9

Diseases and Parasites of Poultry

The art and science of poultry disease control is as complex, variable, and confounded with as many apparently unrelated events as is the practice of human medicine. As more birds are grown in more concentrated areas and in tighter confinement, new disease problems appear and old ones sometimes reoccur. Fortunately, for the average poultryman, good management, the ability to detect disease or parasite problems at an early stage, and the knowledge and judgment to know when and where to go for help when needed should make it possible for him or her to cope successfully with most disease and parasite problems. In this chapter an attempt will be made to present the causes of disease and the basic concepts of disease prevention and control along with examples of the most serious and prevalent poultry diseases.

Disease is considered to be any deviation from a normal state of health. It can be caused by trauma or injury, nutrient deficiencies, microorganisms, such as protozoa, bacteria, mycoplasma, viruses, yeasts, and molds, internal and external parasites, behavioral and reproductive problems, and poisons. Almost all disease problems on poultry farms start from new poultry brought on the premises, contaminated premises from previous flocks, or lack of proper sanitation and other good management practices.

C. R. Parkhurst et al., *Poultry Meat and Egg Production*

DISEASE PREVENTION

Schwartz (1977) has listed 15 fundamental factors of disease prevention in poultry health management.

1. Preventive medicine is the only effective approach in health management in today's intensive poultry operations. As flock size doubles, the possibilities of disease quadruple.
2. Preventive medicine includes disease-free chicks, maximum hygiene and care, vaccination, medication, and adequate nutrition—performed under conditions of strict sanitation and isolation (Fig. 9.1).
3. Change the litter and thoroughly clean and disinfect the house and equipment after each group of birds or when feasible.
4. Select healthy, vigorous, disease-free chicks, poults, or pullets.
5. Keep young birds well isolated from older birds. Separate caretakers and equipment will increase the chances of success in isolation. Maintain breeder flocks on separate premises.
6. Isolate poultry classes from other livestock. Chickens, cattle, turkeys, and swine are subject to cross-infections.
7. Provide adequate commercial feed or carefully formulated home-mixed feeds.
8. Provide a continuous supply of potable water for birds of all ages. In summer keep the water cool by protecting it from the sun. Protect it from freezing in winter. Birds consume up to two and one-half times as much water as feed. When water intake decreases, there is a proportionate decrease in feed intake too. A marked reduction in feed and water consumption is usually the first sign of illness.
9. Do not crowd poultry. Crowding increases cannibalism, feather picking, hysteria, and other stress-related problems. Crowding retards growth, reduces feed efficiency, and decreases production.
10. Have a *sound vaccination program* and follow it carefully. For young birds, raise house temperature 5°F during the vaccination reaction period. Schedule all vaccinations and revaccinations on farms with multiage flocks for the same day. Live-virus vaccines can spread to susceptible poultry.
11. During brooding, regulate temperature, humidity, and ventilation to the comfort of the chicks or poults. Prevent drafts, overheating, and chilling.
12. Keep unauthorized personnel out of the poultry house.
13. Incineration is the most satisfactory method of dead-bird disposal. Disposal pit and deep burying, in that order, are the next

FIG. 9.1. Cleanliness and sanitation are fundamental factors in disease prevention. (Source: USDA.)

best methods. Dead birds, if not properly disposed of, become a disease threat to *all* poultry in the area.

14. In disease outbreaks promptly obtain a reliable diagnosis. Then use the best treatment for control of that particular disease. Birds recovered from diseases such as pullorum and mycoplasmosis should be sold for slaughter—not saved for breeder replacements.
15. It is best to accompany diseased or dead birds to the diagnostic laboratory or be available by telephone; you will therefore be available to give additional information that might be needed.

DIAGNOSTIC ORGANS IN POSTMORTEM EXAMINATIONS

Any large poultry operation loses some birds. Postmortem examinations help to determine whether there is a problem and often offer tangible evidence of what type of disease is in the flock (Fig. 9.2). For that reason, it is important for a poultryman to know and become experienced in conducting postmortem examinations. Such examinations are in addition to but not in place of those done by a qualified

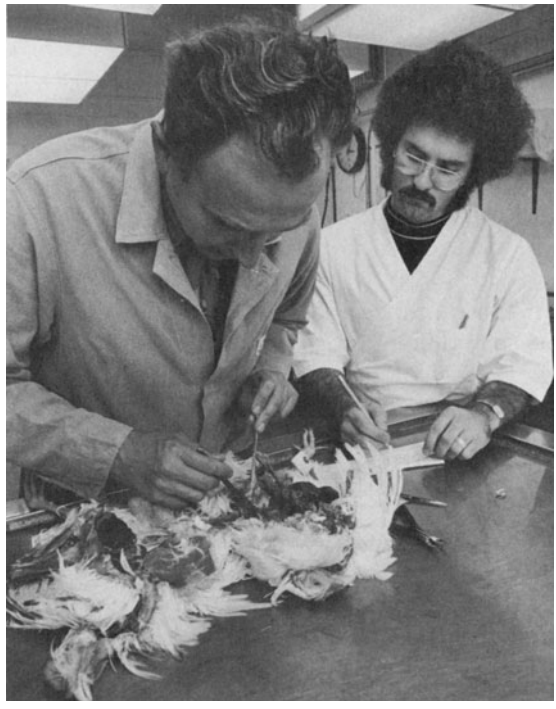

FIG. 9.2. Performing a postmortem on a bird. (Source: USDA.)

veterinarian. The following procedure is recommended by Salsbury Laboratories:

1. Cut the skin on the side of the mouth. Scan the mouth for lesions of pox, mycosis, and a number of other diseases.
2. Open the esophagus. Inspect it for injury from foreign matter on tiny nodules (bumps).
3. Slit the larynx and trachea lengthwise. Examine them for excess mucus, blood, and cheesy material.
4. Cut into the crop. Note whether the contents are impacted or sour smelling. Wash out the crop and examine the lining for signs of mycosis, etc.
5. Observe the condition of the air sacs, which are often cloudy in disease.
6. Examine the heart, liver, spleen, lungs, and bronchial tubes for obvious lesions.
7. Examine the intestines for nodules, tumors, or hemorrhages.

Slit the intestines lengthwise to examine for worms, free blood, inflammation of the lining, ulcers, hemorrhagic areas, and excess mucus.

8. Cut into the ceca, noting the nature of the contents. If blood is found, wash it out and examine the lining. Look for cheesy sores, tiny cecal worms, or a scarred lining.
9. Slit the proventriculus, noting any hemorrhages in the lining, or white coating.
10. Open the gizzard, examining the lining for roughness and erosion.
11. Look for abnormalities of the ovary, oviduct, and kidneys.
12. Look for a swollen brachial nerve, one of the lesions of leukosis.

IMMUNOLOGY OF DISEASE CONTROL

Birds, like other animals, have many mechanisms that provide natural disease resistance. These innate barriers include items such as the skin, cilia of the cells that line the upper respiratory tract, and other features of the body that either prevent the entry of foreign microorganisms or nonspecifically prevent their growth inside the body. The skin and cilia act as mechanical barriers to keep bacteria and other microorganisms out of the body. Because the body temperature of birds is often in excess of 40°C, bacteria that grow well at 37°C may not effectively reproduce inside birds, and so do not pose a serious disease threat. The effectiveness of these mechanisms can be compromised by poor nutrition and management practices.

Even with the above-mentioned natural barriers to infection, birds must possess an active immune mechanism or system to survive constant exposure to the vast numbers of disease-causing microorganisms and agents. Eventually bacteria, viruses, molds, fungi, and toxins gain entry to the body. The immune system, which must react to and neutralize these invaders, is made up of the white cells present in the blood and certain organs of the bird's body (e.g., spleen, thymus, bursa of Fabricius, cecal tonsils, and other lymphoid tissues).

Birds have several types of white cells (or leukocytes). Those in the blood are lymphocytes, monocytes, heterophils, basophils, eosinophils, and thrombocytes. These cells perform many functions that collectively help to prevent or cure diseases. For example, monocytes are very important since they can ingest (i.e., phagocytize) foreign particles and digest them. In addition, it is believed that monocytes can grow and become macrophages, i.e., very large cells capable of phagocytizing large quantities of bacteria and other particles. These bacteria are then digested by enzymes present in the macrophages and

are thus removed from the body. Basophils are often involved in inflammatory immune responses as are monocytes, lymphocytes, and macrophages. There are at least two distinct types of lymphocytes in the body. One type originates in the bursa of Fabricius of young birds. These cells, called B cells, migrate to the spleen and other lymphoid organs of the birds and are capable of responding to bacteria, toxins, and other pathogens or foreign agents by producing proteins called antibodies. These antibodies will react with the particular substance that initially stimulated the B cells.

The second type of lymphocytes, the T cells, arise in the thymus of young birds. These cells also migrate to the spleen and other lymphoid tissues where they can respond. They are industinguishable in appearance from B cells, but perform different functions. The T cells do not produce antibodies; instead they produce proteins called lymphokines. Lymphokines (1) react with leukocytes and macrophages in the bird to increase their phagocytic removal of organisms, (2) cause lymphocytes to be produced rapidly, (3) nonselectively lyse or break down cells, (4) prevent viral replication, and (5) perform other related functions. In addition, B and T cells work together to cause removal of foreign cells and substances from the body. Neither type of lymphocyte alone is capable of preventing disease. T cells are more efficient in preventing viral diseases while B cells are more effective against bacteria.

To maintain flocks of chickens or other poultry in a relatively disease-free state, producers should promote the integrity of natural barriers to prevent microbial entry into the birds. In addition, it is important that sound vaccination programs be practiced, so that the B and T cell populations are continually stimulated to produce the antibodies and lymphokines that will fight and cause removal of disease-causing organisms that enter the body.

POULTRY DISEASE CONTROL STRATEGY

Avian medicine is concerned with the entire population of poultry more than it is with the individual bird. Disease prevention and control are more important in maintaining flock health than therapy and treatment of the disease. Normal disease controls are the husbandry practices utilized by the individual or firm that address preventing disease.

VACCINATION

Vaccines act as insurance against the risk of disease, but like insurance, they have a cost associated with them. These costs include the

price of vaccine, time involved in scheduling and administering vaccines, as well as losses or reactions associated with the vaccine itself. Vaccines are normally used to prevent or reduce problems that can occur if a flock is exposed to the field strain of a particular disease.

Types of Vaccines

Live vaccines contain viruses or bacteria that infect the bird and multiply in its body to produce immunity. Most vaccines used today are modified or attenuated (artificially changed to reduce virulence) or avirulent (non-disease-causing). Killed vaccines (bacterins) are prepared from viruses or bacteria that have been inactivated by processing with heat, formalin, or β-propiolactone treatment. These vaccines are then usually combined with an adjuvant such as aluminum hydroxide or an oil to increase the stability of the killed antigen and to stimulate the immune system for a longer period.

Toxoids are vaccines prepared to stimulate immunity against a toxin, such as botulism. Toxins are treated to destroy their ability to cause disease but left recognizable as an antigen so that antibodies will be produced.

Methods of Vaccination

A variety of methods of vaccinating poultry have evolved depending on the vaccine utilized. These include vaccinating by subcutaneous or intramuscular injection, water vaccination, wing-web vaccination, and eye drop or spray vaccination.

Vaccination Program

Many factors are involved in determining when and if to vaccinate, what to use, as well as the route of administration. Some considerations are the types of diseases in the area, availability and cost of vaccines, climatic conditions, and management.

An example of a broiler vaccination schedule is given in Table 9.1.

NUTRITIONAL DEFICIENCY DISEASES

Nutritional deficiencies are rare in modern poultry operations. Exceptions occur when a ration is misformulated by mistake or accident and when other diseases or stress prevent normal consumption or absorption of feed. Table 9.2 lists the essential minerals and vitamins and their deficiency symptoms.

TABLE 9.1. Example of a Broiler Vaccination Schedule for Individual Bird Protection [a, b]

Age (days)	Vaccine	Method of vaccination
1	Marek's disease	Subcutaneous
	Newcastle disease B_1 strain	Spray
	Infectious bronchitis Mass. strain	Spray
	Infectious bronchitis Conn. strain	Spray
14–18[a]	Newcastle disease B_1	Spray or water
	Infectious bronchitis Mass. strain	Spray or water
	Infectious bronchitis Conn. strain	Spray or water
	Infectious bursal disease—mild	Water

[a] Source: Harris (1967).

[b] Fourteen to eighteen day vaccinations in broilers vary depending on the disease prevalent in the area. Programs vary in the strain of infectious bronchitis used, the route of administration, and whether infectious bursal disease vaccine is used in the area.

PROTOZOAN DISEASES

Protozoa are microscopic single-celled animals. They cause two of the most common and oldest recognized diseases in poultry, coccidiosis in chickens and histomoniasis (blackhead) in turkeys. Less frequent protozoal diseases include trichomoniasis and hexamitiasis.

Coccidiosis infections in chickens are worldwide and are caused by nine species of the genus *Eimeria,* six of which are especially virulent. Seven other species infect turkeys, but all the organisms are host specific, that is, chickens do not become infected with the turkey species and vice versa.

Coccidiosis is spread primarily by birds eating droppings and contaminated litter. Birds with no access to litter and droppings do not become infected. This is one of the reasons why commercial egg type pullets and layers are kept in cages.

Young birds are most susceptible to coccidiosis. The symptoms are weakness, pale skin, ruffled feathers, chirping, and usually bloody droppings. Infected birds droop their wings, huddle together, and have little appetite for feed or desire for water. On autopsy, the intestine and ceca are distended and contain a foamy foul-smelling material. In advanced stages, bloody intestinal contents and pinpoint lesions occur on the walls of the intestine.

Prevention is the best method of handling coccidiosis. To avoid infection, commercial pullets and layers are managed to prevent access to litter and droppings.

For broilers, prevention also consists of feeding a coccidiostat at a continuous low level in the feed. Since broilers are reared on litter with access to the coccidia oocysts the management plan requires the use of a coccidiostat. Treatment of coccidiosis is costly and recovery of meat-type birds lengthens the growing period adding to the cost.

TABLE 9.2. Essential Minerals and Vitamins and Their Deficiency Symptoms[a]

	Functions	Deficiency symptoms
Minerals		
Macrominerals		
Calcium	In blood clotting, skeletal bone formation, strengthening egg shell	Rickets; young—osteomalacia; old—poor egg shell quality and hatchability
Phosphorus	In metabolism as high energy bone, bone formation	Rickets, poor egg shell quality and hatchability
Magnesium	In metabolism of carbohydrates and protein	Sudden, convulsive death
Microminerals		
Manganese	Enzymatic function	Perosis, poor hatchability
Iron	In cellular respiration	Anemia
Copper	In iron absorption, enzymatic function	Anemia
Iodine	As thyroid hormone	Goiter
Zinc	Enzymatic function	Poor feathering, short bones
Cobalt	As vitamin B_{12}	Slow growth, decreased feed efficiency, mortality, reduced hatchability
Molybdenum	Enzymatic function	—
Selenium	—	Exudative diathesis
Vitamins		
Fat soluble		
Vitamin A	Aids growth, vision, maintains epithelial tissue	Decreased egg production; xerophthalmia; ataxis, weakness; lack of growth
Vitamin D_3	Aids calcium and phosphorus absorption; bone formation	Thin-shelled eggs; reduced egg production and hatchability; retarded growth; rickets—young animals; osteomalacia

Vitamin E	Biological antioxidant, to help maintain reproductive capability	Enlarged hocks; encephalomalacia (crazy chick disease)
Vitamin K	In blood coagulation; may be involved in oxidative respiration	Prolonged blood clotting, intramuscular bleeding
Water soluble		
Thiamine (B_1)	In carbohydrate and fat metabolism	Loss of appetite; polyneuritis and death
Riboflavin (B_2)	In energy metabolism	Curled-toe paralysis; poor growth, egg production, and hatchability; dermatitis
Pantothenic acid	In protein, fat, and carbohydrate metabolism	Mild dermatitis; crusty scab-like lesions at corners of mouth and on feet
Niacin or nicotinic acid	In protein, carbohydrate, and fat metabolism	Enlarged hocks; bowed legs, diarrhea, inflammation of tongue and mouth cavity
Pyridoxine (B_6)	In protein metabolism	Reduced egg production and hatchability
Choline	In nerve impulse transfer	Poor growth, fatty liver, decreased egg production, perosis
Vitamin B_{12}	In red cell formation, carbohydrate and fat metabolism	Pernicious anemia, poor growth, embryonic mortality
Folic acid	In red cell formation, protein metabolism	Poor growth, anemia, poor feathering, egg production, and hatchability; cervical paralysis in poults
Biotin	As antidermatitis factor	Dermatitis on feed and around beak and eyes; perosis
Vitamin C	May aid in egg formation during heat stress	Not demonstrated
Inositol	In fat metabolism	Poor growth; fatty liver

[a] Source: Patrick and Schaible (1980).

Blackhead or histomoniasis is primarily an intestinal disease mostly of young turkeys. It is widespread in the United States. The disease is caused by the organism *Histomonas meleagridis.* Blackhead is spread by a parasite of turkeys, cecal worms *(Heterakios gallinarum).* The protozoan organisms, in combination with the bacterium *Escherichia coli,* which is part of the usual gut microflora, cause characteristic "blackhead" lesions to develop.

When these protozoan organisms are passed in the droppings of infected birds and in the eggs of the cecal worm, other birds pick them up from the droppings and litter. Since earthworms feed on cecal worm eggs, they perpetuate the disease and also become a source of infection. Although blackhead can be a particular problem with range turkeys it also affects pheasants and peafowl.

Blackhead gets it common name from the fact that the heads of dead birds turn dark purple or black, a condition called cyanosis. Infected birds have an increased desire for water, decreased appetites, and are drowsy, weak, and droop their wings. Droppings are brownish yellow, watery, and foamy. In young birds mortality frequently reaches 50%.

On postmortem examination, typical caseous or cheesy lesions are found in the lower intestines, ceca, and liver. Liver lesions are also yellowish and circular with depressed centers. These liver lesions look almost like daisies in severely damaged livers and are often called "flowers of blackhead." The intestinal contents contain a caseous like core.

Treatment consists of blackhead drugs or histomonostats mixed in the feed or water for about 5–7 days. Histomonostats can also be used continuously in feeds for turkeys over 6 weeks old to prevent outbreaks. Blackhead, though a serious disease problem, can be avoided or controlled with a sound preventive health plan.

Trichomoniasis is a protozoan disease caused by *Trichomonas gallinae.* It is found in turkeys, chickens, and pigeons. It can be identified by raised caseous lesions in the crop, mouth, and esophagus. The disease is often found in small flocks of poultry and outbreaks are usually associated with unsanitary conditions. Prevention by good management is the best policy to follow. Treatment by copper sulfate at 1:2000 dilution in the water or at 2 lb/ton of feed for 3–4 days is usually recommended. Dimetridazole is also reported to be an effective control.

Hexamitiasis is an acute infectious disease caused by *Hexamita meleagris.* It is found primarily in turkeys under 10 weeks of age but it can also affect quail, ducks, pigeons, peafowl, and partridges. Affected birds show subnormal temperature and frequently chirp. Yellow-colored, watery diarrhea is associated with the disease. Foamy watery mucus is also found in the duodenum and upper intestine. Furazolidone and oxytetracycline are frequently used treatments.

BACTERIAL DISEASES

Bacterial diseases that affect poultry are numerous. One method of classification is to consider the system the organism affects. Examples of respiratory bacterial diseases include colibacillosis, infectious coryza, and fowl cholera infections. Examples of bacterial infections affecting internal organs are paratyphoid, pullorum, fowl typhoid, and omphalitis.

Colibacillosis is characterized by any one of a group of infectious diseases in which *E. coli* is the primary or secondary causative agent. *E. coli* is part of the natural gut flora and is an opportunistic pathogen that can become a problem when stress or disease occurs. All birds are carriers. Diagnosis is through laboratory isolation of the coliform organism. Many antibiotics and drugs are used for treatment but preventive management such as good sanitation and minimizing stress are still the best procedures.

Infectious coryza is a respiratory disease caused by *Haemophilus gallinarum,* a gram-negative nonmotile bacteria. The disease is characterized by nasal discharge, swelling of the face, and sneezing. Lesions include inflamed nasal passages and sinuses with discharges of yellow mucus and cheesy exudates in the cavities. Treatments are numerous and vaccination is available. All-in, all-out rearing and keeping young bird flocks away from older flocks is one control method.

FOWL CHOLERA

Fowl cholera is caused by the bacterium *Pasteurella multocida,* a gram-negative bipolar staining bacillus. The disease was observed as early as 1736. The organism infects all species of poultry worldwide and is becoming an increasing problem. Birds approaching maturity or adults are most often affected. The organism is very susceptible to common disinfectants.

Transmission is by other poultry, wild birds, predators, and rodents. Infection can occur through the respiratory tract, eyes, or open wounds.

One characteristic feature of fowl cholera is that it occurs rapidly. Birds will be found dead with no explanation. As the disease progresses, birds lose weight, decrease feed and increase water consumption, have pale yellow droppings, and sometimes produce a rattling noise from mucus in their air passages. A differential diagnosis is necessary because symptoms can be similar to other respiratory diseases. Positive identification is made by the presence of bipolar staining organisms in the blood and isolation of the causative agent. Flocks

can be immunized with a three-strain cholera killed bacterin or a live "Cu" vaccine. Treatment products include sulfadimethoxine, sulfaquinoxaline, and oxytetracycline.

NONRESPIRATORY BACTERIAL DISEASES

Paratyphoid infections affect many birds and mammals and are caused by several groups of salmonellae that are not host specific. The pathogenic effect of paratyphoid organisms stems from the endotoxins they produce. These species of salmonellae are motile nonhost adapted and number between 10 and 20 species. Salmonellae tend to be susceptible to disinfectants and formaldehyde gas. Contaminated feed ingredients are one source of infection. Feces, infected feed, water, or contaminated litter are other sources. The salmonellae localize in the gut and are eliminated intermittently by the host, which becomes a carrier. Paratyphoid is generally a disease of young birds, which show profuse diarrhea, dehydration, shivering, and huddling near the heat source. Posted birds show severe enteritis, and swollen livers, spleens, and kidneys. Treatment is designed to hold the disease in check to permit marketing of recovered birds. Many drugs and antibiotics have been used with some success.

Pullorum disease, often called white diarrhea, is primarily an egg-transmitted disease caused by *Salmonella pullorum,* a nonmotile, gram-negative bacillus. Young chickens are highly susceptible as well as other avian species and some mammals. Vertical transmission from hen to egg to chick is the most important route. Horizontal spread in the hatchery from contaminated incubators, hatchers, and chick boxes is another way. Mortality in young birds is high around 4 or 5 days of age. Chicks show pasted vents, chalk-white feces stained with bile, and increased water consumption.

Prevention is based on establishing and maintaining pullorum-free breeder and multiplier flocks. Stained-antigen, rapid, whole blood testing is used for chickens (Fig. 9.3). Tube agglutination tests utilizing sera are used for turkeys and for confirming plate test reactions. Detailed regulations for control of pullorum are given in the National Poultry Improvement Plan, ARS, BARC-East, Bldg. 265, Beltsville, MD 20705. Treatment has been helpful in lowering mortality by the use of furazolidone, sulfa drugs, or broad-spectrum antibiotics. Water medication is preferred to feed medication because infected birds stop eating.

Pullorum can be transmitted to humans by uncooked eggs and poultry meat. In humans it causes acute gastroenteritis or upset stomach. Recovery usually occurs in a few days.

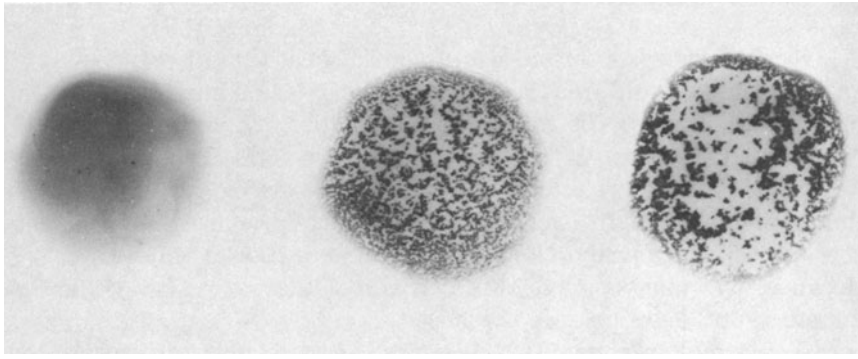

FIG. 9.3. Reactions to the stained-antigen, rapid, whole-blood test for pullorum disease. Left, negative reaction; center, questionable reaction; right, positive reaction. (Source: USDA.)

Salmonella gallinarum is the causative bacterium of the disease called fowl typhoid. It is a septicemic infectious disease mainly of chickens and turkeys. Since the antigenic reactions in birds are the same as for pullorum, reactors are identified during pullorum testing.

Unlike pullorum, the age of highest susceptibility is 2 weeks or older with mortality rates of 5–30%.

Transmission is the same as pullorum. It is not possible to distinguish pullorum from typhoid by visual symptoms. Positive diagnosis is by actual isolation and identification of the *S. gallinarum* organism.

Acute fowl typhoid lesions include bile-stained enlarged livers, enlarged spleen and kidneys, and pallor throughout the body. Prevention and treatment are the same as for pullorum. Pullorum and typhoid are mandatory reportable diseases to the State Veterinarian under regulations established under the National Poultry Improvement Plan. Killed bacterin vaccines are no longer available under United States licensing laws.

Omphalitis or navel ill is an inflammation of the navel involving bacterial infection caused by improper closure of the navel. The bacteria involved may include *E. coli, Pseudomonas, Salmonella,* or *Proteus.* Chicks hatched from dirty eggs or near exploded eggs are likely candidates for omphalitis. The disease is related to poor incubator and hatchery sanitation, excessive incubator humidity, chilling, and overheating. Poorly managed breeder flocks that allow fecal contamination of eggs is also a source. Mortality may reach 10–15% but can be lessened by using a broad-spectrum antibiotic in the drinking water.

MYCOPLASMA

Mycoplasmosis is a serious contagious disease that affects poultry at any age. Some 20 different serotypes of mycoplasma have been isolated from avian species. The following three types are pathogenic: *Mycoplasma gallisepticum, Mycoplasma synoviae,* and *Mycoplasma meleagridis.* Mycoplasma is a scientific generic name for a group of organisms that are smaller than bacteria but larger than viruses. Mycoplasma are species specific and they infect humans, livestock, and poultry. Because mycoplasma have thin cell walls, they are easily killed by disinfectants when outside the host.

Mycoplasma gallisepticum (MG) was called chronic respiratory disease before the causative agent was found. The disease causes respiratory distress and air sac lesions in birds. Turkeys may show signs of sinusitis. The organism may be present in the bird and show no signs of disease until the bird undergoes stress. Airsacculitis is the term used to describe MG infections complicated by a respiratory virus. *E. coli* is an opportunistic bacteria that is often found along with mycoplasma. Prevention is initiated by blood testing breeders and using only MG clean breeding stock. Infected flocks should be marketed as soon as feasible. Treatments effectively used include tylosine, oxytetracycline, and gallimycin.

Mycoplasma synoviae (MS) or infectious synovitis is characterized by inflammation of the synovial membranes of the joints and tendon sheaths. MS affects layers, breeders, broilers, turkeys, and even pheasants and geese. The spread of the disease is usually by direct contact from the respiratory tract or indirectly from such things as artificial insemination of turkeys with semen from affected toms. Egg transmission from infected breeder flocks is also possible.

Prevention includes blood testing of breeders and using only clean breeder flocks. Good sanitation and isolation should reduce the odds of introducing the disease. Chlortetracycline is one drug used for treatment.

Mycoplasma meleagridis (MM) is an organism that is host specific for turkeys. MM is an egg-transmitted and venereally transmitted disease. The disease may end as airsacculitis. Poor performance in turkeys and increased skeletal abnormalities are signs of MM. Egg transmission is probably the primary source of infection. Turkey hens commonly become infected when inseminated with semen from infected toms. Prevention should include blood testing and care and screening of breeder toms to keep from infecting the hens during insemination. Treatment is similar to that for MG and can include tylosine, oxytetracycline, or gallimycin.

VIRAL DISEASES

There are 17 or more viral diseases that can affect poultry. Examples are Newcastle, laryngotracheitis, infectious bronchitis, fowl pox, infectious bursal disease, avian influenza, Marek's disease, and lymphoid leukosis (Fig. 9.4).

Newcastle disease, so called because it was first isolated at Newcastle upon Tyne in England, is a contagious disease of the respiratory tract with pronounced nervous symptoms. Newcastle affects all birds, but chickens and turkeys are the most susceptible poultry. Man and other mammalian species can be infected by the virus. The etiologic agent is an RNA paramyxovirus existing in more than 100 strains. The lentogenic (mildly pathogenic) and mesogenic (moderately pathogenic with respiratory distress) forms of Newcastle are most com-

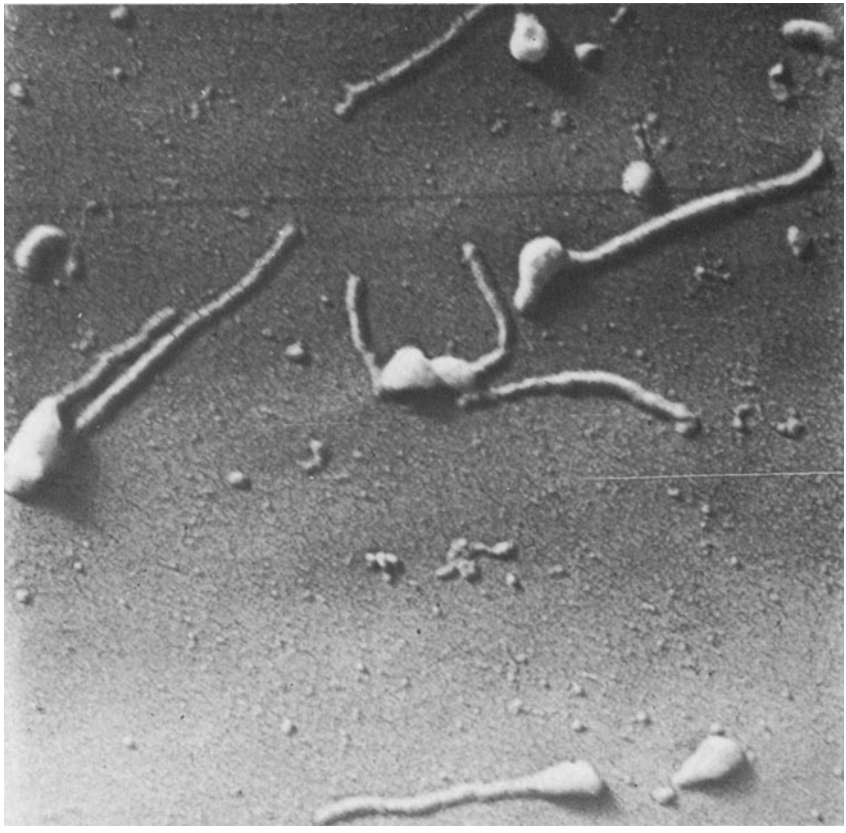

FIG. 9.4. Electron microscopic photograph of Newcastle virus particles. ×122,000. (Source: USDA)

velogenic (highly pathogenic with high mortality) form of Newcastle is the most feared in the poultry industry. Prevention is by vaccination; however, vaccines do not protect fully against the velogenic (highly pathogenic) form.

Infectious laryngotracheitis or avian diphtheria is a highly contagious disease which primarily affects mature chickens. The symptoms are severe respiratory distress and bloody tracheal exudates. The disease is caused by a "group A" herpesvirus (DNA). The virus is easily destroyed by disinfectants and ultraviolet light but can survive for a long time in dead birds or tracheal expectorants. Chickens, pheasants, and peafowl are susceptible. The trachea contains bloody mucus in affected birds as well as cheesy plugs. Death is usually caused by asphyxiation. Vaccination with an attenuated vaccine is the conventional form of prevention in problem areas. No specific treatment of laryngotracheitis is available.

Infectious bronchitis is a highly contagious disease manifesting itself by respiratory signs, gasping, and coughing. Turkeys are naturally resistant but chickens of all ages are affected. Infectious bronchitis is caused by an RNA-based coronavirus that has many serotypes. Mortality can be high in chicks. Transmission can be direct from bird to bird or through common fomites such as vehicles and egg cases. Vaccination with a modified live virus that contains the serotype found in that area is the best prevention. No specific treatment is used, except that broad-spectrum antibiotics are administered to prevent complications from secondary infections.

Fowl pox is a chronic contagious disease that occurs in a diphtheric (wet) form and a cutaneous (dry) form that can affect most species of birds of all ages. The disease can be transmitted directly from bird to bird. The virus itself usually invades the body through skin abrasions. Mosquitoes of the *Culex* and *Aedes* genera are mechanical carriers. Mosquitoes are often associated with pox problems of range turkeys in the fall of the year. Wet pox show signs of raised whitish-yellow plaques visible in the mouth. Dry pox often result in yellow-brown wart-like masses on the unfeathered portions of the head, comb, or face. No known treatment exists but vaccination during an outbreak helps to reduce losses. Vaccination is accomplished by using fowl pox and pigeon pox vaccines as a primary method of prevention.

Infectious bursal disease is a contagious disease infecting the bursa of Fabricius of chickens. It tends to occur in 3- to 6-week-old chickens and is thought to be a diplornavirus. The disease appears to affect egg-type chickens more than meat-type birds. Transmission can be direct from bird to bird or indirect through feed and water contaminated with feces. Darkling beetles are proven vectors. Lesser meal worms also harbor the virus. Posted birds show signs of bursal atrophy

after having been enlarged. The kidneys and ureters are enlarged and distended with urates. There is no treatment but good management can help reduce the severity of the disease. Vaccination of the breeder can result in chick protection for up to 2 weeks through the maternal antibodies. Presently, some states do not allow infectious bursal disease vaccination.

Avian influenza, often called fowl plague in the past, is a contagious disease that infects chickens, turkeys, ducks, and wild birds. It is a type A influenza virus that has several serotypes. It can be spread from bird to bird through fecal or airborne transmission as well as by clothing, vehicles, or other fomites. Recovered birds shed the virus for several months. Migratory waterfowl and sea birds can carry the disease but show no clinical signs. Positive identification requires viral isolation. Quarantine, depopulation, and clean-out of houses are used when highly pathogenic strains are encountered. Vaccines are generally not useful because of the antigenic variety within strains. Vaccination complicates the problem further because vaccinated birds test positive for the disease. All suspected outbreaks should be reported to the state veterinarian.

Marek's disease is a contagious disease of young chickens. It is a neoplastic disease caused by a cell-associated DNA herpesvirus that is antigenically related to the turkey herpesvirus. The primary route of transmission is through inhalation of dander from the feather follicles of infected birds. Droppings and litter can remain infective for up to 16 weeks. Birds can shed the virus from the skin for up to 76 weeks. The darkling beetle is also suspected as a vector. Upon posting, several types of lesions may be apparent (Fig. 9.5), peripheral nerves are enlarged and discolored, and lymphoid tumors occur in internal organs in the visceral form (Fig. 9.6). No treatment exists but prevention can be accomplished by vaccinating day-old chicks with an HVT (herpesvirus turkey origin) Marek's vaccine administered by subcutaneous injection on the back of the neck.

Lymphoid leukosis is a contagious neoplastic disease that generally affects chickens that are over 16 weeks of age. Tumors develop in the viscera, especially the liver and bursa of Fabricius. Lymphoid leukosis is caused by oncovirus C which is an RNA virus of the retroviridal family. Females appear to be more susceptible to lymphoid leukosis than males. The disease is characterized by rather persistent low mortality. Lymphoid leukosis is primarily spread by egg transmission. Gross lesions of the disease are manifested in lymphoid tumors in the internal organs. The liver tends to enlarge when it is affected. The use of genetically resistant strains of chickens and elimination of virus-shedding hens from the breeder flock are the best means of prevention.

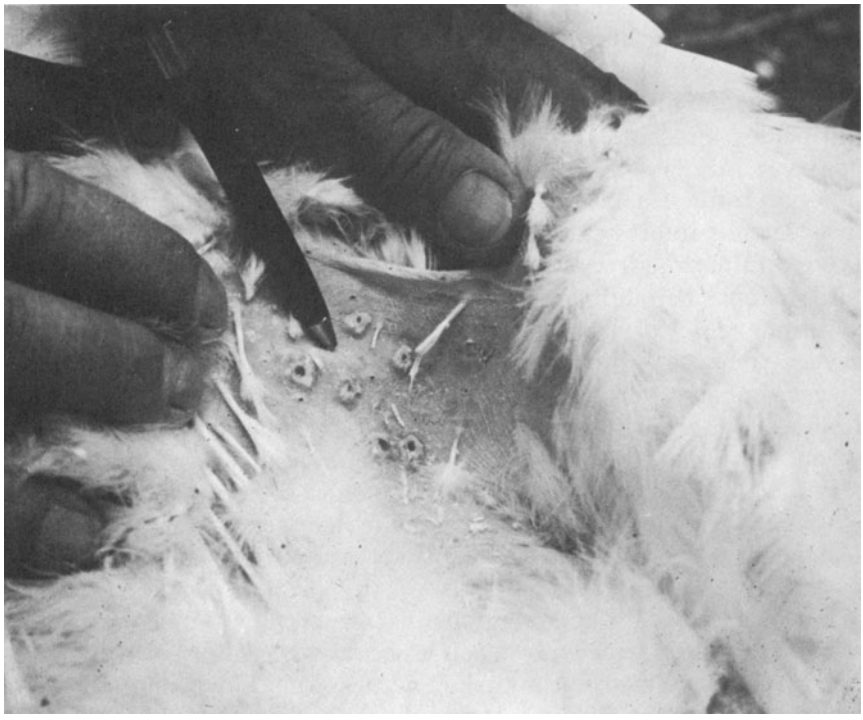

FIG. 9.5. Skin lesions from Marek's disease. (Source: USDA.)

FUNGAL AND MOLD DISEASES

Fungi or yeast-like molds can, under certain conditions, cause major losses in poultry. Aspergillosis, commonly called brooder pneumonia, is probably one of the two most widely spread infectious mycotic diseases. This disease is caused by *Aspergillus fumigatus* spores that may occur in contaminated incubators, feed, or litter. Transmission is by inhalation of the spores from a contaminated source such as the litter. Birds show gasping and accelerated breathing, and upon posting yellow exudates are found in the lungs, air sacs, or trachea. Prevention is the best treatment. Mycotic agents are generally too expensive to treat commercial poultry.

Candidiasis, or thrush as it is sometimes called, is a mycotic disease of the digestive tract. It is caused by *Candida albicans* and results in thickened areas in the crop, proventriculus, gizzard, and vent areas. Unsanitary and overcrowded conditions can lead to the disease since it is present in the natural gut flora. Prevention is best accomplished by a good sanitation program and by avoiding overtreatment of birds with

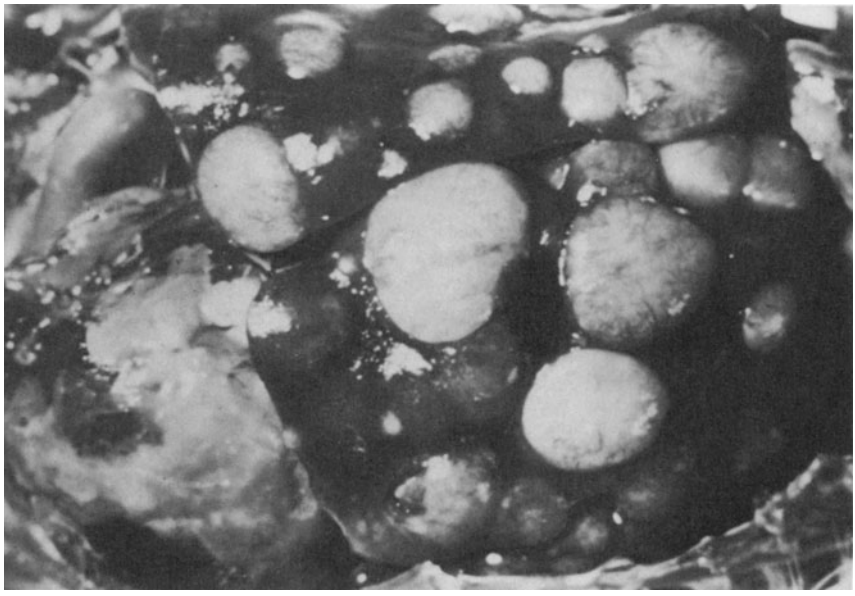

FIG. 9.6. Typical liver tumors found in a laying hen infected with avian leukosis. (Source: USDA.)

antibiotics or other products that can alter gut flora. Treatment can be by mycostatin in the feed or copper sulfate in the water.

Favus is an uncommon myotic disease primarily of chickens and turkeys. The disease manifests itself in grayish-white crusted lesions on unfeathered skin. The disease is caused by the fungus *Trichophyton gallinae*. Mildly infected birds should be segregated to recover; badly infected birds should be destroyed.

MYCOTOXICOSIS

The toxic metabolites produced by molds growing on foodstuffs are chemical compounds known as mycotoxins. Over 120 mycotoxins have been identified that causes toxicosis in animals. Some 12 different aflatoxins have been isolated but all seem chemically similar. Aflatoxin B_1 is the most toxic and can impair immunity and cause death at low levels. Aflatoxins are produced by *Aspergillus* and frequently *Aspergillus flavus*.

One of the series of trichothecene toxins is T-2 which is produced by *Fusarium tricinctum*. It causes dermal necrosis in the mouth.

Ochratoxin A is one of several ochratoxins that may cause kidney,

liver, or bone marrow damage. Ochratoxin is produced by *Aspergillus ochraceus* and *Penicillium viridicatum.*

Rubratoxin (A or B) can cause liver damage in poultry and reduced weight gains. It is produced by *Penicillium rubrum* and *Penicillium purpurogenum. Penicillium citrinum* produces a mycotoxin called citrinin that can cause kidney damage in young birds and acute diarrhea in layers. Ergot is a mycotoxin produced by *Claviceps purpurea.* Ergot grows on the heads of small grains such as rye. Ingestion causes degenerative changes in the heart, liver, and kidneys. Precautions should be taken in purchasing and storing grains to help prevent mycotoxicosis.

EXTERNAL PARASITES

Lice, mites, chiggers, beetles, bedbugs, and ticks (Fig. 9.7) can at times become problems for poultry. Poultry should be kept free of external parasites since they interfere with feed conversion as well as egg production, and parasite-weakened birds are more susceptible to disease. Some parasites can be carriers of disease themselves. External parasites generally lower the value of poultry by marring the skin and increasing condemnations.

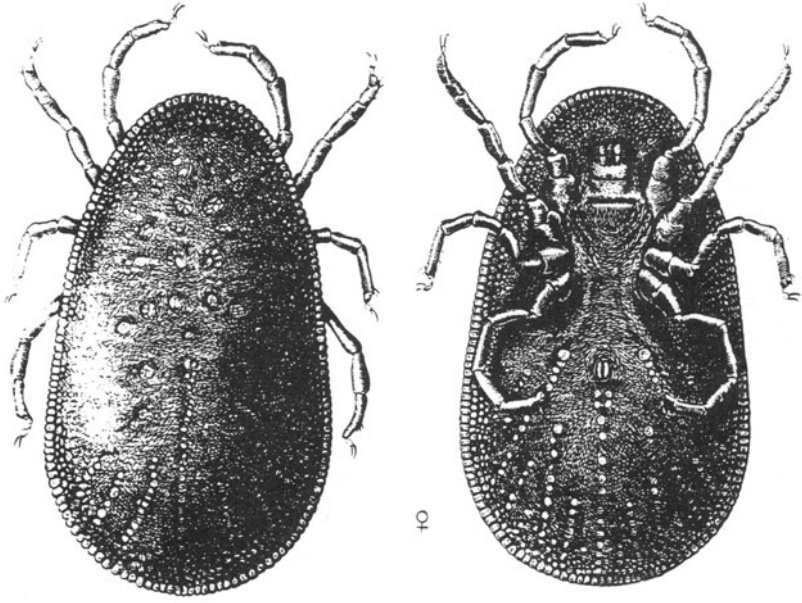

FIG. 9.7. Poultry ticks can occasionally become a problem. (Source: USDA.)

Several species of lice are found on poultry. They lay their eggs on birds, hatch, and complete their life cycle while still on the birds. Lice are generally host adapted and try to avoid light. The most common variety is the skin louse which infests the tail and vent area. To help prevent infestation, wild birds such as sparrows and starlings should be controlled and buildings should be bird proofed.

Mites are becoming more of a problem in the poultry industry as production units become larger. The chicken mite, *Dermanyssus gallinae,* or roost mite is a blood-sucking parasite that feeds on birds at night, then hides in cracks and crevices during the day. Because these mites can live approximately 6 months without feeding they can survive between flocks in an empty house. Transmission can be from bird to bird as when mating or from farm to farm carried on egg flats or cases. English sparrows are a primary vector.

The northern fowl mite, *Ornithonyssus sylarium,* commonly called the feather mite, is similar in appearance to the chicken mite. The northern fowl mite sucks blood and tissue juices from the host. A sign of infestation is the black tufting around the feathers of the vent and tail caused by deposits of egg masses. Mites cause stress in birds, which causes decreased egg production and lowering of fertility.

Other mites that can cause problems from time to time in poultry are the scaly leg mite, *Knemidoctopes mutans,* and the airsac mite, *Cytoditis nudus.* Chiggers, *Trombicula alfreduggesi,* commonly called red bugs, are common in the southeast and can be a problem primarily in range turkeys. The chiggers feed on tissue that is liquified by a substance injected at the site of the bite. In addition to irritating and stressing the birds, carcasses are downgraded at processing because of trimming to remove the sites of irritation. Prevention by carefully selecting range sites and treating range grounds when necessary is the best treatment.

The darkling beetle, *Alphabatobious diaperinus,* or lesser meal worm is common in the litter in most broiler operations. Darkling beetles attack live poultry on occasion but usually feed on dead carcasses. They are potential disease carriers and are also destructive to poultry house insulation. They serve as intermediate hosts for tapeworms and are suspected to be carriers of botulism, salmonellosis, and Marek's disease.

Bedbugs, *Cimex lectularius,* are blood-sucking parasites that feed at night. Bedbugs can survive up to a year without feeding. Anemic and unthrifty birds with signs of skin irritation are signs of infestation. Bedbugs are becoming more of a problem in the south and can often be found in broiler breeder flocks.

Fleas of all species can cause anemia and lowered egg production.

Proper sanitation and control of wild birds and rodents are good preventive measures. In the United States, the common flea varieties are the sticktight flea, *Echidnophaga gallinaceae,* the Western hen flea, *Ceratophyllus niger,* and the European chick flea, *Ceratophyllus gallinae.*

The fowl tick *(Argas persicus)* is not a true tick. The fowl tick is a flat oval reddish brown bug. These blood sucking arthropods can be a problem in the Southern and Southwestern segments of the U.S. Fowl ticks breed during warm weather and lay their eggs in cracks and crevices in the poultry house. Since the ticks feed only at night they are difficult to detect. Fowl ticks go through a larval, nymph and adult stage in their life cycle. Since all life stages can remain alive for long periods of time erradication is difficult once an infestation occurs. Fowl ticks can be transmitted from building to building on equipment. The ticks then move from the infested house onto the birds and then from bird to bird. Fowl ticks are not parasites of people. The mortality is usually not severe, highest losses can be expected when newly hatched chicks or poults are moved into infested buildings. Treatment of infested buildings requires the use of an approved wettable powder thoroughly sprayed on walls, ceilings, floors and cracks and crevices.

External parasite populations can be kept to a minimum through continuous good management practices, proper sanitation, and the careful use of approved insecticides.

INTERNAL PARASITES

The occurrence of internal parasites in poultry is almost universal. Although internal parasites seldom prove fatal they stress the host causing poorer performance, which helps other infections to gain a foothold.

Internal parasites of poultry include large roundworms, *Ascaridia galli,* inhabit the small intestine and feed on intestinal contents unattached to the walls of the intestine. The worms are more common in floor-raised birds such as pullets. Birds become infected by ingesting feces of infected birds. Depressed behavior, unthriftiness, and diarrhea are common signs of infestation. Numerous effective wormers are available including piperazine and hygromix.

Cecal worms *(Heterakios gallinarum)* inhabit the tips of the ceca. They are not economically important but are intermediate hosts to the blackhead organism, *Histomonas meleagridis,* in turkeys. Poultry can become infected by eating earthworms or infested feces. Several wormers can be used for problem flocks.

Tapeworms can be any of a variety of species of cestodes. They are flat white segmented parasites that are host specific and generally a problem of range birds. The tapeworm head attaches to the wall of the small intestine and feeds on the contents. The life cycle is indirect and dependent on an intermediate host such as earthworms, slugs, and snails. Proper disposal of manure and eliminating wet areas in which intermediate hosts accumulate are the best preventive measures. Treatment can be with di-*n*-butyl tin dilaurate followed by removal of old litter.

Capillaria worms, commonly called hair worms, can be any of four species, *Capillaria contorta, C. columbae, C. annulata,* or *C. obsignata.* Capillaria worms are blood suckers that are passed by ingesting feces from infected birds. *Capillaria annulata* and *C. contorta* are found in the crop and esophagus. *Capillaria columbae* and *C. obsignata* are found in the small intestine. Several wormers are effective. Vitamin A supplementation aids recovery of infested birds after worming.

Gapeworms, *Syngamus trachea,* are bloodsucking nematodes that frequently infect turkeys and pheasants under range-type conditions. Gapeworm ova are ingested and hatch. Later male gapeworms attach to the lining of the trachea; female worms then attach to the males forming a "Y" appearance. Suffocation of the birds may occur in heavy infestations. Signs include gasping, choking, and "gaping" to breathe. Thiabendazole used in the feed appears to be a satisfactory treatment. Good management and preventive measures can greatly lessen the incidence of infestation of internal parasites.

BEHAVIORAL DISEASES

Hysteria, a sudden and unprovoked migration to one end of the house resulting in piling up and possible suffocation, occurs in poultry flocks with losses and damage to the flock. Malnutrition, vitamin deficiencies, hereditary, and trauma pain have been suggested as possible causes. Light breeds such as leghorns are the most susceptible.

Cannibalism is a condition in which birds actually pick or eat each other to death. Prevention by debeaking and good management are the best ways to control this condition. Generally, overcrowding and overheating are associated with this condition. Excessive light intensity and certain nutrient deficiencies can also aggravate the problem.

REPRODUCTIVE DISEASES

Eversion or prolapse of the oviduct occurs in pullets and young hens. It is caused by straining during or following the laying process. Obesity in meat-type birds can contribute to the problem.

An impacted oviduct is a condition in which an egg becomes lodged in the oviduct. Internal layers are birds whose egg yolks fall into the abdominal cavity instead of the oviduct where they are reabsorbed.

Disease prevention and control programs consist of isolation, proper sanitation, good management, and a vaccination program suited to the area of production.

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