown but since similar membranes have been produced by inoculation with chicken pox virus, some have regarded it as merely a form of the latter disease. It has also been confused with roup as membranes are sometimes found in that disease. Until further investigation, it seems best to describe it as a separate malady.

The disease sometimes affects incubator chicks from a day to 1 month old. It may also become serious in pullets during their first winter. Pullets are sometimes found dead without showing previous symptoms but usually death is preceded by a period of dullness followed by gasping for breath and then suffocation. Baby chicks become dull, refuse food and gasp for breath, giving the appearance of being affected with gape worms. Gapes has never been reported in Colorado. The disease should not be confused with white diarrhea, which is more common.

Thick, tenacious, yellow membranes will be found in the mouth, throat, larynx or windpipe. Frequently the membrane is in the upper end of the windpipe only and may be entirely overlooked. Pneumonia may also be present in which case portions of the lungs will become firm and will not collapse. The membrane closes the windpipe and thus the bird dies of suffocation.

Treatment of baby chicks affected with the malady is not very promising. They should be kept away, not only from other chicks but from the older birds, as well, as they may readily transmit the disease to chickens of all ages. All affected ones should be destroyed and their bodies should be burned. The brooder should be thoroly cleaned and disinfected at frequent intervals. If any survive they should be kept isolated for several weeks in order not to spread the disease.

Older birds are somewhat more amenable to treatment but as they sometimes suffocate at night the disease may continue in the flock for some time before any sick birds are seen. All sick birds should be isolated and if the membranes can be seen they should be swabbed with tincture of iodine. Potassium permanganate may be added to the drinking water until the water is purple. A pinch of calcium hypochlorite in the drinking water twice or three times a day will also assist. Pens and houses should be cleaned and disinfected at frequent intervals as long as the disease lasts.

Since much of the roup in older birds is now looked upon as primarily a housing problem, very special attention must be given to see that there are no drafts, that the house is not too cold nor too warm and that the birds are not overcrowded.

Infectious Bronchitis

(Canadian Flu)

This disease may be merely a highly virulent form of diphtheritic roup. It first appeared widely in this country in 1924 and the tendency in literature has been to regard it as a separate disease under a



A chick with infectious bronchitis,
gasping for breath.

distinctive name. In the year above mentioned, the disease affected mature fowls in feeding plants thruout the Mississippi Valley and was particularly prevalent in carload stuff shipped to New York City. Because fowl plague existed at the same time, it created a great deal of interest and there is still a possibility that some outbreaks called plague were in reality this malady. It was also especially prevalent in shows and was carried home by show birds, causing a great

mortality. During the season of 1930 it has been frequently seen in baby chicks altho the mortality in these, seemingly is not as high as it is in the mature fowls.

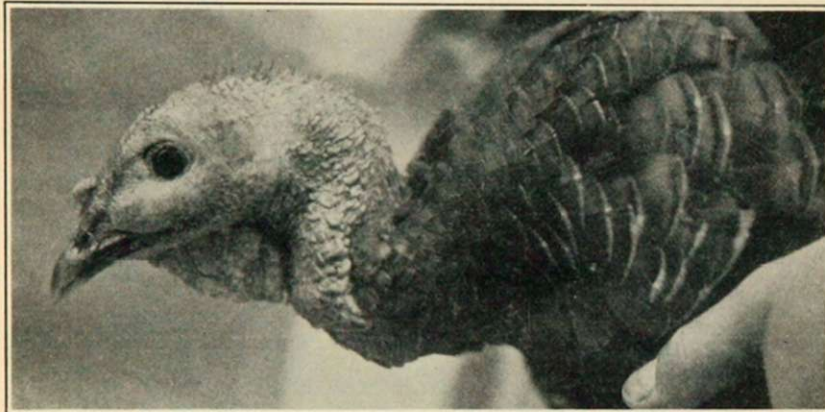
The chief symptom is gasping for breath. The disease spreads so rapidly that a few cases may be seen in a house in the morning and by night 75 to 90 percent of the birds may be affected. Not infrequently death will take place in from a few minutes to a few hours after the first symptoms are noticed. The most typical postmortem finding is the presence of clotted blood in the trachea which is apparently the reason for the difficult breathing. In the birds that die later in the outbreak, typical diphtheritic membranes may be found in the trachea which indicates that it may be the same disease as we have described under diphtheritic roup.

Treatment of mature fowls is of little avail, death usually taking place either before it can be administered or in spite of it. In baby chicks, placing in a tight compartment and applying medicated steam has seemingly been of some value. Water to which a teaspoonful of carbolic acid or oil of eucalyptus has been added can be boiled in the compartment. The steaming can be repeated at intervals of a few hours and apparently does bring some relief in the breathing, altho of course it is merely palliative. When the disease breaks in a large flock of mature fowls it spreads so rapidly and the mortality is so high that vigorous measures must be instituted at once or the loss will be great. To stop the inroads it is better to slaughter all the mature fowls in a given house and sell those for meat that have not yet shown symptoms. The house can then be thoroly disinfected and allowed to remain vacant for at least a month before putting other fowls into it. In a large establishment this may be repeated in each house that becomes affected. Special care must be given that attendants ministering to the sick fowls do not go into the houses where the disease has not yet developed. While the disease is being studied no vaccine or other immunizing agent has been developed that offers any hope of success.

Turkey Roup (Sinus Disease)

While this disease has been called roup it probably is not due to the same cause as roup in the common fowl, and probably has no relation to it. It may not be very often fatal, but it is apt to keep the birds thin and in an unmarketable condition. It is supposed to be the result of exposure to cold wet weather, or to improper protection in roosting. If it is due to a microorganism the cause has not been discovered.

The symptoms are well known to all turkey raisers. They consist of a puffy condition of the face due to a filling of the sinuses below the eyes with a glairy mucus. Pressure will usually empty the sinuses into the nasal cavity but they fill up again within a few hours. Opening up the sinuses will relieve the condition temporarily but has not given permanent relief.



A turkey with a puffed sinus.

The most effective treatment is that reported by Tyzzer of Harvard University. He recommended the introduction of one cubic centimeter of a 15 percent solution of argyrol into the sinus, by means of a hypodermic syringe. Frequently one treatment is sufficient to effect a cure. For those that fill up again a second or a third treatment may be required. Our limited experience with this method indicates that it is highly effective. When using the treatment plunge the needle thru the wall of the enlarged sinus and inject the solution without attempting to withdraw it. Argyrol may be purchased at any drug store.

Chickenpox

The disease is characterized by warty nodules on the comb and wattles and other unfeathered portions of the head. It is largely confined to older birds, is not so common in Colorado as roup or diphtheria and is generally less fatal. There are occasional outbreaks where the mortality is quite high. It seems to have been definitely proved that the cause is a microorganism that is too small to be seen even by the microscope. Affected birds live several days and frequently recover, especially if properly treated. At times the inflammatory disturbance of the skin spreads to the mucous membranes of

the mouth, forming there false yellow membranes simulating diphtheria.

Treatment consists of painting the nodules and the false membranes with tincture of iodine. In the milder cases the growths fall off and the birds recover. All sick birds should be isolated as soon as found and either treated or destroyed. Houses and pens should be cleaned and disinfected.

The California Experiment Station prepared a vaccine from the nodular growths that has been quite successful in preventing the disease. At first the vaccine was administered subcutaneously but more recently it has been shown to be more effective when placed in a scratch on the skin or applied to the point where a few feathers have been plucked. The scratch method seems preferable. Vaccination is to be recommended in the presence of this disease.

Fowl Paralysis

While leg weakness or paralysis has been known in fowls for a long time, the condition usually appeared in sporadic cases and received little attention until the past 5 or 6 years. In that time however, it has become increasingly common and has appeared at times in such numbers as to approach epidemic proportions. It has been reported in nearly every state in the union and from several foreign countries. Bulletins have been issued from both the Rhode Island and Connecticut Experiment Stations and articles have appeared in various veterinary journals.

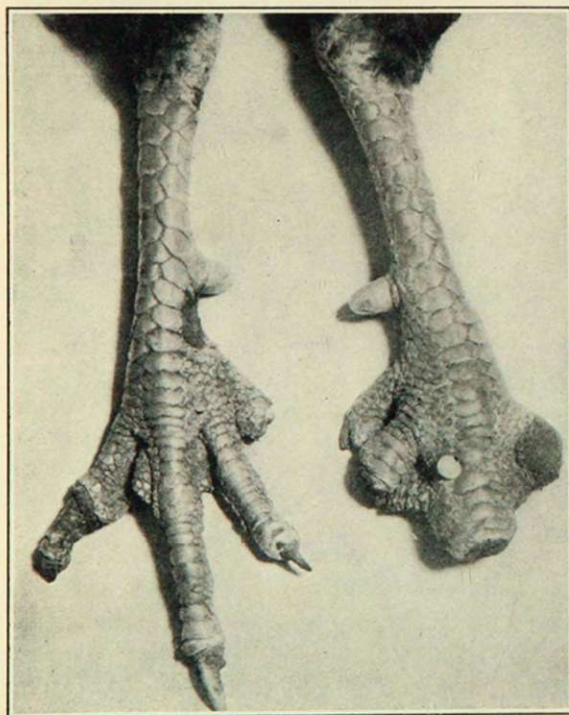


A chicken affected with fowl paralysis.

It is a disease of mature fowls from 5 to 15 months of age and usually appears during the first winter. The symptoms may come on suddenly, the bird merely being found down in the house and unable to move about or only one wing or one leg may be affected with no complete paralysis for several days. Motion is retained but it seems incoordinated and purposeless. The bird may live for weeks if fed and watered and sometimes recovery takes place spontaneously. Usually, however, it is fatal after a few days or weeks.

Outside of the paralytic symptoms the bird may become blind, the iris often taking on a grayish color. Occasionally the muscles of the neck are affected so that the head may be held in an unusual position. Diarrhea may also be associated with the disease.

On postmortem a fair percentage will show enlargement of the nerves of the axillary or sciatic plexuses, a less number will show lymphatic tumors most commonly starting in the ovary and in the writer's experience about 50 percent will show coccidia in either the duodenum or cecum.

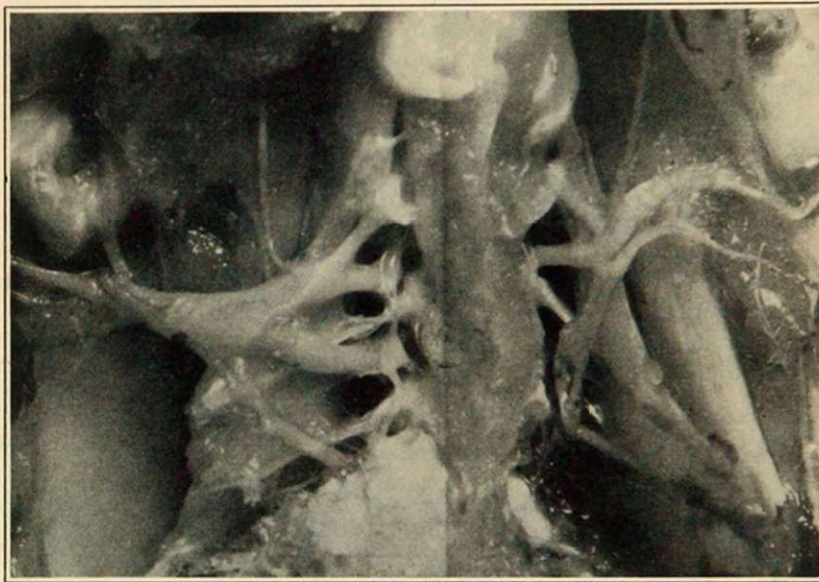


A chronic case of fowl paralysis, showing loss of toes.

A number of explanations of the cause have been given. The disease has at various times been attributed to worms, especially tapeworms, to coccidiosis in chronic form, to lack of vitamins (green stuff) in the feed and to a filterable virus that affects the nerves. It seems that all of these may at times cause a paralytic condition but the present large increase is now generally believed to be due to a virus affecting the nervous system. Transmission experiments have been contradic-

tory. It seems however, to be spread from one fowl to another and may destroy as many as one-third of a flock in a single season.

Until the cause is determined, little can be expected in the way of treatment. It is better to destroy all affected birds to prevent a possible spread. Special attention should be given to both feed and housing to see that vitamins are supplied. If there is a shortage of green stuff, vitamine A can be supplied by adding cod liver oil in



Fowl paralysis, showing enlargement of the nerves.

the proportion of 1 percent of the ration. Birds should be exposed to sunlight and have plenty of room for exercise. If parasites exist they should receive appropriate treatment. Finally, if the disease persists it may be necessary to dispose of the whole strain, disinfect thoroly and start over again with new stock as there is some evidence that the malady is hereditary.

Leukemia

This disease, which resembles fowl typhoid in some respects, has now become wide-spread in the United States. Its association with typhoid can be better understood when we learn that the latter disease was originally described as infectious leukemia. Both diseases show a great decrease in red blood corpuscles, with usually a corresponding increase in the whites. Fowl typhoid, however, is due to a bacterium

while leukemia seems to be due to an organism so fine that it cannot be seen by the microscope, and will pass thru the finest clay filter.

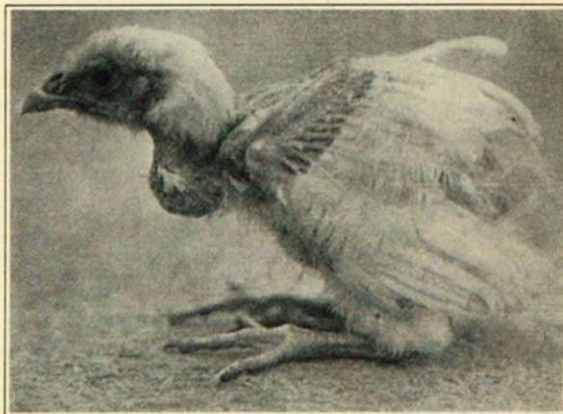
Once the disease establishes itself in a flock, it is not easily eradicated, altho it seldom takes a large number at one time. The symptoms of the disease are seldom such as to attract the attention of the flock owner, as the birds are usually found dead. In the acute type the cause of death is usually hemorrhage from the liver, in which case the abdomen will be found filled with blood. In the more chronic type paleness of all tissues is easily observed on postmortem examination. The liver is enlarged sometimes to enormous proportions. In the more advanced cases the liver is white, fibrous and nodular. The spleen is usually enlarged, sometimes to three or four times its normal size. Occasionally the heart shows the presence of white lumps.

No highly effective means of control has been discovered. We do not know how the disease is spread, and no vaccine or other immunizing agents have been discovered. Certainly there are no medicinal remedies so far tried that have proved effective. As a consequence we are limited to the destruction of the diseased birds. General cleanliness and sanitation will probably be of assistance, but no disinfection of the premises can destroy the virus within the birds themselves.

Coccidiosis

This is a highly contagious disease of chickens and other fowls which is very wide spread and highly destructive, especially to half-grown chickens. It is most fatal in chicks from 2 to 10 weeks of age. In older birds, particularly during the first winter, it sometimes causes leg weakness and finally death.

The cause is a one-celled animal of microscopic size that is present in large numbers in the droppings of affected birds. The disease is spread by contamination of the drinking water and the food, by means of the droppings of the diseased individuals.



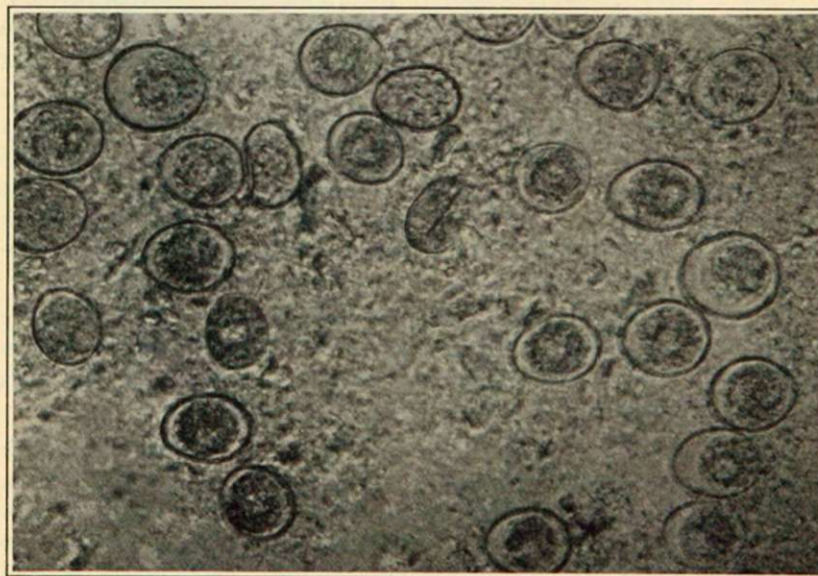
A chicken affected with coccidiosis.

The younger chickens show a bloody diarrhea, great weakness, and die in from 1 to 5 days. The older birds lose weight, the comb and wattles become pale and finally the birds become unable to stand on their legs. They usually die only after several days or weeks.

Since it has been shown that the parasites are not capable of affecting other birds for 2 or 3 days after they are discharged, daily cleaning of the brooders, pens and houses will go far toward eliminating the disease. Where it is possible, the diseased birds should be destroyed and the well ones moved to entirely new ground. Where this is not possible, daily cleaning with occasional disinfection will help materially.

Various medicinal agents have been used in the drinking water but it cannot be said that they are very satisfactory. Among these has been bichloride of mercury (corrosive sublimate) in the proportion of a 7-and-one-half-grain tablet to a gallon of water and powdered crude catechu, one-third teaspoonful to the gallon of water.

The California station seems to have made the most progress in handling the malady by the addition of large quantities of milk to the ration. They showed that the organism did not develop in the intestines if a certain acidity could be maintained. This was best brought about by the addition of milk, either in the form of fresh milk, dried milk or dried buttermilk. It was shown to be essential, however, that



Showing coccidia (magnified).

milk comprise at least 40 percent of the ration. If it is to be used as whole milk, no water should be given the birds as otherwise they will not take a sufficient quantity. They recommend the following ration where dried skimmilk is to be used.

Dry skimmilk	40 pounds
Wheat bran	10 pounds
Yellow cornmeal	30 pounds
Ground barley	20 pounds

The milk should be continued for 2 or 3 weeks after the outbreak.

It seems that we must look upon coccidia as being always present to some degree in our mature fowls and in the soil of our poultry yards. The real problem is then, by better sanitation, to hold down the number of coccidia ingested until the young birds have developed a resistance to their presence.

Blackhead

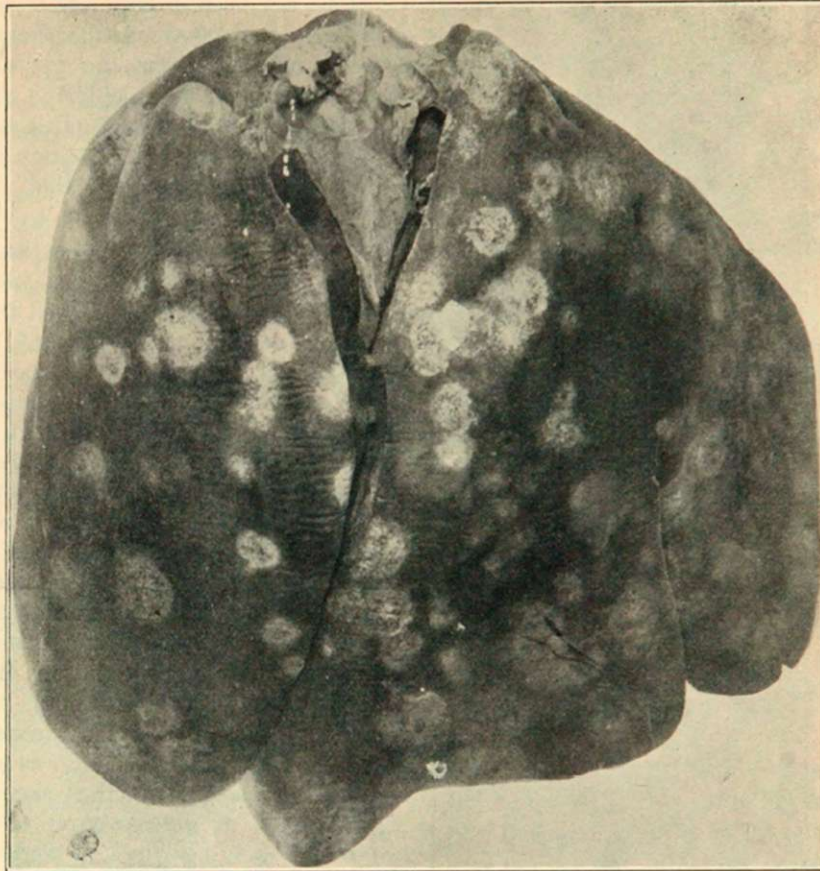
(Enterohepatitis)

This is the great wide-spread, fatal disease of turkeys, and as such is the most common cause of loss. The name "blackhead" is not particularly significant because in any wasting disease of turkeys the head tends to turn dark just prior to death, due to poor circulation. Birds may suffer from this malady for a long period of time without showing any particular darkening of the head. Enterohepatitis is a better term because in nearly all cases both the intestines and the liver are affected.

The disease is caused by a protozoan parasite, *Histomona meleagridis*, described many years ago by Theobald Smith. Graybill was instrumental in showing that the organism may be spread thru the common cecal worm of fowls, *Heterakis papillosa*, altho recent work has seemed to indicate that this parasite is not essential in the transmission of the disease.

Blackhead affects turkeys of almost all ages but is particularly fatal in the young. Older birds may suffer with a chronic infection which will last for months and even recoveries are noted. In birds from 1 to 3 months of age the mortality is very high.

The disease is manifested by dullness, inability to keep up with the flock, loss of appetite, drooping wings and sulfur-colored diarrhea. Young birds usually live only a few days after showing symptoms. On postmortem examination the most constant changes are swollen ceca, (blind guts) with thickened, cheesy walls, particularly noticed from the inside, and circular grayish areas thruout the liver with a



Blackhead is identified by light circular spots on the liver.

considerable enlargement of that organ. These findings are quite diagnostic. The condition in the cecum might be mistaken for a chronic form of coccidiosis but in that case the liver is usually not affected. The liver changes simulate those of tuberculosis to some degree but in the latter disease the spots are usually smaller and those near the outside project from the surface. Furthermore tuberculosis is seldom a disease of the cecum.

Treatment.—Some years ago it was recommended that upon the appearance of blackhead, turkeys be confined and that water be given to which had been added one-third teaspoonful of powdered catechu to the gallon. Still later bichloride of mercury was added to the drinking water in the proportion of 1 to 8,000. Neither of these rem-



Ceca from a turkey affected with black-head—much enlarged and thickened.

edies has been highly effective altho some good results have been reported from the use of both of them. If bichloride of mercury is to be used it must be remembered that it is highly poisonous for man and that it will discolor metal vessels.

In recent years ipecac has had a considerable vogue. It was recommended to be used in the proportion of 1 teaspoonful of the powder mixed in the mash for each 10 birds. The presumption is that because of the popularity of emetine in amoebic dysentery in man it was that that ipecac which contains emetine would be valuable in black-head. It must be stated that most of the glowing reports of the use of ipecac come from growers and that in the hands of experiment station workers it has not been effective. Ipecac has been recommended also as a preventive agent in the same proportion as given above, administered to the flock at weekly intervals.

Tyzzar of Harvard University showed several years ago that tryparsamide, when administered subcutaneously to diseased birds, would result in recovery in the majority of the cases. He used the drug in 25 percent solution in water and gave from 1 to 3 grams at a dose. The limited experience at this station with this drug has indicated that it does have considerable value and that birds treated early can actually be cured by its administration. Its use, however, is somewhat impractical, first because of the necessity of hypodermic administration, but largely because of the expense. In many instances the cost of the drug will almost equal the value of the bird. For this reason it is not recommended.

No treatment so far attempted is really efficient. The disease should be controlled by preventive methods.

Prevention.—Since the finding of Graybill of the close association between the disease and the cecum worm of common fowls, it has seemed wise to recommend that turkeys be raised on places where no chickens are reared. Chickens themselves rarely suffer from blackhead but apparently they can be instrumental in spreading the disease to turkeys. Probably the young poults contract the disease also from the hens, which is the reason for the use of artificial hatching in many places.

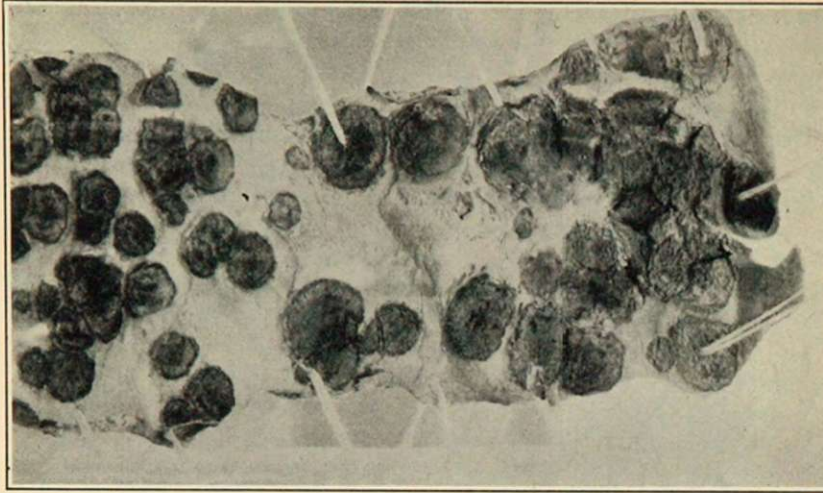
If poults are to be mixed with hens, the coops should be moved at weekly intervals in order that the little turkeys will run over new ground. The rotation system of yards by which birds are moved weekly or even every 2 weeks from one yard to another and are not allowed to come back to the same yard oftener than once a month, has proved quite effective. Where turkeys are herded, taking them out in a new direction each day will be fairly effective in preventing blackhead.

In other words, sanitation is the keynote of prevention. Keeping down the roundworms by the continuous administration of tobacco dust has received very favorable consideration in many places. Tobacco dust can be added to the mash in the proportion of 2 percent and kept up for weeks at a time without any serious damage arising. It seems worthy of a trial, altho again, controlled experiments have not been as favorable as the field work.

In some large establishments turkeys are raised in confinement on hardware cloth, on cement floors and on coarse gravel which allows such a system of sanitation to be practiced that the droppings are not mixed with the food. Blackhead can be reduced to the minimum by these methods.

Thrush

This disease of turkeys has been recognized in Colorado during the past 10 years and is now apparently spreading thruout the West. It was originally named "thrush" because it was thot to be due to a yeast-like organism which is the cause of thrush in babies. More recent work however, throws some doubt on this original view. The Nevada Experiment Station has used the name "mycosis." It is presumably due to a microorganism of some kind, but just what it is has not been definitely proved. It is characterized more especially by circular, yellowish, raised, non-inflammatory areas in the mucous membrane of the crop. At times these are also seen thruout the length of the gullet and not infrequently in the small stomach between



Circular patches found in the mucous membrane are typical of thrush.

the crop and the gizzard (proventriculus.) The crop of diseased birds fill up with an ill-smelling fluid, the birds fail to eat and do not move around freely. They may live for several days or even weeks after showing symptoms, but the disease is probably always fatal.

Whether the malady is spread from one bird to another, or whether they all get it from the same source is not known. Various plans of treatment have been tried, but seldom found effective. The most promising seems to be irrigation of the crop with a considerable quantity of mild antiseptic solution. A saturated boric-acid solution can be used, and also a 1 to 1000 solution of potassium permanganate. A small rubber tube is passed into the crop, the solution is poured in thru a funnel, and after it remains a short time the crop can be emptied by holding the bird with the head down and letting the solution drain out the tube. Daily irrigations of this kind are frequently recommended, but not many cures are recorded. Such birds ought to be separated from the main flock because of the possibility of the spread of the disease.

PARASITIC DISEASES—EXTERNAL PARASITES

Lice

There are many species of lice infesting poultry. These insects rarely cause death in themselves but in birds depleted by other diseases they bring about much irritation and loss of flesh. Most lice

are of sufficient size so that they are easily seen on examination under the wing or inside the thigh.

The treatment as recommended by the United States Department of Agriculture consists in the application of sodium fluoride either as a dusting powder or as a dip. Sodium fluoride can be purchased at most any drug store or poultry supply house. It may be applied directly by putting a pinch deeply into the feathers at numerous places over the body of the bird. This is commonly known as the pinch method. The powder is gradually dispersed and may be expected to kill the lice within 4 or 5 days. The dipping method is more rapid in its action and possibly more effective, but it can only be used in favorable weather. The dip is made up by adding 1 ounce of sodium fluoride to 1 gallon of warm water and the hens are thoroly dipped so that all portions of the body are reached. This method usually results in the destruction of the lice within 24 hours but where infestation is severe it is better to repeat it in one week.

Mites

Common red mites of the fowl (*Dermanyssus gallinae*) are night prowlers, usually leaving the birds before morning and spending the day hidden away from the light in the cracks under the roosts. For this reason they are easily attacked. By way of prevention it is better to have the roosts set in slots so that they can be readily removed at frequent intervals. The mites can then be sprayed directly with some injurious oil. Waste cylinder oil from automobiles, to which has been added a pint of kerosene to the gallon, is highly effective for spraying purposes. Straight kerosene will kill the mites but it may require frequent applications because of its thinner body. Crude petroleum and creosote are also effective.

Scaly Leg

This is a disease of the leg with loosening of the scale and increase in size due to the burrowing habits of a sarcoptic mite. It is a very common disease among barnyard fowls and is more frequently seen in older birds. The legs should be softened with warm water to which has been added a generous quantity of soap. Following this the mites can be destroyed by most any of the ordinary antiseptics. Five percent carbolic acid in water will be effective. Tincture of iodine as well as iodine ointment applied straight will also destroy the mites, altho these are more expensive.

Airsac Mites

This little mite is found in large numbers in the airsacs which are so extensive in fowls. These airsacs may be found in the bones, in the

thoracic and abdominal cavities, around the lungs and abdominal viscera. The mites are only visible by means of the microscope. However, they are sometimes present in such numbers as to bring about a high degree of emaciation in the fowl. Since nothing is known as to their means of transmission or anything which will destroy them there is at present no satisfactory means of treatment.

Flesh Mites

These mites gain entrance to the tissues and imbed themselves under the skin and between the muscles, where they may be frequently seen as yellowish nodules pinhead in size. Not infrequently the housewife notices these on dressing the fowl for the table and is concerned as to their indication. No means of control has been worked out but apparently they are not injurious, at least to people eating the birds after cooking. A large percentage of fowls will be found to be so infested if a careful examination is made. They probably do the bird little or no harm.

INTERNAL PARASITES

Roundworms

The roundworms of the common fowl are largely of two varieties, those found in the intestinal tract in front of the cecum (*Ascaridia lineata*), and those found in the cecum (*Heterakis gallinae*). The intestinal roundworm is from 1 to 3 inches in length and may be present in such numbers as to almost fill the gut. The cecum worm is much smaller, seldom attaining more than one-half inch in length and may be found in enormous numbers in that organ. These roundworms produce emaciation and weakness but seldom cause death. Because of their interference with nutrition, however, it is best to keep birds free from them.

The most commonly used treatment and the easiest to administer is carried out by adding tobacco dust to the mash in the proportion of 2 percent (2 pounds of tobacco dust to 100 pounds of mash) and keep this before the birds for from 1 to 2 weeks. This method of treatment when used at occasional intervals will keep down the worms but may not be as effective in individual birds as the single dose method. Some recommend nicotine sulfate but this is so poisonous that unless it is mixed with some bland substance like Fuller's earth, it will destroy the fowls. It is highly effective but should be used in a form put up commercially so that dosage and buffer can be regulated. The United States Bureau of Animal Industry recommends oil of chenopodium given by rectal injection when mixed with cottonseed oil, more especially for the cecum worm. The dose is one-

tenth cubic centimeter of oil of chenopodium in 5 cubic centimeters of cottonseed oil for half-grown birds. By the use of a rubber bulb syringe it is contended that this can be injected just as easily and far more efficiently than when given by the mouth.

Cleanliness means much in the prevention of worms since the eggs are continually being passed out with the droppings, and unless these be cleaned up at frequent intervals a continuous cycle will be established which will keep the chickens constantly infested. Ordinary disinfectants are of little value in the destruction of worm eggs. Their entire removal from the premises is essential if the circle is to be broken.

Tapeworms

There are many species of tapeworm infesting the fowls running in size from those that can be observed only by the aid of the microscope to several inches in length. Several species may be found in the same bird at the same time. These worms are easily differentiated from the round worms because they are jointed and flat. In young birds they are even more serious than the roundworms, not infrequently causing death. Hall of the United States Bureau of Animal Industry has found that the best medicinal treatment is powdered kamala. He recommends the administration of 1 gram (15 grains) by the mouth either in a capsule or in the form of a tablet. Birds will swallow these quite readily when placed in the back of the mouth. This dosage is for mature fowls. Where young birds are treated, the dosage may be cut in half or even more. Kamala will destroy certain of the weak chickens and particularly any that may be suffering from deficiency disease or roup.

Poultts can be handled in the same way but here again kamala is quite injurious to the young birds. For those 2 or 3 weeks old, should it be found necessary to treat them, not more than 1 grain should be given. This can be increased to the full 15 grains as turkeys approach maturity. Probably old birds would stand 30 grains but it is the young ones that are more apt to have tapeworm troubles. There are other remedial agents that will kill tapeworms but because of the greater value of kamala they will not be mentioned.

Tapeworms pass a part of their life cycle in insects of various kinds, particularly the common housefly. Consequently, it is better to collect the droppings at frequent intervals and treat them so that they will not be infested with flies. All measures tending to keep down the flies will also tend to break the cycle of the tapeworm. The addition of powdered borax to manure piles is an effective means of reducing the number of flies.

MISCELLANEOUS DISEASES

Crop Bound (Impacted Crop)

This condition usually develops as a result of catarrhal inflammation of the crop in which the consumption of a quantity of dry, indigestible and fibrous food probably plays a considerable part. Possibly also the consumption of spoiled food would be a factor. The most prominent symptom is enlargement of the crop, due to the food not being softened and passed on to the gizzard. As the disease progresses, birds become dull and finally refuse to eat. The crop becomes pendulous and loses its tone. Finally death results unless treatment be administered. If the condition has not become too far advanced the mere addition of a considerable quantity of water thru a rubber tube, with consequent softening of the food mass, may result in the crop being cleared. More commonly, however, it is not noticed until it has advanced too far for this method of handling. In that case a tube can be passed into the crop, water poured in, and by holding the head of the bird down, the water can be returned thru the tube, thus getting out a portion of the crop content. In case this is unsuccessful the only method left is an operation with manual removal of the crop content thru the wound. If the bird is of sufficient value and this seems to be required it would be better to take it to a veterinarian. This condition can be prevented by exercise, feeding of green food, and keeping plenty of water before the birds.

Cannibalism

This often develops in little chicks where a large number are kept together, where it takes the form of toe pecking. Sometimes in older birds it consists of feather pulling and picking out the vent. The latter condition may develop where vent gleet is present in the flock or where prolapse of the oviduct takes place. Once the birds get a taste of blood they may even attack healthy members of the flock and literally disembowel them. In the case of baby chicks, keeping them in the dark will be of some value. Another method is to keep them busy picking at pieces of meat or other food material hung just out of their reach. Sometimes deep straw in which is placed a small amount of grain will serve the same purpose but is more useful for older birds.

Where other measures fail, cutting off the point of the beak with a knife will be effective.

Apparently at times it indicates that the protein ration is insufficient, but the mere addition of meat scrap or something of that nature to the ration will not stop it once the habit is formed. Birds that are injured should be removed from the flock as quickly as pos-

sible to stop the onslaught. This may result from improper nutrition and idleness, but it becomes a habit.

Constipation

This may be present in birds of all ages and on postmortem examination is usually most apparent in the ceca. Not infrequently birds a few weeks old may have this condition in such large numbers as to indicate that it is in reality an infectious disease, but careful examination will eliminate maladies which are commonly present in birds of that age. The ceca will be found literally plugged full of a dried mass that it is impossible to move. In mature fowls the condition may result in prolapse of the cloaca or even of the oviduct.

Treatment is by the administration of salts in the drinking water. For 100 mature fowls, 1 pound of salts may be used; for baby chicks not more than 1 ounce for the same number. The dosage may be proportioned according to age between these two extremes. However, this treatment is only temporary and unless other measures are taken the condition will return in a few days. More green stuff must be added to the ration and there must be provision to see that the chickens get plenty of exercise. Salts should never be kept up for any considerable period of time.

Dropsy

Occasionally older fowls will be standing around showing an enlarged abdomen which tips the fowl into a more upright position. This is due to accumulation of fluid in the abdominal cavity and may be the result of a number of different conditions. Occasionally tumors develop in the abdomen that will result in dropsy. The accumulation of egg yolks either in the oviduct or the abdominal cavity proper may result in a similar condition. Any chronic disturbance of the heart, kidney or liver may also be responsible. For this reason dropsy as such is merely a symptom of other conditions and not a disease within itself. Unless the cause can be determined and corrected there can be no hope of curing the dropsical condition. Mere removal of the water is without avail.

Broken Yolks

Occasionally yolks instead of being discharged into the oviduct are thrown out into the abdominal cavity and since they cannot escape, become broken, the watery portion absorbed and the whole mass pressed into yellow, cheesy, concentrically layered foreign body. Sometimes a similar condition develops within the oviduct itself. These masses may lay for weeks or even months and as other yolks come down they are added to the central substance. Finally such an in-

flammation is set up as to destroy the life of the bird. They are often spoken of as yolk concretions.

If their presence can be suspected during life, an operative procedure for their removal is likely to be successful but too often they are discovered only after the death of the bird. It is that that jumping down off high roosts by heavily laying birds is a factor in their development. Ordinarily only an occasional bird is found in this condition but where the disease is affecting several in a flock it would be well to lower the roosts and cut down on the grain feed in order to lessen the activity of the ovary.

Egg Bound

This condition is usually seen in pullets and is more apt to develop with the first egg laid. It may also be associated with constipation. Sometimes when it is neglected the egg may become broken and two or three others pushed down against it. The condition may be determined by the restlessness of the bird, going frequently to the nest without laying. It may be relieved by manipulation with a greased finger, using great care not to cause a prolapse of the oviduct. Sometimes it may be necessary to break the egg before it can be removed.

Prolapse of Oviduct

This is usually seen in constipated birds that are being pushed by feeding a strong laying mash. It also is more common in birds that have a low vitality.

The administration of salts will correct the constipation for the time being, and the addition of green stuff to the ration will tend to keep the bowels loose. Cutting down on the laying mash is advisable where the condition is developing frequently.

After the prolapse has once taken place it should be returned as quickly as possible, being careful to be particularly clean about it. Salts can then be administered to the affected bird and all grain withheld for a few days. There is great danger that cannibalism will start in a flock affected in this way. Consequently the birds should be watched carefully and removed at the first sign of this condition taking place.

Vent Gleet

This is probably an infectious disease but the particular cause has not been isolated. It seemingly spreads from one fowl to another, being transferred by the male. The vent becomes extremely raw, bloody and ill smelling.

At the first evidence of the disease the affected birds should be removed and preferably destroyed. The males should be taken away until the disease is clearly eradicated. Individual treatment is usually unsuccessful. Most antiseptics have been tried but for the most part have failed.

Subcutaneous Emphysema

(Air Under the skin)

This is a peculiar condition that sometimes develops in younger fowls and not infrequently follows caponizing. The presumption is that when it develops spontaneously it is the result of a wound thru the skin made in such a way that the movements of the bird pump air under the skin. It has also been suggested that rupture of an airsac will result in this condition, but the first explanation seems most valid.

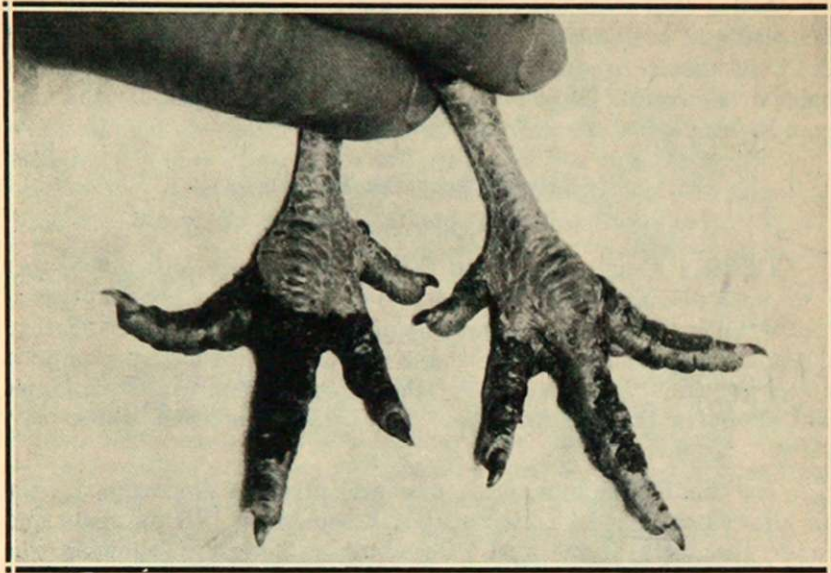
The skin can be punctured in several places if necessary and the air allowed to escape. Unfortunately it sometimes fills up again and causes the death of the bird. Occasionally, however, following this treatment the bird will survive.

Bumblefoot

This is a bruising of the soft cushion of the foot most commonly due to jumping down on hard floors from a high roost. If the foot is bruised, infection develops and pus formation results. Prevention consists in lowering the roosts or padding the floors with straw. It is most commonly seen in the heavier birds. Treatment may have to be surgical. The bruised, suppurative area may be opened up freely and washed out with any good antiseptic solution. It is then well to bind it up with gauze and cotton and dress it daily until recovery takes place. A bird affected in this way should be placed in a clean enclosure where there are no roosts. Most cases result in recovery under proper treatment.

Sod Diseases

This is a disease described by this station a number of years ago because of its unusual prevalence thruout Eastern Colorado where settlers were running baby chicks on unbroken sod. The cause of the disease was never determined altho it was apparent that there was some relationship to the sod itself since it did not develop in cultivated areas. Chicks in the eastern part of the state, raised in restricted pens or under sheds where there was no sod did not develop the malady. It manifests itself in baby chicks by the formation of blisters between the toes and occasionally on the face around the bill.



Showing the scabby condition of the feet when in the later stages of sod disease.

These blisters soon break and are replaced by heavy crusts. As a result of the inflammation the toes turn up and the chick may stub around on its heels. Occasionally the disease is also seen in mature fowls where it affects the skin around the face more particularly. The mortality is quite high in baby chicks but the mature birds do not often die from it. The cause not being known the only method of prevention now recommended is to keep baby chicks from running on sod. Treatment is of little value altho carbolized vaseline applied to the affected parts will be of some assistance. Some have dipped the feet in kerosene but there is no evidence that this has resulted in any lessened mortality. After the raw sod is broken up and the ground put under cultivation, the disease vanishes.

Tumors

Many varieties of tumors have been described in fowls. The most common one is a lymphatic tumor which some workers believe is associated with fowl paralysis. These tumors frequently are found in the ovaries, occasionally scattered thru the liver as white masses, and sometimes found along the intestinal tract where they resemble tubercles. A very common tumor also is found on the skin, which grows to considerable size. This tumor can be removed surgically sometimes and with a fair degree of success. It may not be a true

tumor in many cases but only a large mass as the result of irritation. For the most part tumors of fowls are incurable as we do not know their cause. They are mentioned merely because they do occasionally exist and must be differentiated from other conditions.

POISONING

Botulism

Botulism more commonly develops in fowls as the result of eating discarded canned goods from the kitchen. The housewife occasionally finds a can of corn, string beans, spinach or other vegetable that has apparently spoiled and, feeling that it is hardly fit to feed to the family, dumps it into the chicken feed. This not infrequently results in the destruction of great numbers of chickens.

It is never safe to throw any spoiled food to chickens without first boiling thoroly. This will kill the toxin which is really the harmful substance, but will not kill the spore from which the bacteria that produce the toxin really develop. Occasionally fowls will find the carcass of an animal that has become putrid and in which these toxins have developed.

The symptoms are fairly diagnostic; a number of fowls will be affected at one time, paralysis develops, the head cannot be held in its upright position and may even rest on the ground; finally complete paralysis ensues and the bird dies. Death will often take place within a few hours after the food has been eaten.

Treatment after the disease develops is seemingly without avail. While an antitoxin has been produced which is effective, if given at the same time the birds are given the food, it does not seem to save them after the symptoms of the disease have become manifest. Removal of the offending food from the crop as early as possible after the first symptoms have been shown has also been tried on a large scale but without success. The amount of the toxin that it takes to kill a fowl is almost infinitesimal. Prevention is the only satisfactory way of handling the problem.

Salt Poisoning

Fowls seem quite susceptible to this form of poisoning and numerous deaths may be attributed to this cause. The ordinary amount of salt put into human food is not sufficient to kill chickens but when excessive amounts are added they may result disastrously. In one instance a woman put salt into her cake instead of sugar. When the discovery was made it was only natural to throw the cake into the chicken feed. It caused the loss of several fowls. In another in-

stance ice-cream salt from the freezer was dumped into the chicken feed with serious results. Brine used for pickling and for sauerkraut may find its way into food for chickens.

Chickens showing salt poisoning become paralysed, the neck becomes twisted placing the head in peculiar positions. Usually a considerable number will be affected at one time, and careful inquiry will reveal the source.

Arsenic Poisoning

With the large number of arsenical preparations used for spraying, it is surprising that this form of poisoning is so rare in fowls. Occasionally, however, paris green or arsenate of lead gets into the chicken feed in sufficient amount to cause disaster. Individual treatment for mineral poisons is ordinarily out of the question and our efforts must be directed to prevention.