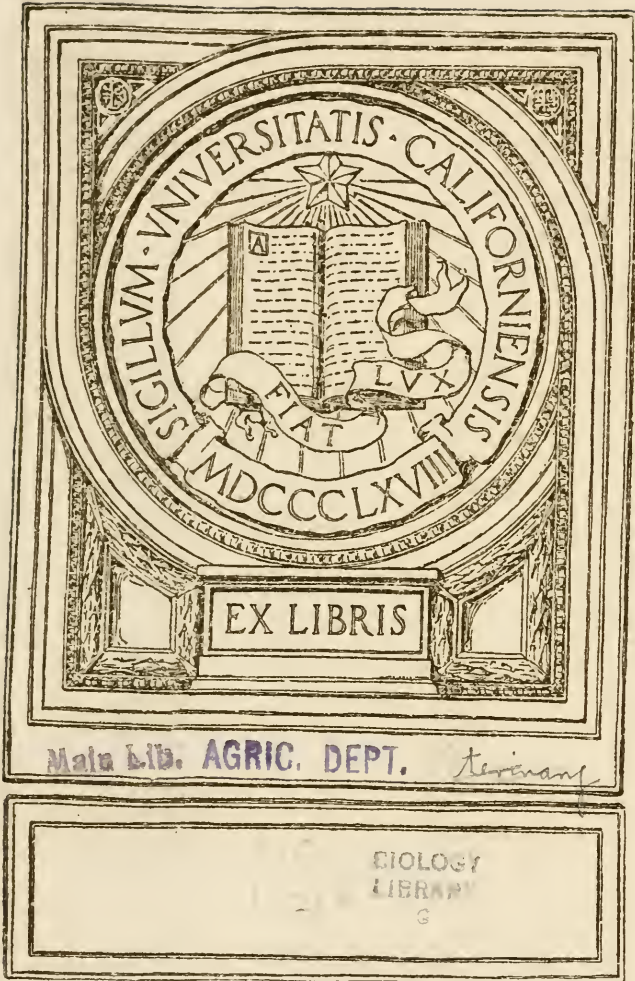


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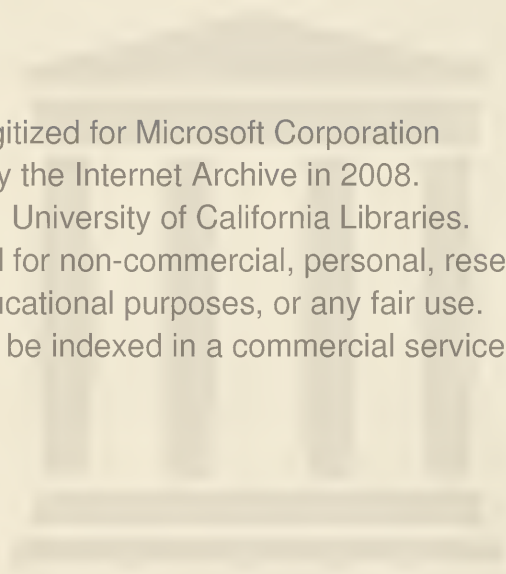
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VETERINARY MEDICINE SERIES

Edited by
D. M. CAMPBELL, D. V. S.
Editor
American Journal of Veterinary Medicine

POULTRY DISEASES AND THEIR TREATMENT

By
B. F. KAUPP, M. Sc., D. V. S.
Commissioner of Health,
Spartanburg, S. C.

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No. 2

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BY

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*Success is not luck, nor pull, nor a
soft snap, but the longest, steadiest,
hardest task one ever undertook.*

PREFACE

This book is written to fill a demand from Veterinary students, students in Poultry Husbandry courses at our Agricultural Colleges, for Veterinary practitioners and for others interested in the scientific treatment of poultry diseases.

An effort has been made to make the language so plain that all can comprehend the subject-matter, which is a summary of thoughts from experimental research in the Laboratory of Pathology of the author and of many other investigators.

For the purpose of simplification, the synonyms are given for the various names of diseases. Then follow, in order, the cause, or causes, the symptoms, the conditions found upon postmortem examination, and lastly the treatment for each disease.

The author is under very great obligations to Dr. D. M. Campbell, Editor of the *AMERICAN JOURNAL OF VETERINARY MEDICINE*, for editing and arranging his laboratory notes on this subject into a related whole, as here presented, and for the section on Sanitation and some other portions.

B. F. K.

Spartanburg, S. C., February, 1914.

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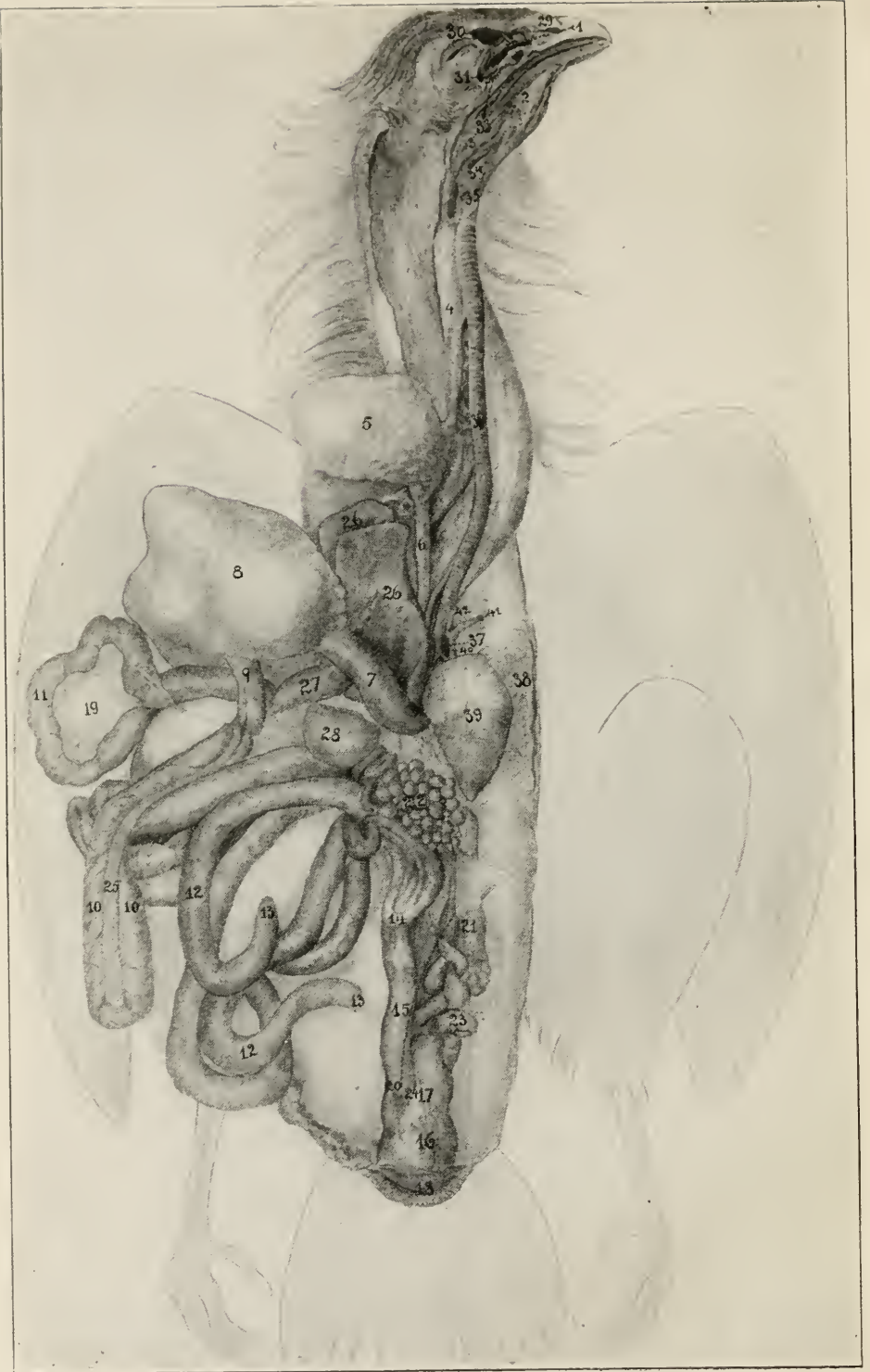


PLATE I.

SECTION I

Visceral Anatomy of the Hen

Digestive and Genito-Urinary Tracts

PLATE I.

1. Beak. 2. Tongue. 3. Pharynx (throat) through which the food passes to the esophagus (gullet) 4. 5. The crop, a storehouse or granary where the food accumulates during feeding. 6. Second portion of the esophagus, through which the food passes from the crop into 7, the proventriculus.

A part of the abdominal organs are laid over to the left, so that the proventriculus or true stomach, lies over the liver. The second portion of the esophagus empties into the proventriculus, or true stomach, in whose walls are found secreting glands similar to those of the stomach of higher animals.

The food, after being soaked in this secretion, passes into the gizzard, 8, a muscular organ, where the grain and other coarse particles are ground by the contractions of its muscular walls and the grit which it contains. From the gizzard, the food passes into the duodenum, 9. 10 represents the deep (duodenal) or the first portion of the small intestines, between the folds of which is located the pancreas, 25, which pours its digestive secretion into the small intestines. 11 represents the floating portion of the small intestines supported by the mesentery (web-like membrane) 19, which

also shows the distribution of the blood vessels in their course to that part. 12 represents the ceca, or two blind guts, the blind extremities indicated at 13. These empty into the remainder of the intestine at 14. 15 represents the rectum, or straight gut, which is joined by the egg sac, 23, at 17, forming the cloaca or common pouch, 16.

At 20, the ureter from the kidney, 21, empties the secretion from that gland into the rectum. The cloaca discharges its contents, feces, urine, and eggs, through the anus, 18, into the external world. The right ovary perishes as the hen develops, so that only one ovary, the left, 22, remains. The egg canal, 23, has a muscular wall for the purpose of forcing the egg along as it develops; it is also provided with glands which aid in the formation of the albumin, egg shell, etc. This sac, at its anterior end, receives the ovum (yolk) from the ovary as soon as it is mature.

The liver, 26, which has been turned back, is crossed by the proventriculus, 7. The gall-bladder is shown at 27, where the bile (liver secretion) is stored up till active digestion begins in the small intestine, into which it is then discharged. The spleen, a blood-forming organ, is indicated at 28.

Organs of Respiration

The nostrils are shown at 29; air passes from this point through the nasal passage, indicated by the dotted line, and enters the pharynx through the opening (posterior nares) at 33. 32. Turbinate bone of the right nasal chamber. 30. Frontal sinus. 31. Maxillary (infraorbital) sinus, analogous to the same in the higher animals.

The air passes through the pharynx, 3, into the

larynx, 35, through the opening (glottis) 34. From the larynx the air passes through the trachea (windpipe) 36. At 37 there is a flattened portion, the false larynx, provided with vocal cord-like structures—the organ of sound. Just below this point is the bifurcation (branching) of the trachea, one branch going to each lung. 38. Left lung.

Organs of Circulation

The heart, 39, is illustrated pulled down, to bring it into view. 40. Main artery (aorta) leading from the heart. 42. Carotid artery, a branch of the aorta, supplying the neck and head. 41. Left brachial artery, a branch of the aorta, supplying blood to the left wing.

SECTION II

Sanitation

Where any considerable number of birds are brought together on limited grounds, disease is certain to appear among them sooner or later. The greater the number of birds kept on any given area, other things being equal, the sooner disease will appear, the more rapidly will it spread, and the greater will be the loss from it.

All intelligently directed measures to prevent or delay the appearance of disease in a flock, all sane measures to limit its spread and encompass its eradication, constitute *sanitation*. Measures, the purpose of which are to cure the sick birds or relieve their suffering, come under the head of *therapeutics* or *therapy*.

On farms of considerable size, where attention is given chiefly to general crops, and but few fowls are kept on a practically unlimited range, the loss from disease may be small, where indifferent or even bad sanitation prevails; but in intensive poultry plants, where the number of birds is large for the size of the range, there can be no continued exemption from devastating epizootics, if reasonable sanitation is not enforced. Any attempt to operate such a plant in insanitary buildings and yards, or under conditions that do not permit of sanitation, while it may succeed for a time, will result in loss oftener than otherwise and, in the end, must inevitably fail.

Site for Poultry Plant

A rolling, or even steep, plot of ground is desirable for the location of the poultry houses and the runs for the fowls. Good drainage is a necessary requirement, and must be provided for artificially if the location is such that natural drainage is not perfect.

The surface of the poultry yard must be free from unevenness so that water will not collect in little pools.

The poultry runs and buildings should have a free exposure to sunlight, though some shade must be provided for protection during excessively hot summer days.

The soil should contain a goodly proportion of sand. It is very desirable that it be of such a nature that the runs will not readily become muddy during wet weather, and such that they will dry very quickly after rains.

Buildings and Runs

It is not within the province of this work to discuss plans for the construction of poultry houses and poultry yards. Those desiring information on this subject may secure detailed directions from several agricultural experiment station bulletins (Bulletin No. 215, Wisconsin Agricultural Station, Madison; Bulletin No. 266, Michigan Agricultural Experiment Station, Lansing; Bulletin No. 107, Missouri Agricultural Experiment Station, Columbia; Bulletin No. 244, New Jersey Agricultural Station, New Brunswick, etc.).

The arrangement of the poultry house should admit the sunlight freely to all parts of the building, provide plentiful ventilation without permitting a draught to blow directly upon the roosts,

and enable the building to be easily and thoroughly cleaned.

Sunlight is one of the most powerful of disinfectants, even a parasiticide for certain young parasites, and is necessary to the health and contentment of the fowls. It has the advantage also of revealing filth in the building which might otherwise escape the eye of the attendant, and remain to breed disease in the flock.

Ventilation should be definitely provided for in the construction by ventilators and the proper arrangement of doors, windows and other openings and not left to cracks in the walls and to chance openings. Cracks in the walls are an abomination and ever present protection to, and nursery for external parasites, and a harbor in which disease germs may weather the application of disinfectants.

The interior of the poultry house should be whitewashed after a thorough cleaning and disinfecting, twice, or better, four times a year. Whitewash is desirable because of its clean appearance, its cheapness, and the ease of its application (use a spray pump), because of the antiseptic value of the lime, and because of its high reflection of light.

The roosts should, of course, be removable to permit of cleaning, and should come near to the floor so that heavy birds may not be injured in jumping off of them. Like the walls, they should be free from cracks and whitewashed two to four times yearly. During the hot season, the roosts should be wet with kerosene once a week. This will aid very materially in keeping mites and lice from the fowls. Dropping pans placed under the roosts are a convenience worth while, for sanitary reasons.

The floor of poultry houses should be of concrete; it should be filled in until it is several inches to a foot higher than the surface of the ground surrounding the building; immediately beneath the concrete there should be a layer of cinders or very coarse gravel, six or eight inches thick. A floor so constructed will not absorb dampness from below. It is lasting, and is easily cleaned and disinfected.

An open shed facing the south, where the birds can enjoy scratching and dust throughout the year, is a great aid in maintaining the health and productiveness of the flock.

Portable houses and runs, that can be moved from place to place, furnish fresh soil, a change of food, abundant insects, etc., and possess many advantages of sanitation.

The poultry yards or runs should furnish, at least, 100 square feet or better, 150 square feet of space for each bird; as stated previously, the runs should be well drained and free from puddles of mud and water.

Water Supply

Fowls require water in abundance at all times for the best production of eggs (which are sixty per cent water) and flesh (which is sixty to eighty per cent water) and to avoid great suffering during hot weather.

The water should be clean, supplied fresh every day, and in vessels so arranged that the birds cannot get into them and thus contaminate it with the filth from the yards which adheres to their feet. As is shown under the discussions of the various infectious diseases and parasitisms, these are spread in most cases, not by direct contagion

between the sick and the well birds, but, indirectly, through the medium of the soil and roosts on which the birds live, the food that they eat, and the water that they drink.

The vessels containing the drinking water should, under normal conditions, be thoroughly cleaned and disinfected daily in hot weather, and once a week the remainder of the year. When disease is present in the flock, the vessels for drinking water should be cleaned daily, regardless of the season, and this practice should be continued for several days after all symptoms of the disease have ceased to appear in the flock. Vessels containing water for small chicks should be cleaned daily.

The cleaning is mainly a matter of thorough washing; the disinfection of drinking vessels can best be accomplished with a five per cent solution (in water) of carbolic acid.

Chickens tolerate certain antiseptics internally very well and do not resent the taste of them in drinking water to the extent that other animals do, and it is a wise policy to use antiseptics in the drinking water whenever an infectious disease is present on the premises or when the purity of the water is under suspicion.

The most desirable antiseptic to use in the drinking water is potassium permanganate. Place a quantity of the crystals in a large bottle or jar and fill with water; of this solution use sufficient in the drinking water to give it a slight color which will remain for some hours. More water can be added to the stock solution from time to time, as needed, care being taken to keep an excess of the permanganate crystals always in the bottom of the jar.

Pure carbolic acid may be used in the drinking water with good effect during the presence of contagion, or to insure the purity of the water. Add a sufficient quantity to make a one-half of one per cent solution (five teaspoonfuls to the gallon). Do not use the permanganate and the carbolic acid at the same time.

Under many conditions, particularly when enteric diseases are present in the flock, mercuric chloride (corrosive sublimate, bichloride of mercury, perchloride of mercury) is a valuable antiseptic for the drinking water. Employ it in solutions of 1 to 5,000 to 1 to 10,000 (from three-fourths to one and one-half grains to the gallon).

Both mercuric chloride and carbolic acid are very poisonous and must be handled with great care. On this account, the comparatively harmless potassium permanganate should be used, or chinisol, which is equally harmless, may be used in a solution of 1 to 2,000 (two tablets to the gallon of drinking water).

Disinfection

The removal of parasites and disease germs or their destruction is termed disinfection. Because of the ability of these organisms to multiply, from a single individual or a single pair, at an astonishing rate and speedily reinfect the premises, it is obvious that to be of any value the disinfecting must be thoroughly done.

The first step in any disinfection is the removal of *all* visible filth. A small lump of manure behind a nest box or a single grain of dirt in a crack in the floor or on the roosts may furnish the hiding place from which will emerge the parasites or germs to reinfest the whole building, and

spread disease anew among the flock, thus undoing the whole of the disinfection.

Disinfection of Buildings.—The first operation in disinfecting a poultry house, therefore, is the thorough removal of all manure, trash and litter. If the roosts and nests are removed from the building, they must be cleaned and disinfected before they are returned; if left in the building during the disinfection, they must be as thoroughly cleaned as the remainder of the building, and the disinfectant used must be applied to them as carefully as to other parts of the building.

The floor and roosts should next be scraped, and they and the walls and ceiling carefully and vigorously swept. All parts of the interior of the building must then be thoroughly scrubbed with water, to which lye has been added, and a broom or stiff brush and then flushed out, using plenty of water. The building is then ready for the use of the disinfectant.

There are three different classes of agents that may be successfully used in disinfection. The disinfectant may be applied in gaseous form, as a liquid, or heat may be utilized.

A gas may be used in disinfecting only when the building can be closed tightly enough to prevent its ready escape. This excludes the great majority of poultry houses; but in such as it can be employed, all doors, windows and other openings must be tightly closed and kept closed for several hours. After disinfecting a building with gas the interior should be whitewashed, as directed under the use of liquid disinfectants.

Of the gases that may be used, only three need to be considered here—hydrocyanic acid, formaldehyde and sulphur dioxide.

Hydrocyanic acid gas is extremely poisonous, a single breath of it sometimes sufficing to kill a man. It possesses the advantage of requiring but a few minutes to effectively disinfect a building and of killing all living organisms in it, bacteria, molds, parasites and even roaches and other vermin, and rodents. It will also destroy the eggs of parasites. It is extremely dangerous, however, except in professional hands, and its use must not be attempted by the poultryman.

Excluding hydrocyanic acid on account of the hazard attending its use, formaldehyde is the gaseous disinfectant of choice. It may be secured in a forty per cent watery solution known as formalin, from which the gas may be readily generated.

After hermetically sealing all openings into the building except one door, place in an earthen or metal vessel two quarts of formalin for each 1,000 cubic feet of space in the building, place this vessel in a much larger one and set on the floor, then empty into the formalin one-half pound of potassium permanganate for each quart of formalin and retreat from the building at once and close the door.

The temperature of the room, during the disinfection, should be above 50 deg. F., and the more it is above this temperature, the better. Moisture in the air is an aid in this sort of disinfection; it may be secured by sprinkling the floor just before starting the generation of the gas. The building should be kept closed six to twenty-four hours. It must be thoroughly aired before the fowls are permitted to reenter it.

Such disinfection may not destroy rats and mice, or the larger parasites and their eggs.

For disinfecting with sulphur fumes, the ordinary commercial flowers of sulphur should be used. It must be burned in the building to generate sulphur dioxide, which is effective in disinfection only in the presence of water vapor; therefore some means for providing the necessary moisture in the building must be provided. This may be accomplished by spraying the walls and ceiling until they are dripping, just before beginning the disinfecting, or by boiling a large vessel of water in the building during the generation of the sulphur fumes.

Fire is required to generate the sulphur fumes and care must be taken not to endanger the building with it. A large iron vessel partly filled with live coals may be used; set it on the floor, or if the floor be of combustible material, on several bricks laid on the floor, and pour onto the live coals two pounds of sulphur for each 1,000 cubic feet of space in the building. Care should be taken to ascertain that the sulphur actually begins to burn.

The building should remain hermetically sealed for from twelve to twenty-four hours and then be thoroughly aired before the fowls are admitted.

Compared with hydrocyanic acid and formaldehyde, sulphur dioxide is a feeble disinfectant, but effective work may be done with it by a thorough, careful application, and attention to all details.

The disinfection of the drinking water and drinking fountains is discussed fully under "Water Supply." (See page 22.)

Disinfectants that can be applied in liquid form are best suited for disinfecting the ordinary poultry house. It requires longer to apply them than it does to prepare for disinfection by gas, and germs and parasites protected in crevices and

in decayed surfaces of wooden walls cannot be reached, as by the gaseous disinfectants. Fowls need not be shut out of the building for several hours, as is the case when the gas is used. This is often a considerable advantage. Furthermore, the germs and parasites hidden in the walls and roosts and buried in the decayed surface of wooden buildings can in a great measure be covered up and rendered harmless by the use of whitewash, which should always be a part of the cleaning-up and disinfecting of a poultry house.

Liquid disinfectants are best applied with the spray pump, and all the force possible should be used in throwing the spray on the walls. In this way it will reach all parts of an uneven surface better than when applied with a brush, and much time will also be saved in its application.

Disinfectants will act more vigorously when applied hot, and solutions should always be at least warm when they reach the surfaces to be disinfected. A copious quantity should be used. The solution may cost but a fraction of a cent, or at most a few cents a gallon, and it is a poor policy to economize by using an insufficient amount. Every part of the surface of the interior of the building should be thoroughly wet and completely covered with solution when disinfection is completed; great care must be observed that no part is skipped.

Mercuric chloride is one of the most powerful disinfectants, but it is intensely poisonous and must be used with caution. No puddles of the solution should be left from which the birds may drink when they come into the building, and tablets of this disinfectant must on no account be left where children can get them or where their

elders may mistake them for something else, e. g., a headache remedy.

For disinfecting buildings the mercuric chloride should be applied in a solution of one to five hundred (one ounce to four gallons of water) and four times as much common salt (one ounce to the gallon) should be used with it. The solution should be applied as hot as can be handled with a spray pump. After the surface is dry it is a good precautionary measure to apply the disinfectant a second time and to follow as directed heretofore with the spray of whitewash, covering the interior, walls, ceilings, roosts, nests and floors. The ordinary whitewash is very satisfactory for this purpose; "government" whitewash may be preferable, but as the interior should be whitewashed at frequent intervals, there is no particular advantage in having a whitewash of great lasting qualities.

There are a great number of disinfectants that may be used in solution for disinfecting poultry houses, but certainly none are superior to the coal tar disinfectants. Formalin, for example, is exceedingly irritating to the eyes and respiratory passages of the one doing the spraying. Potassium permanganate needs to be applied in almost saturated solution to be effective, and thus becomes expensive. A solution of copper sulphate is not fatal to all parasites. Crude petroleum leaves the building unsightly and the odor persists unduly long, and so it is with many others.

Of the coal tar disinfectants, crude carbolic acid perhaps stands at the head on account of its low cost, however, it is quite variable in composition. It should be used in five per cent solution, and

may be mixed with the whitewash and applied at the same time; thus saving one operation. Use two pounds of the crude carbolic acid to each five gallons of the whitewash. Cresol, another of the coal tar products, gives satisfactory results in two per cent solution (one pint to six gallons of water). Pure carbolic acid is rather too expensive for this sort of disinfection; if used, a five per cent solution (one pint to two and one-half gallons of water) should be employed. Kreso and Kreso dip (Parke, Davis & Co., Detroit); Zenoleum (Zenner Disinfectant Co., Detroit); Liquor Cresolus Compositus (U. S. P.); Creolin (Pearson); and many other disinfectants may be substituted for the crude carbolic acid.

Heat is one of the most reliable of disinfectants. It may be utilized in poultry house disinfection in the form of a flame from a gasoline blow torch. Every portion of the walls, ceiling, floor, roosts, nests, boxes, etc., must be carefully flamed.

This method, although tedious, is effective. Used with ordinary care, it is devoid of danger to the operator or building.

Disinfection of Yards.—A complete disinfection of poultry yards and runs, that is, a destruction of all the disease germs and parasites with which it may be contaminated by an infected flock, is scarcely possible by the ordinary means employed in poultry house disinfection. Fortunately it is seldom necessary.

When it is remembered that the germs of nearly all diseases, and the eggs of nearly all internal parasites of poultry, are eliminated in the dejecta (feces) of affected birds, the danger from contaminated runs will be better appreciated, and with the realization that each mature hen pro-

duces nearly one hundred pounds of manure per year, the importance of the yards as a factor in the spread of disease is seen to be very great.

The problem of having clean (non-infected) yards for poultry can be solved only by a change of grounds from time to time. As mentioned heretofore, the movable poultry house offers many sanitary advantages. Plowing or spading a yard, thus exposing surface layers of the soil to the disinfecting action of the sunshine, and keeping the birds off it for a season, offers the most practical means of disinfecting it.

Where the construction of the poultry buildings are such as preclude a change of location, the two-yard system can in most cases be installed. It offers many advantages: while one yard is being used, the other may be plowed and a crop grown. This may be a crop upon which the birds may be turned for half an hour each evening to allow them a feed of green forage.

In any system of yards where the area of the grounds is small for the number of birds, the yard should receive frequent attention at the hands of the cleaner. If the yard is grassed, and the grass is short, it should be swept weekly, gathering the manure in piles and carting it away, as street cleaners do. A yard that is bare of vegetation can be cleaned in the same way, even more easily and effectually. This will lengthen the "sanitary life" of a yard to many times its duration without such cleaning.

Immediately surrounding the poultry house there should be a strip of gravel on which the birds may be fed, and on which they will spend much of their time, to the very great saving in contamination of the yard. The feeding ground,

of course, should be cleaned (usually by sweeping) frequently, and it may be thoroughly wet down with a disinfectant in case of a serious outbreak of infectious disease.

Disposal of Sick and Dead Birds

A strict adherence to the rules of sanitation would require that the well birds be removed from the buildings and enclosures in which sick birds are found, or in which birds have died of disease, and that they be not returned until after thorough disinfection of the building and grounds. Such a procedure is not often practicable and the poultryman is left the alternative of removing the sick or dead birds from the flock to prevent as far as possible an extension of the infection.

Whenever an ailing bird is discovered in any flock it should be isolated immediately. Do not wait to discover what is the matter with it, whether it is an infectious disease or a disease at all, or to decide as to its treatment. Remove it from the well birds first and decide upon further measures afterward. The same directions apply with equal force to the finding of dead birds among the well ones. Remove the carcass immediately and unless there is conclusive evidence that death was not due to disease, disinfect the place where it has lain.

Sick birds should be placed by themselves, where they will not be molested by other birds or animals. They should be given as comfortable quarters as possible and be disturbed only for treatment. Unless the poultryman is very positive that he knows what ails the sick bird, and what means should be taken to prevent others in

the flock from acquiring the same disease, he will usually find it best to call a veterinarian and leave the matter with him, particularly is this true if there are a large number of birds on the premises or if the flock be one of high value, because of pure breeding.

Immediately after the removal of a dead bird from the flock the poultryman should satisfy himself as to the cause of its death. If it is obviously due to accident or if it is due to some disease already recognized as present in the flock such action should be taken as the conditions seem to warrant, but if there is any doubt as to what has occasioned the death a careful autopsy should be held. Since a postmortem examination ordinarily means very little to one without at least some fundamental training in pathology, the poultryman will ordinarily find it advantageous to take the dead bird to his veterinarian for examination. This should be done immediately, before the changes incident to decomposition have masked the lesions which disease may have produced, or before parasites that may have caused death have changed their location or escaped from the body.

Mode of Performing Autopsy.—Lay the bird on its back. With a sharp knife open the abdominal wall, commencing close to the anus, passing the knife forward between the ribs and breastbone to a point just back of the “wishbone” (clavicle). In like manner open the left side, being careful not to injure any of the organs in the cavities. Now grasp the sternum or breastbone, forcing it forward, and it will break so that it will be easy to remove it. This will lay the cavities open so that all organs can be observed, as illustrated and

named in Plate I, to which refer for further description.

The final disposal of carcasses of birds, whether dying from known or unknown causes should be carefully attended to. The habit of throwing dead birds onto the nearest manure pile or into an unoccupied field cannot be too severely condemned.

Among many people there is a belief that if the body of a person that has died is not properly buried, the spirit of the departed will haunt its living relatives and if they do not heed its warnings, bring great disaster to them. If poultrymen entertained a similar belief regarding the disposal of dead birds it would save them much loss from disease and parasites among their flocks. The carcass of a bird that has died of an infectious disease or of a parasitism may be the means of infecting grounds and spreading disease among the flock many months later, or portions of it may be carried to neighboring farms with disastrous results to neighboring flocks.

The dead birds found in a flock should be burned whether or not they have died of contagious disease, for even if they have died of some cause other than disease the chances are that they harbor intestinal parasites which are capable of being spread from the carcass to live birds. Where time cannot be taken to properly burn the dead birds they should be buried and buried deeply, so that they cannot be dug up by dogs, skunks or foxes, and so that worms may not carry infection from the carcass to the surface of the ground.

SECTION III

External Parasites

More than thirty species of external parasites infest birds; their economic importance is very great; fowls heavily infested with any of them are unprofitable and many of the kinds of external parasites are so injurious as to kill the infested birds.

It is necessary to know something of the life history of these parasites and their habits to intelligently treat their parasitisms. This information is given as briefly as possible in the following pages:

The external parasites affecting birds consist of *lice*, which infest all ages and breeds; *scab parasites*, producing scaly legs; the *air sac mite*, which is a modified scab parasite and infests the air sacs; the *chigger* (chigoe or jigger) or red mite, a great pest in the hot summer months; a distinct bird *flea*; the *chicken bug*, which in many respects resembles the common bedbug, and the *ring worm*. In all, seven different classes.

LICE OF BIRDS

This embraces a group of biting lice, their bodies are flat and their mouth parts are arranged for biting and cutting. They live upon feathers, epidermis and secretions of the body of their host. As may be noted in Fig. 2, the mouth parts are located just back of the antennæ and are not always visible. The antennæ or feelers consist of five articles or joints each. The thorax in some species is long and narrow, in others

short and globular. They are provided with three pair of legs which are attached to the thorax. The free extremity of the legs is provided with two hooklets or claws which enable them to hold on to their host. The body and legs may be covered with a greater or less quantity of hair or bristles.

The lice of birds are placed under the following genera: *Menopon*, *Goniodes*, *Goniocotes*, *Lipeurus*, *Docophorus* and *Nirmus*.

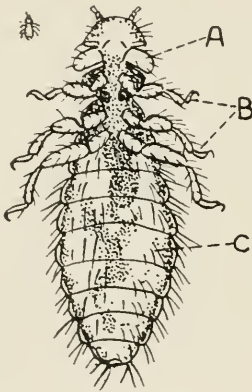


Fig. 2

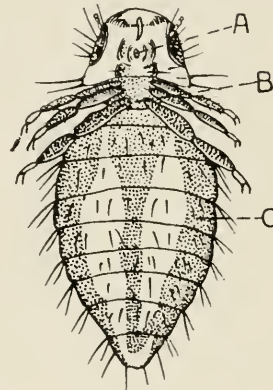


Fig. 3

FIG. 2. *MENOPON BISERIATUM*
A, Head provided with mouth parts for biting, feelers (antennæ) and eyes. B, legs attached to the thorax. C, abdomen.

FIG. 3. *MENOPON PALLIDUM*
A, Head. B, thorax provided with three pairs of legs. C, abdomen with hairs.

Lice of Chickens

Menopon biseriatum (the large chicken louse).—This is the largest louse found upon chickens. It is about one-twelfth of an inch in length. It is light in color. Fig. 2 illustrates this louse much enlarged; the short mark at the right shows the actual length of this louse. This parasite is common on the heads of young chickens.

Menopon pallidum (the small chicken louse).—This louse is illustrated in Fig. 3 and, as may be seen, is smaller than the *M. biseriatum*. In some parts of the country this louse is the more common of the two and is a source of considerable trouble. It may spread from chickens to other animals and birds.

Goniodes dissimillia.—This is a rather large louse and is apparently rare. The head is subquadrate, the thorax short and narrow and the abdomen large and globular.

Goniocotes hologaster.—The head is nearly quadrate, the thorax narrow and the abdomen short and globular. Fig. 4 illustrates this species.

Lipeurus infuscatus.—This is another louse that may infest chickens. It has been studied in the author's laboratory and has also been reported by Osborn as occurring in Iowa. However, it is not very common. Fig. 5 illustrates this louse.

Lipeurus infuscatus.—This louse is long and slender. The front part of the head is rounded, the thorax a trifle narrower than the head and the abdomen is long and thin.

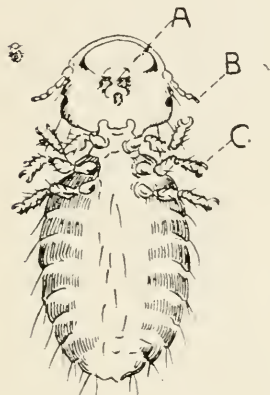


Fig. 4



Fig. 5.

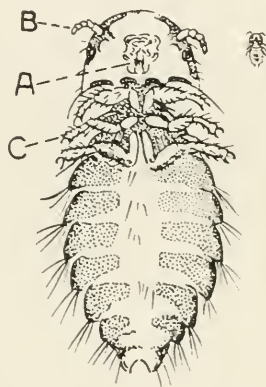


Fig. 6

FIG. 4. GONIOCOTES HOLOGASTER

A, Mouth parts. B, antennæ. C, hooklets on free extremity of leg.

FIG. 5. LIPEURUS INFUSCATUS

A, Mouth parts. B, abdomen. Drawing to right of head indicates actual size.

FIG. 6. GONIODES STYLIFER

A, Mouth parts. B, antennæ (feelers). C, legs. Drawing to right of head indicates actual size.

Lice of Turkeys

Goniodes stylifer.—This is the common turkey louse. Its head is well rounded in front, rather square cut, with scallops behind; the thorax is narrow and the abdomen large and globular. Fig. 6 illustrates this louse.

Lipeurus polytrapezius.—This is a long, slender louse, with two or three bristles extending from each segment of the abdomen. Its head is well rounded in front and the thorax is rather broad and long.

Lice of Ducks

Menopon obscurum.—The head is crescent-shaped in front and the abdomen has dark, lateral bands. It is dark fawn colored.

Lipeurus squalidus.—The head is narrow and somewhat elongated in front. There are six hairs on the front part of the head. This louse is common in some localities.

Lice of Geese

Lipeurus jejunos.—A slender, pale, yellowish-white louse. It is probably universally distributed.

Trinoton continuum.—This is a fairly large louse, covered with few hairs. It is common on geese.



Fig. 7



Fig. 8

FIG. 7. *LIPEURUS BACULUS*
A, Mouth parts. B, antenna. C, l. gs. Drawing to right of head indicates actual size.

FIG. 8. EGGS OR NIT OF THE *GONIODES STYLIFER* (Greatly Magnified)
A, Egg cemented to the barbs of the feather.

Lice of Pigeons

Lipeurus baculus.—This is the common louse of the pigeon. It is long, slender, light-colored and the abdominal segments are provided with two or three hairs on each side. Fig. 7 illustrates this parasite.

Life History of Lice

The females of lice are slightly larger than the males. They lay oval, white or whitish-yellow eggs (nits), and securely cement them to the barbs of the feathers. This is illustrated in Fig. 8. When the eggs hatch they break open at the end or a small cap is lifted from the end, in much the manner that a chick escapes from the egg. The young have much the same shape as the adults and are ordinarily considerably lighter in color. The males are usually less numerous than the females. If conditions are favorable the eggs hatch in from ten days to three weeks, and the lice live for a considerable time, several months under favorable con-

ditions. During their development they moult frequently, sometimes as often as ten times, becoming slightly darker with each molt.

Lice breed with great rapidity; it has been computed that the offspring of a single pair would reach the enormous total of 125,000 individuals in the third generation, which may mature in eight weeks!

Effects of Louse Infestation

Chicks hatched in the incubator are free from lice and stay so until placed with lousy hens or chicks, or in quarters infested by lice. Lice produce much irritation. The effect of large numbers upon birds is quite marked. The lousy birds scratch, pick at the feathers, show signs of being drowsy, may refuse to eat, and, in growing birds, the body development or growth is interfered with.

Young chicks infested with lice often sit around, moping, with wings hanging down, and in a week or two may die. For this reason brooder chicks should thrive better, grow faster, and are freer from many ailments than chicks hatched by the hen. It has been said that a lousy bird will have more of a tendency to wallow in the dust than one not so infested.

The effect upon older birds is not so severe as upon younger ones, but is noted in conditions of flesh and in the production of eggs. The irritation is sometimes so severe that hens desert their nests. Their combs may become dark or black. Birds unable to rest day or night, become emaciated and die.

To find the lice, part the feathers and the lice will be found running over the skin or base of the feathers. A favorite location for lice is under

the wings where the temperature is warm; but they may be found on any part of the body and at all seasons of the year, but are most common in the hottest months of the year, July and August. During these months conditions are more favorable for their propagation.

Dealing with Louse Infestation

A time-honored and very effective method of treating young chicks for lice is to grease the head and neck, under the wings and around vent. Blue ointment, lard and sulphur, salt and butter, and various other greases are used, but none is more effective than lard alone, which, although tedious to apply, is justified by the excellence of the results obtained from its application.

Older chickens may be either dusted with insect powder or dipped in a preparation for destroying the parasites as we dip larger animals. A dusting powder composed of equal parts of pyrethrum and sulphur is an excellent one for ridding birds of lice; tobacco dust, which may usually be secured at any tobacco factory, may be added to the combination and perhaps will increase its efficiency. This powder should also be sprinkled in the dusting places of the infested chickens. Dusting places should always be provided.

An insect powder gun is needed for dusting the birds. This may be secured at almost any drug store.

If it is the wish to dip the birds, prepare a five-per cent solution of creolin, or the same strength of either zenoleum or kreso dip.

The Maine Agricultural Experiment Station gives the following directions for freeing birds from lice:

When the treatment of individual birds for lice becomes necessary some kind of powder dusted into the feathers thoroughly, seems to be, on the whole, the most effective and advisable remedy. The powder used must be of such a nature, however, that it will be effective. There are so-called "lice powders" on the market which are no more effective than an equal quantity of any inert powdered substance would be. It is not only a waste of money but of time as well to use such powders. At the Maine Station no lice powder has been found that is so satisfactory as that originally invented by Mr. R. C. Lawry, formerly of the poultry department of Cornell University. This powder (which can be made at a cost of five cents per pound) is described as follows by the Maine Station:

In using any kind of lice powder on poultry, it should always be remembered that a single application of it is not sufficient. When there are lice present on a bird there are always unhatched eggs of lice (nits) present, too. The proper procedure is to follow up a first application of powder with a second at an interval of four days to a week. If the birds are badly infested at the beginning, it may be necessary to make still a third application.

The lice powder which the Station uses is made at a cost of only a few cents a pound, in the following way:

Three parts of gasoline and one part of crude carbolic acid, 90-95 per cent strength, or, if the 90-95 per cent strength crude carbolic acid cannot be obtained, take three parts of gasoline and one part of cresol.

Mix these together and add gradually, with stirring, enough plaster of paris to take up all the moisture. As a general rule it will take about four quarts of plaster of paris to one quart of the liquid. The exact amount, however, must be determined by the condition of the powder in each case. The liquid and dry plaster should be thoroughly mixed and stirred so that the liquid will be uniformly distributed through the mass of plaster. When enough plaster has been added the resulting mixture should be a dry, pinkish-brown powder having a fairly strong carbolic odor and a rather less pronounced gasoline odor. Do not use more plaster in mixing than is necessary to blot up the liquid.

This powder is to be worked into the feathers of the birds

affected with vermin. The bulk of the application should be in the fluff around the vent and on the lower side of the body and in the fluff under the wings. Its efficiency, which is greater than that of any other lice powder known to the writer, can be very easily demonstrated by anyone to his own satisfaction. Take a bird that is covered with lice and apply the powder in the manner just described. After a lapse of about a minute, shake the bird, loosening its feathers with the fingers at the same time, over a clean

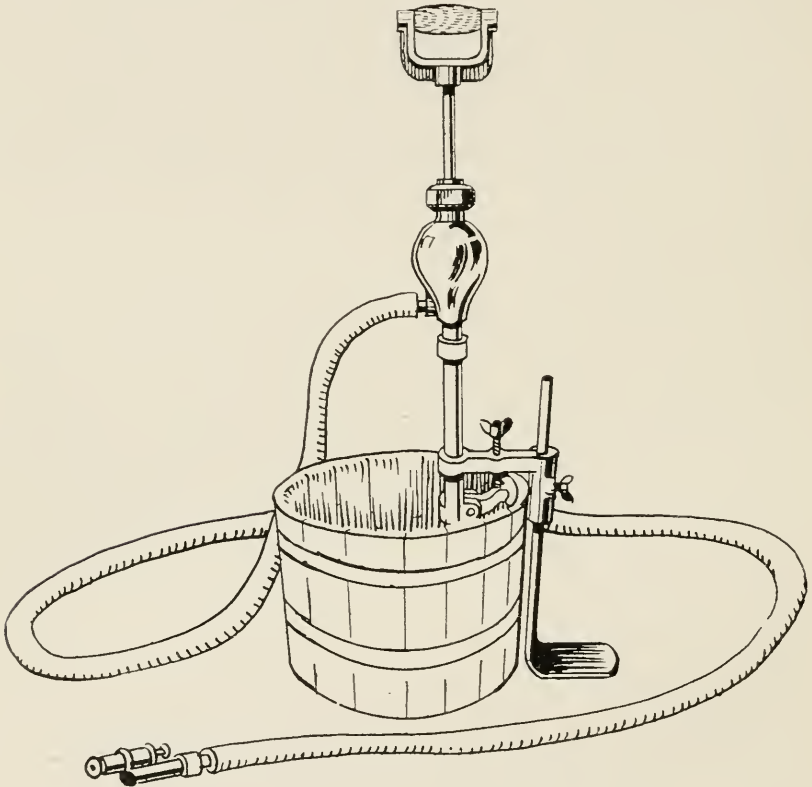


FIG. 9. INEXPENSIVE, DURABLE SPRAY PUMP

piece of paper. Dead and dying lice will drop on the paper in great numbers. Anyone who will try this experiment will have no further doubt of the wonderful efficiency and value of this powder.

After freeing the flock from lice care should be exercised that a reinfestation is not brought about by the introduction of lousy birds.

The lousy henhouse should be thoroughly and frequently cleansed and the walls whitewashed.

The whitewash should contain in it, some parasiticide as carbolic acid five per cent, creolin five per cent or corrosive sublimate one part in one thousand. The roosts should be scrubbed with boiling water and after drying in the sun should be saturated with kerosene. The litter and straw should be removed from the nests and burned and one inch of air-slacked lime placed in the bottom of the nests before refilling them with straw. If the henhouse be tightly closed, doors, windows, cracks and all openings, and thoroughly fumigated with sulphur fumes and water vapor it will aid in destroying lice or other parasites that may be in the cracks and crevices, and difficult to reach with whitewash. Fig. 9 illustrates a cheap and convenient spray pump for applying the whitewash. With this some force is used which drives the parasite-destroying fluid into the cracks and crevices not possible to reach where it is applied with a brush.

Scabies

The acarids, or mites, as they are commonly called, are exceedingly common, widely distributed and of great economic importance. They are eight-legged parasites, belong to the spider family and are so small as to be nearly or quite invisible to the unaided eye, though readily discernible with the aid of a hand lens of low magnifying power.

There are numerous species of mites that infest birds. Some live on the feathers and scales of the skin, others bore into the skin and still others inhabit deeper portions of the body.

There is one form of scabies called depluming scabies that is very rare, and so far as the author

knows has not been reported in this country. It affects the body of both chickens and pigeons. The one on chickens is the *Sarcoptes laevei* variety *gallinae* and the one on pigeons is the *Sarcoptes laevei* variety *columbae*.

The ascarids parasitic for birds are placed under the following genera: sarcoptes, cytodites, trombidium and dermanyssus. Unlike the various genera of lice the scab parasites differ greatly in the effects which they produce and therefore a separate discussion of each one will be given.

Scaly Legs—Scabies of the Legs

This condition is very common; it constitutes leg scabies, and is caused by a parasite called the *Sarcoptes mutans* variety *gallinae*.

Sarcoptes Mutans

Description.—This parasite is one of the same family of scab parasites that infest horses, cattle, hogs, sheep and cats.

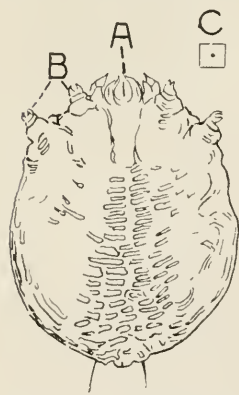


FIG. 10. SARCOPTES MUTANS VARIETY GALLINÆ

A, Mouth parts. B, short, stubby legs. C, dot indicating actual size of parasite.

That particular branch of the family affecting chickens is distinguished by calling it "variety *gallinae*"; *gallinae* being a Latin word meaning "of the chicken." Owing to the small size of the parasite, it is often called a mite. Fig. 10 illustrates the parasite magnified 100 times; the actual size of the parasite is shown by the small dot in the square at the right side of the drawing. In the drawing it will be noted that the legs are short and strong and that its mouth parts are arranged for biting the skin. They subsist upon serum that exudes at the point of attack and forms scales or scabs (see Fig. 11).

Life History.—The female lays her eggs under the scabs, where in about ten days they hatch, if conditions are favorable. The larvæ or young mites are provided with only three pairs of legs and are not provided with sexual organs. They pass through several molts and are finally developed into the adult stage, and at that time are provided with four pairs of legs, with genital organs and are sexually mature.

The tearing off of the scabs favors the escape of the parasites, which in warm weather may live in the filth, roosts, nests or other parts of the building for at least thirty days, and may in that time find their way upon other birds and infest them, causing in turn scaly legs on the new host. Thus birds become affected by being placed in infested quarters, or by having an infested bird placed in the same lot or enclosure as at poultry shows, should any of the birds there be infested.

Symptoms.—This parasite attacks chickens, turkeys and cage birds, but the writer has not observed it infesting ducks or geese. It always attacks the unfeathered portion of the legs above the foot, and often the upper portion of the toes. The minute parasite crawls under the scales of the legs and there irritates the tissue by attacking it with its strong mouth parts. As a result of this irritation a vesicle or small blister appears. The blister is practically microscopic in size and later ruptures. This small quantity of serum dries and forms a minute scale. These scales accumulate until later large scaly masses appear. Fig. 11 is a good illustration of this condition.



FIG. 11. SCALY LEGS (Scabies)
A, Mass of scabs due to dried serum that exudes from injured part. B, scale of leg forced up and out of place by accumulation of dried serum.

The parasites can be found as minute white specks in the serum between the scab and leg. Both legs are usually affected at the same time.

Itching is present and the birds may pick at the affected parts. Itching is more intense at night. The birds may become weak, stop laying and even die from the effects of the irritation and loss of rest.

Treatment: Eradication.—The scabby patches should be soaked with soapy water till the scabs can be easily removed (this will take time, but in valuable birds it will pay; if insufficient value to justify this expenditure of time and labor, kill the bird and burn the affected parts, the legs and feet). After removal of all scabs possible, scrub thoroughly with kerosene or kerosene emulsion, using a nail brush and taking pains to make certain that the liquid reaches the deepest parts.

Kerosene emulsion is made as follows: Kerosene (coal-oil) one-half gallon, common soap, two ounces, water, one quart. Dissolve the soap by boiling in the water, add this solution, boiling hot, to the kerosene and stir with an egg-beater, or otherwise violently agitate. When ready for use take one part of the emulsion and add to this nine parts of water.

Lime-and-sulphur dip.—This well-known parasiticide used warm and scrubbed thoroughly under the scales is very effective. The lime and sulphur dip is made as follows: Unslacked lime, one-third of a pound, sulphur, one pound, water, four gallons. This mixture should be boiled for two hours and the amount lost by evaporation made up by adding water. The lime acts as a solvent for the sulphur; the dissolved sulphur is a valuable parasiticide.

Commercial Disinfectants.—Five per cent solution (in water) of creolin, zenoleum, or kreso dip

is also effective. These solutions should be used warm.

Premises.—For the eradication of scab parasites from infested premises, follow the directions given for ridding premises of lice. (See page 40.)

Air Sac Disease

This is a very serious malady of birds that is fortunately rather rare in this country; it is exceedingly difficult to eradicate once it has become established in a flock. It is due to a scab parasite called *Cytodites nudus*, synonyms for which are: *cytoleichus sarcoptides*, *Cnemidocoptes mutans*, and air-sac mite.

Cytodites Nudus

Description.—The body of this parasite is ovoid in shape, as illustrated in Fig. 12. It is whitish in color and is provided with conical-shaped mouth parts, through which it sucks fluids from the parts infested. The legs are rather short, conical, and in both male and female all are provided with suckers, which aid in moving about and in holding on. The legs are composed of five articles (segments or joints) each. The larva has three pairs of legs and the adult four pairs.

Life History.—The ovigerous female lays eggs, as a rule, but at times has been observed to deposit eggs ready to hatch and even young larvæ. The larvæ pass through changes similar to those of the scaly-leg mite by moulting several times, and finally reaching the adult or sexually developed stage.

Symptoms.—The air sac mite inhabits the abdominal air sacs, the air spaces of bones, and the air cells (alveoli) of the lungs of chickens and pigeons. If only a few parasites are present no symptoms may be noticeable, but if they exist in large numbers their effects may be serious. The bird will become thin in flesh and even emaciated, will appear dull, stay apart from the others of the flock, and the comb will usually be pale in color. The wings will droop and there will be labored

(heavy, difficult) breathing. Coughing may occur and a rattling of mucus (rales) in the trachea or bronchi may often be heard.

Postmortem Appearances.—By a careful examination of the infested air sacs or the bronchi and sacules of the lungs, the mites may be found appearing as minute white specks, about the size of the scaly leg parasites.

For the specimen from which the accompanying drawing (Fig. 12) was made, the author is indebted to Dr. W. B. Mack, Reno, Nevada, who obtained it from a flock of birds examined in New York. Besides the white specks moving on the surfaces of the air sacs, whitish-yellow points, due to the irritation caused by the parasite, may be found. The bronchi may be congested. In severe cases inflammation or bronchitis, and even pneumonia, may exist.

The air-sac mite has also been reported as infesting the liver, kidneys and other abdominal organs, in which cases they produce yellowish, pearl-like nodules or tubercles.

An outbreak of this disease in Colorado was studied by the author during the spring of 1912, in which several birds in a flock of sixty became ill. They were dull and weak, with a partial loss of appetite and a tendency to crane their necks when they tried to swallow, became poor in flesh and after one to two or three weeks died. The comb, in most instances, turned black shortly before death.

On autopsy there were found myriads of small, yellowish-white specks over the abdominal air sacs, lungs and trachea. These specks, when examined under the microscope, proved to be the air-sac mite (*Cytodites nudus*) as illustrated in Fig. 12.

Treatment.—It is said that sulphur given with the feed will be absorbed and eliminated by the lungs in sufficient quantities to kill the parasites that infest them, but this is doubtful. A better method of handling an outbreak of air-sac disease

among birds of average value is to kill all the birds in an infested flock. None of them should be sold, as they may find their way into other flocks and infest them. It is a very serious disease and one of which it is difficult to rid the flock.

Chigger (Jigger) or Red Mite Infestation

There are two varieties of chiggers found in this country, one is the *Trombidium holosericeum*, the other the *Dermanyssus gallinae*.

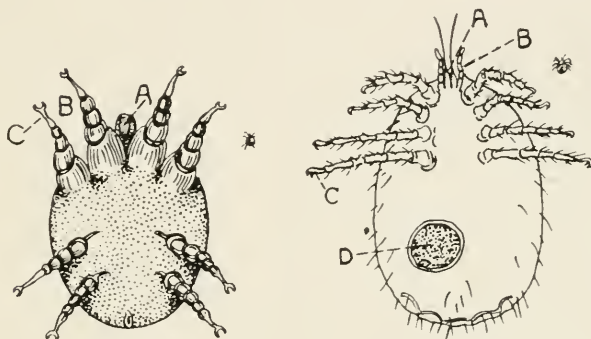


Fig. 12

Fig. 13

FIG. 12. *CYRTODITES NUDUS*
A, Rostrum. B, ambulacrum. C, pedicle of ambulacrum.

FIG. 13. *TROMBIDIUM HOLOSERICEUM*
A, Mouth parts. B, palpi. C, hooklets on free extremity of the leg. D, uterus filled with eggs.
Drawing to right indicates actual size.

Trombidium Holosericeum

This parasite is the common chigger (jigger) or red mite of the henhouse.

Description.—It is very small, as indicated by the mark by the side of Fig. 13. The body is oval in shape (shape of a hen egg); it is provided with four pairs of legs in the adult state and three pairs in the larval. The distal end of each leg is provided with two hooklets or claws, with which it clings to objects and which enable it to crawl about. Its mouth parts are conical in shape, as illustrated in the drawing. (See Fig. 13.)

Life History.—Mites lay their eggs in the cracks and crevices and filth of henhouses. If the temperature is warm the eggs hatch in a few days into the asexual, six-legged state. After passing through a few moults it arrives at the eight-

legged, sexual or adult state. The parasite multiplies very fast in the warmer parts of the summer, July and August, when conditions are more favorable for their propagation.

Symptoms of Trombidium Infestation.—By means of its conical mouth parts, referred to above, it wounds the skin and sucks blood. The engorged parasite is blue to red in color, depending upon the quantity of blood taken into the digestive tract. During the summer of 1911 the author observed one infested flock of chickens in which the affected birds showed symptoms similar to birds infested with lice. They became unthrifty, ceased laying, sitting hens deserted their nests, all exhibited unkempt appearance of the feathers and many died. Many were found dead under the roosts of mornings. Examination of the nests, roosts and birds revealed millions of the parasites. This was in the month of August.

Treatment: Eradication.—The same treatment as for lice will be found very effective. Absolute cleanliness, plenty of kerosene repeatedly applied to the roosts, air-slacked lime on the floors, and in the bottom of the nests.

Dermanyssus Gallinae

Description.—By referring to Fig. 14 it will be seen that the body of this parasite, commonly known as the mite chigger, differs from the *Trombidium holosericeum* in that it is ovopyriform in shape instead of oval. The diameter of the posterior third is greater than that of the anterior third. The abdomen and legs are provided with rather short bristles. Its mouth parts are conical in shape and arranged for injuring the skin and sucking blood. The color varies according to the amount of blood contained within the intestinal tract, varying from yellow to a yellowish-red. The free extremity of the legs is provided with an apparatus which enables them to hold on or cling to objects and to move about rapidly.

Life History.—The female, like the female of the preceding genus, lays her eggs in the cracks and crevices and filth of the floors and nests, where they hatch out in a few days, if the temperature be favorable. The young, six-legged asexual

larva goes through several moults, finally maturing into the adult, sexual, eight-legged parasite.

Symptoms of Dermanyssus Infestation.—This parasite lives in the poultry houses and dove-cotes, hiding in the straw of nests, cracks and crevices of the roosts, and other places of concealment in the daytime. It is the most common and most injurious of mites and is present in every poultry house unless it is kept unusually clean. It comes out at night and makes its attack. Few of these parasites

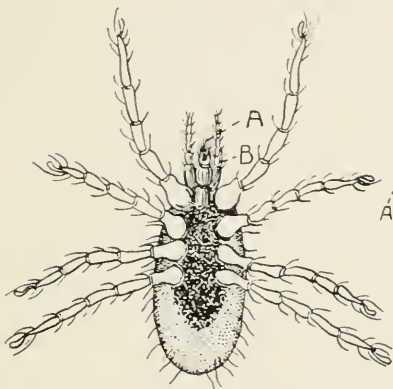


Fig. 14

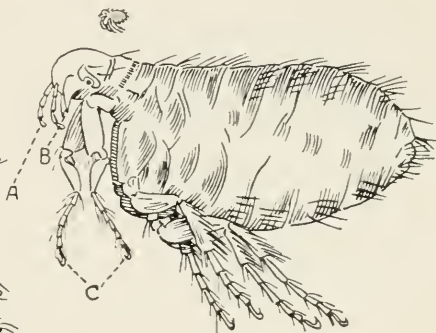


Fig. 15

FIG. 14. *DERMANYSSUS GALLINÆ*
A, Conical-shaped rostrum. B, palpus.

FIG. 15. *PULEX AVIUM*
A, Antennæ. B, stylette. C, hooklets on free extremity of leg.

are to be found on the birds (chickens and pigeons) in the daytime, but at night they may be numerous. Birds so harassed at night cannot sleep or rest and soon become emaciated. The laying hens will leave their nests and even cease laying. Birds may be found dead under the roosts in the mornings from the attacks of these mites.

These parasites may also attack horses and other animals kept close to the quarters of infested birds; they cause irritation, the animal scratches,

rubs, and unable to rest at night, becomes thin in flesh, and weak.

Treatment.—The same as has been outlined for lice and chiggers. (See page 40.)

FLEAS AFFECTING BIRDS

But one genus and species of flea is parasitic upon the chickens. It is known, technically, as the *Pulex avium*. It is far more common in the southern half of the United States than it is in states further north.

Pulex Avium

Description.—This is the common chicken flea. It resembles to some extent the flea that infests dogs and man; however, a microscopic study shows it to be a distinct species. Fig. 15 illustrates this parasite. It is provided with antennæ or jointed feelers. In the larval state its mouth parts are arranged for mastication and in the adult for wounding the skin and sucking blood. It is flattened laterally, the thorax being a trifle deeper than the head and is provided with three pair of legs, of which the posterior pair are longer than the others, giving the insect great power to jump. The free extremity of the legs is provided with two hooklets or claws. In color the chicken flea is light to dark brown.

Life History.—The female lays about twenty brown, oval eggs in some dirty, dusty place, such as the floor, cracks, crevices or nests. These eggs hatch in a few days (six to twelve) if the temperature be warm, and from them come wormlike larvæ composed of thirteen segments each. The mouth parts are arranged for mastication. The larval stage lasts about eleven days; they then pass through a pupa stage in a tough brown cocoon. The pupa stage lasts about fourteen days, when the six-legged adult flea emerges from the cocoon.

Chicken Flea Infestation

Symptoms.—In an outbreak of flea infestation studied by the author during the summer of 1911, the presence of the fleas in the flock was first noted because of the insects attacking persons who entered the hen house. Investigation revealed the presence of fleas in large numbers.

It is noteworthy in this outbreak that all the

lice and chiggers disappeared from the flock, although the chickens in this flock had been troubled by these parasites, more or less, during the three years preceding. Although fleas irritate the skin and suck blood, no noticeable effect on these birds was noted by the owner. Perhaps, because it being summer, the birds were largely out doors and under favorable conditions as to health. Symptoms similar to those produced by lice have been recorded in other cases.

Treatment: Eradication.—Dipping the hens in any of the following solutions, five per cent creolin, five per cent kreso dip, or five per cent zenoleum, is effective in ridding the birds of fleas and preventing their reinfestation for a short time. A dusting powder, used as directed under the discussion of lice, may also be employed with success. Do not neglect to stop reinfestation by treating the premises the same as directed for lice. (See page 40.)

TICK INFESTATION

The chicken tick is the *Argas miniatus*. It is not common in the United States, although it does occur in some of the southern states and in Mexico.

Argas Miniatus

Description.—The body is flat and thin. It has an overreaching dorsal surface that hides the mouth parts. The mouth parts are provided with mandibles, which have hooklike denticles at the free extremity and a hypostome provided with six rows of irregularly-arranged, toothlike denticles. With this apparatus it holds on to its host. By the side of this apparatus there is, on either side, a palpus, an articulated, fingerlike structure taking the place of antennæ as found in the insect parasites. This tick is a blood sucker. The engorged female is nearly one-half inch long. Fig. 16 is a drawing of a full-grown female, taken from a hen in southern Texas.

Life History.—The engorged female drops to the ground, from the hen, and finding a hiding place under some object, lays her eggs, which, if the weather be warm, hatch in a few days into the six-legged, asexual state. Upon gaining access to chickens it begins to draw blood and molts, finally reaching the eight-legged, sexual state. It is now ready to again reproduce.

Symptoms of Infestation.—Large numbers of ticks cause trouble similar to that caused by numerous lice. The parasite, being a blood-sucker, robs the host of considerable blood and causes irritation. The birds do not thrive, sitting hens leave their nests, laying hens cease laying, young

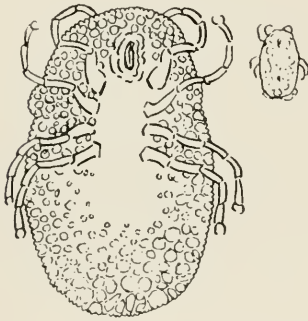


FIG. 16. ARGAS MINIATUS

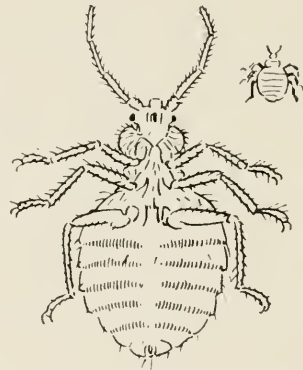


FIG. 17. ACANTHIA INODORA

birds make but little growth. Badly infested birds may die.

Treatment.—Combat the parasite with sanitary measures, as outlined for the prevention of lice. lice. (See page 40.)

THE BEDBUG OF POULTRY

The chicken bug or dove cote bug is known as the *Acanthia inodora*. It is often found around unclean roosts and dove cotes. It is closely allied to the bedbug, from which it requires a microscopic study to differentiate it.

Acanthia Inodora

Description.—Fig. 17 illustrates a specimen obtained from an infestation in Colorado. It will be noted that it is provided with long antennæ, which possess long joints or articles. Its head is rather narrow and it has prominent eyes. The thorax is crescent-shaped on the anterior border and is much wider than the head. It is provided with three pairs of legs. Its abdomen, like the abdomen of the louse, is segmented and is practically destitute of hair.

Life History.—The *Acanthia inodora* lays its eggs in the filth, where they soon hatch, if the weather be warm, and rapidly develop to the adult state.

Symptoms of Infestation.—This bug is quite a pest in Mexico and some parts of the southern United States. At times they are found in great numbers swarming over the roosts and nests, specking the eggs with their excrement, attacking the hosts at night and sucking their blood. The conditions, as a result, are the same as is the case in any other form of infestation by external parasites.

Treatment.—Similar to the preceding. The chicken bug is at times a formidable foe, even invading dwellings and proving more troublesome than the common bedbug (*Cimex lectularia*). They begin to appear about the middle of April, and at times it is necessary to keep the chickens entirely out of doors.

The bugs may live for many months on the filth about a dove cote or henhouse and the disinfection must be most thorough to eradicate them.

FUNGI AFFECTING BIRDS

Three harmful fungi affect chickens. One kind affects the mouth, another the skin and the third the lungs. They are more or less common in this country.

Thrush—Aphtha—Sore Mouth

This is a condition affecting the mouth and is due to a low-grade fungus called the *Oidium albicans* (saccharomyces albicans). This consists of hyphæ (fine thread-like processes) which in some instances show well marked chains of cells. It reproduces by forming round or ovoid spores.

Symptoms.—Eberth has reported a case in a bird that was emaciated and died in convulsions. On the inner lining or mucous membrane of the first portion of the esophagus whitish to brownish yellow deposits adhering to the mucous surface were observed. These were found to be composed of the spores and filaments of this fungus. It has also been reported as occurring in turkeys.

Treatment.—If the patches can be seen it is best to cauterize the area with stick of lunar caustic (moulded nitrate of silver). Intestinal antiseptics are also indicated such as are given in other intestinal disorders as fowl cholera. (See page 83.)

Tinea Favosa—Honey-Comb Ringworm

This malady is due to another low-grade fungus, the *Achorion schoenleinii*. The fungus somewhat resembles the *Oidium albicans* appearing in hyphæ or threads and reproducing by spore formation.

Symptoms.—This disease has been called favus, baldness and white comb. It is a disease that is highly contagious and attacks the comb, face and neck. If not treated, but allowed to spread and go on uninterrupted, it may later extend to the body.

The disease first appears on the comb or face

as whitish or light-gray, small, roundish patches, which vary from the size of a millet seed to a half-inch in diameter. Later these patches may coalesce and form large areas.

The diseased area is covered with a scale which may be depressed in the center and turned up at the edges, giving it a cup-like shape. In the course of four to six weeks the crusts may be one-fourth inch in thickness.

The feathers become dry, erect, brittle and break off at the surface, leaving large denuded areas. A disagreeable odor is given off by the diseased areas which has been likened to that of mouldy cheese. As the disease progresses the bird loses its appetite, becomes gradually emaciated, weakens and finally dies.

Treatment.—In the early stage this disease yields to treatment readily. The crusts should be soaked with soapy water containing a five per cent solution of creolin, liquor cresolis, kreso dip, carbolic acid, or similar antiseptic. The fluid should find its way to every part affected. The premises should be disinfected as for lice or other parasites.

Pneumomycosis—Aspergillosis

The third fungus disease affecting birds is usually due to the *Aspergillus fumigatus*, an organism similar to the common green molds. It affects the lungs and is discussed under "Diseases of the Organs of Respiration." (See page 145.)

SECTION IV

Internal Parasites

Parasites infesting the intestinal canal of fowls are harbored by most fowls, and serious infestations by these parasites are by no means rare. These parasites are commonly spoken of as worms. Other internal parasites, such as gapeworm and air-sac mite, while not so common as the intestinal worms, are by no means unknown, and have the same possibilities of serious infestation.

Intestinal parasites in small numbers infest all fowls without doing perceptible harm, but there is always the possibility that conditions for their propagation may become so favorable as to turn the mildest infestation into a devastating parasitism. Indeed, this very thing has occurred numberless times, and not a few flocks have been entirely destroyed by it. The death of any bird from the effects of internal parasites should be looked upon with apprehension.

Internal parasites may be classed under four orders, as follows: *Nematodes*, or round worms; *Cestodes*, or flat, ribbon-shaped segmented worms; *Acanthocephala*, or thorn-headed worms; and the *Trematoda*, or the flat leaf-like worms, called flukes.

IMPORTANT ROUND WORMS

These are the commonest of internal parasites; they may be found in the ceca of nearly all fowls, and usually in other portions of the bowel. When numerous they may seriously interfere with digestion and lessen nutrition, and by their irrita-

tion of the intestine cause a stubborn diarrhea. Rarely they become so plentiful in the intestine as to wholly obstruct it.

The round worms include four important internal parasites of birds; the large, round, intestinal worm; the small, round intestinal worm; the gizzard worm; and the gapeworm, besides a number of rare, or for other reasons, unimportant worms, all of which will be described in turn.

Ascaris Inflexa

This parasite, sometimes called the *Heterakis perspicillum*, is commonly known as the large, round worm. It is very common, having been found by the author in twenty-four out of eighty-seven autopsies.

Description.—This intestinal parasite is round in shape and whitish-yellow to white in color, varying from one to two inches in length. There are two sexes, male and female, the female being considerably the larger. Fig. 18 shows the actual size of the male and the female specimens from which this drawing was made. Some few specimens are much larger than the ones shown.

Life History.—The *Ascaris inflexa* reproduce by laying eggs, microscopic in size, which pass out to the ground with the feces. Other birds become infested by drinking or eating food contaminated or soiled with the excrements of infested birds. In this way one infested bird introduced into the flock may spread the disease to all the other birds in the flock.

Symptoms of Infestation.—These parasites harm the host by ingesting food during its digestion by the host, thus robbing it to a certain extent. A few worms may produce no noticeable effect upon the health of the bird, but if present in large numbers they cause serious trouble. It has been found that the poison or excrementitious (waste) matter given off by these and other intestinal worms is absorbed and has a deleterious consti-

tutional effect, similar to that of like infestations by parasites in the larger animals and in man.

At times the worms are found in large masses, partially obstructing the bowel, causing constipation, and possibly irritation sufficient to set up inflammation. There may be a loss of appetite, unthrifty condition, unkempt appearance of plumage, dullness, languor and drooping wings, emaciation, loss of color from the comb and mucous membranes followed by death in a few weeks.

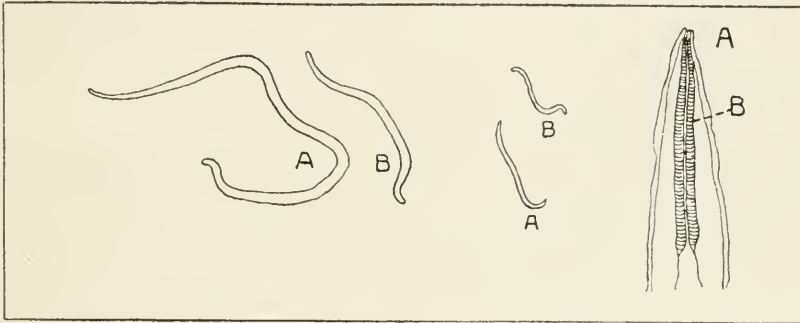


Fig. 18

Fig. 19

Fig. 20

FIG. 18. *ASCARIS INFLEXA* (natural size)
A, Female. B, male.

FIG. 19. *HETERAKIS PAPILLOSA* (natural size)
A, Female. B, male.

FIG. 20. *HETERAKIS PAPILLOSA*, HEAD EXTREMITY (magnified)
A, Mouth parts. B, esophagus.

By careful examination of the contents of the digestive tract of the birds killed for food purposes the poultry raiser may keep informed as to whether this form of parasitism is present in his flock. If these worms are present in members of the flock close observation will occasionally discover them passed in the feces.

Treatment.—It is necessary to keep the yard and henhouse clean, lime scattered on the floor and about the yard, and the water for the birds kept in a clean fountain and the food in clean troughs, made for the purpose, and disinfected daily, and

so constructed that birds cannot step into them. If at all possible, birds should be moved upon new ground. The parasite eggs in the droppings removed from the henhouse may be destroyed by mixing the manure with unslaked lime.

The birds may be given one teaspoonful of turpentine followed by a tablespoonful of olive oil. If the crop is full the dose of turpentine should be doubled. Five to ten grain doses of areca nut is a good treatment. The areca nut can be mixed with soft feed and fed from a clean trough; it acts as a cathartic as well as a parasiticide. One grain doses of thymol is an excellent treatment for round worms. Two grains of santonin for each bird is likewise an effective treatment.

Heterakis Papillosa

This is another very common worm and is usually found in the cecum or blind gut. The author has found it present in about fifty per cent of the adult birds autopsied in his investigation work among poultry during the past four years. It is spoken of as the small round worm by poultrymen.

Description.— This worm is much smaller than the *Ascaris inflexa*, being only about one-fourth to one-half inch long. It is white in color. Fig. 19 illustrates the male and female, natural size. Fig. 20 illustrates the head parts, magnified several times, and Fig. 21 the caudal or posterior end of the male, magnified several diameters.

Life History.— So far as known the life history is the same as that of the *Ascaris inflexa*. While the latter infests the small intestines as stated above, this one is found principally in the ceca or blind gut.

Symptoms of Infestation.— When present in large numbers the small round intestinal worm of chickens (*Heterakis papillosa*) produces considerable irritation and results in an unthrifty

condition of the affected bird. It robs the host of nutrients, as does the *Ascaris*.

Treatment.—Sanitary measures for the prevention and eradication of this parasitism and direc-

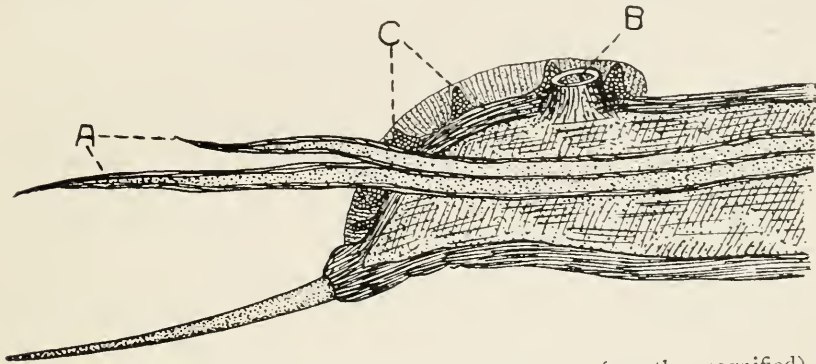


FIG. 21. *HETERAKIS PAPILLOSA*, TAIL EXTREMITY (greatly magnified)
A, Spiculæ. B, preanal sucker. C, papilla.

tions for its treatment are the same as for *Ascaris inflexa*. (See page 61.)

Spiroptera Hamulosa

This is the gizzard worm of chickens. Specimens have been sent to the author's laboratory from Missouri only.

Description.—The male measures about one-half inch in length and the female about three-quarters of an inch. Fig. 22 illustrates the worms, natural size.

Symptoms of Infestation.—The economic significance of this parasitism is due chiefly to the loss of weight and the stunted growth which it causes. The affected birds become anemic, emaciated, extremely lazy and have a ravenous appetite. The worms produce nodules in the walls of the gizzard. The birds become infested from eating food contaminated or soiled with the excrement of infested birds or by taking



FIG. 22. *SPIROPTERA HAMULOSA*
(natural size)
A, male. B, female.

in young, immature worms through soiled food and water.

Treatment.—The treatment is difficult owing to the fact that they are imbedded in tumefactions in the walls of the gizzard. Give turpentine and olive oil as directed for the treatment of *Ascaris inflexa* infestations. The treatment should be repeated three or four times at intervals of one week.

Syngamus Trachealis

This parasite is sometimes called the *Scleros-toma syngamus*, and popularly the forked worm or gapeworm. There is another worm slightly larger than this one that infests the bronchi and trachea of ducks, swans and geese. It is called the *Syngamus bronchialis*.

Description.—The male is very much smaller than the female, upon which it exists as a parasite. Fig. 23 illustrates these worms in copulation as they are always found. A, illustrates a section of mucous membrane. B, the male, which, it will be noted, is much thinner than the female and scarcely one-fourth inch long; and C, the female, about one inch in length. The mouth parts are surrounded by a capsular arrangement by which it holds firmly to the mucous membrane of the trachea or bronchi (windpipe). The mouth parts are provided with chitinous teeth, with which they wound the mucous membrane; from this wound they suck blood.

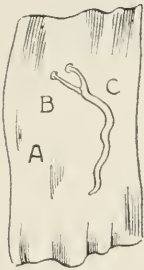


FIG. 23. SYNGAMUS TRACHEALIS (natural size)

A, Mucous membrane of trachea.
B, male. C, female.

Life History.—The female produces eggs which escape from her body only after she is expelled from the host and her body decomposed. The embryos thus escaping from the decomposing and disintegrating female are taken up by earth worms. Thus, chicks drinking contaminated water, or eating these infested earth worms, in turn, become infested; or if the chick should pick up an expelled female containing the mature eggs, the embryos would be liberated in the stomach of the chick, in which case they migrate to the air sacs and air passages and grow to maturity.

Symptoms of Infestation.—Wild as well as tame birds (chickens, turkeys, pheasants, partridges, pea-fowl, magpies, black storks, starlings, crows, parrots, swifts, woodpeckers and martins all have been reported as having become infested) are susceptible to gapeworm infestation.

The poultryman's trouble is usually with young chicks and turkeys. The small, immature gapeworms or eggs containing the embryos find their way to the intestinal tract of the young bird as described above, and from the intestine they migrate to the trachea (wind pipe) and its branches and attach themselves, where, by growing in size, they gradually obstruct the passage of air to the lungs. As a result, the bird finds breathing difficult and after a while gasps for breath, extending its head high into the air, finally becoming asphyxiated. Usually a lump may be found by feeling along the trachea, if the worms be lodged in that part of the trachea, which is palpable. A definite diagnosis may always be made upon autopsy by the presence or absence of the worms in the trachea, where, if present, they will be found in pairs attached to the mucous membrane.

Prevention.—Hatch the eggs in an incubator. Do not allow the chicks to run out in wet grass, where they may find earth worms or contaminated water. Feed only in containers which are constructed for the purpose and kept clean.

Treatment.—By grasping the bird in the left hand and forcing its mouth open a doubled horse hair may be run down the trachea and by twisting and again withdrawing, the worms may usually be dislodged. Gentle pressure over the region of the mass may so injure the worms as to cause them to loosen their hold and be expelled by the

bird during the coughing which this causes. Care must be exercised lest the trachea be injured. A feather from which all barbs except the tip have been removed may be dipped in turpentine, forced down the trachea, and when the tip has passed the mass of worms it may be twisted as it is withdrawn. This usually results in their removal. By referring to Plate 1, No. 34, the location of the opening of the trachea through the larynx may be seen.

UNIMPORTANT ROUND WORMS

There are other round worms that may infest the intestinal tract, but which have not come under the observation of the author. They are not common, or important, to the poultry industry. The list follows:

Heterakis Differens

This is a slightly larger species than the *Heterakis papillosa*. Its mouth has no apparent lips; the pharyngeal bulb is distinct; there are two unequal spicula. It is found in the posterior portion of the intestines of chickens.

Heterakis Compressa

This is a round worm of about the size of the *Ascaris inflexa*. The tail ends in a sharp mucro. It is found in the small intestines of chickens.

Trichosomum

Several species of this genus have been reported from various parts of the world, but have not been observed by the author in this country. They are shaped something like the old-fashioned blacksnake whip. They are blood suckers, and in the adult stage live in the small intestine.

Heterakis Maculosa

A round, white worm found in intestinal vesicles of the pigeon. The female is about three-fourths of an inch and the male about one inch long. At times this worm is a

serious menace to the flock, killing many birds. The symptoms are similar to those produced in chickens by round worms.

TAPEWORMS. (Flat Segmented Worms.)

Tapeworms inhabit the intestinal tracts of all species of birds, animals and man. More than thirty different species of tapeworms have been recorded in poultry.

Tapeworms differ from round worms, in that they have no complete digestive tract, are flat and segmented and have no distinct sex; that is, the male and the female are combined in a single individual (hermaphrodite). The tapeworms all live in the intestinal tract, in their adult stage, and absorb, through their integument, nutrients, taken in and digested by their host; thus they rob their host of food nutrients. The species studied in the author's laboratory are from chickens. The worm is divided into a head, neck and body. The head is provided with four suckers and in some species a circular row of hooklets. The neck in some species is long, in others short, but always unsegmented. The body is composed of segments. These segments grow from the neck. At first they are short and narrow, but become longer and wider as the distance from the head increases. At varying distances from the head the segments become mature, that is, fully developed sexually, and ready to propagate. Each segment is really a separate animal and is a hermaphrodite, that is, provided with both male and female generative organs. Each segment impregnates itself, after which the eggs are developed. As soon as the segment is filled with fully developed or mature eggs, the segment detaches itself, passes out with

the feces and falls to the ground. Thus, at times, we may find in the excrement of an infested bird the segments, white in color and possessing the power of movement; that is, it contracts and expands, showing it to be alive. This is especially noticeable if the segments be placed in water. Before it is detached each segment absorbs its own nutrients through its integument. This nutrient consists of the food eaten and digested by its host as alluded to above. New segments are constantly developed by the head of the tapeworm, growing down, becoming ripe, i. e., filled with mature eggs, and detached; if not interfered with, this process goes on almost indefinitely.

Upon disintegration of the segments shed from the worm, and passed out with the feces, the eggs become scattered. The life history of the worm from this state is not well understood. It probably has an intermediate host, by which the eggs are taken up, and within which they pass through a cystic stage and form embryos, which reach the intestine of the bird, become attached and develop to the adult stage.

The larva consists of a head with its fixation apparatus, namely, the suckers and hooklets, if such be present in the adult, and a neck. Having attached itself to the mucous membrane of the intestines, it now absorbs digested food and begins to develop segments, which in a few weeks begin again to be shed at intervals, containing fully developed eggs, which number several hundred in each segment. Under proper conditions, each egg is capable of producing a single tapeworm as before.

Taenia Infundibuliformis—Tapeworm

This worm is sometimes called the *Choanotaenia infundibulum* and also the *Drepanidotaenia infundibuliformis*.

Description.—This worm varies in length from one and one-half to three inches. Fig. 24 illustrates a mature worm. Its head is oval, the neck short and the segments shorter than wide. The head is provided with four sucker-discs and a crown of from sixteen to twenty hooklets, which cannot be seen except by microscopic examination. The anterior border of the segments is a trifle shorter than the posterior border, giving the border of the worm a serrated aspect. The male and the female genital pores irregularly alternate.

Life History.—The eggs passing out to the ground are taken up by the intermediate host, which, according to Grassi, is the earth worm. Rovelli claims to have found the larval or cystic stage in the house-fly.

Symptoms of Infestation.—If a bird be infested by large numbers of tapeworms it is robbed of much food, as related above, and it becomes unthrifty, shows an unkempt appearance of the feathers and possibly a loss of flesh. As a result of the irritation produced by these parasites there is a loss of appetite, derangement of digestion, catarrhal condition of the bowel and loss in egg production. Birds five to six months of age may harbor adult tapeworms. This tapeworm often causes the death of the infested bird. In the later stages of infestation the bird appears dull and a complete loss of appetite is noted.

Treatment.—Give thirty grains of epsom salt dissolved in warm water; follow with two or three teaspoonfuls of turpentine. A few teaspoonfuls of a decoction of pumpkin seeds usually rids the



FIG. 24. TÆNIA INFUNDIBULIFORMIS (natural size)

A, Head.
B, segmented body.

bird of tapeworms. This should be followed by a heaping teaspoonful of epsom salt or a table-spoonful of olive oil. Powdered area nut is also effective. Thymol in one grain doses is said to rid the digestive tract of worms.

Davainea Tetragona

This is the parasite that causes nodular teniasis (nodular tapeworm disease). It has been observed and reported as occurring in some of the eastern states and causing quite a loss to poultry raisers.

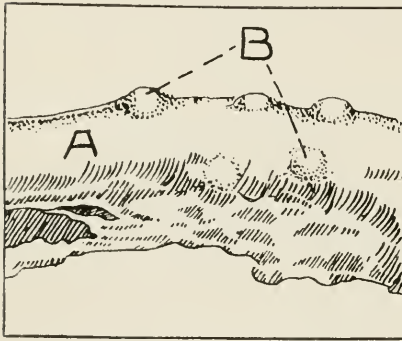


FIG. 25. NODULAR TENIASIS
(tapeworm disease)

A, Section of intestine of chicken (natural size). B, nodules (natural size).

Fig. 25 illustrates the nodules as they are found and about natural in size. This is from a drawing of the outer (serous) surface of an intestine, which presents a nodular appearance that might be mistaken for tuberculosis.

The mucous (inner) surface of the intestine is similarly elevated, and protruding from the nodule into the intestine may be seen a portion of some of the worm. In later stages these nodules may show ulcerations on the mucous surface. There may be seen in these nodules a greenish-yellow necrotic material. A secondary invasion, with pus germs, may take place, in which case pus will be present. Before the nodules are formed these worms may be seen between the villi.

The occurrence of this tapeworm in the intestine is similar to the tapeworm described above (*Tania infundibuliformis*).

Treatment.—The treatment should be the same as for the *Tania infundibuliformis* (which see), or mix with the feed one teaspoonful of powdered pomegranate root bark for every fifty adult birds.

Other Taeniae

Two or three other species of tapeworms closely resembling these in their gross appearance have been described, but judging from the records they do not appear to be common. Tapeworms are also found in the intestinal tract of ducks and other birds.

THE THORN-HEADED WORMS (Acanthocephala)

The third class of worms listed belong to the order Acanthocephala. The body is cylindrical, but they are not provided with a complete digestive tract, as are the nematodes, or round worms. They have transverse markings, and, like the tapeworms, live by absorbing, through their integument, nutrients eaten and digested by their hosts, thus robbing them to a certain extent. Furthermore, when present in great numbers, these parasites cause digestive derangements and emaciation of their hosts. They are provided with a globe-shaped proboscis, armed with hooklets, which they embed in the mucous lining of the intestines; thus attached by their heads, their bodies float in the intestinal contents.

Echinorynchus Polymorphus

This is one of the three species of this genus that live in the intestines of the duck. It is also found in the goose.

Description.—The *Echinorynchus polymorphus* varies in length from one-fourth to one inch. The body is orange-red

in color. It has a neck-like construction, just back of the hooked, globe-shaped proboscis. Its proboscis is provided with eight or nine rows of hooklets.

Life History.—This worm reproduces by laying eggs. The intermediate host is certain fish, as the shrimp and cray fish. Ducks become infested by eating fish infested by the larval or cystic form. This parasite is probably rare in the United States.

FLUKES (Trematodes)

The remaining group of worms which inhabit the intestinal tract of birds belong to the order of Trematodes and are commonly known as flukes.

The flukes of birds are harbored for the most part in the intestinal tract. If we are to judge from reports, these worms are exceedingly rare in this country.

Notocotyle Verrucosum

Perhaps the most common of the flukes is the *Notocotyle verrucosum*. Its body is white or reddish white and from one-twelfth to one-fourth of an inch long. Its body is an oblong oval in shape, narrow in front and rounded behind. It is found in the intestines, principally the cecum or blind gut of chickens and ducks.

No serious results have been attributed to the flukes of poultry, although it is well known that they cause serious maladies in other animals. There have been three or four other similar worms described which closely resemble this one.

SECTION V

Diseases of the Digestive Tract

Birds are not subject to the manifold ills of the digestive system that prevail in higher animals and man, at least the list of digestive ailments which we recognize in birds are not so numerous as they are in higher animals. Beginning with the anterior portion of the digestive canal, the mouth, we find its part in digestion relatively unimportant compared to that of the same organ in mammals, and its ailments correspondingly fewer and less important.

The food is not masticated in the mouth as in higher animals, but is swallowed whole, passing into the crop, where it is softened by the action of the fluids secreted by that organ and perhaps also by the action of bacteria swallowed with it. After maceration in the crop is accomplished, the food passes into the proventriculus (stomach), where the processes of digestion are carried still further by the secretions (juices) of that organ. The thoroughly soaked and softened food is next received into the gizzard and ground (with the pebbles—grit—always present in that organ) to a paste by the action of its strong muscular walls.

From the gizzard the food passes into the small intestine, where digestion is carried on much as it is in other domestic animals, by the action of the secretions of the intestine, liver and pancreas.

Domestication has affected the feeding habits of birds much as it has the feeding habits of

horses. In the wild state birds, like horses, eat most of the time, but they secure their provender but slowly. Under domestication they are fed nutritious, highly concentrated food in a readily accessible form, two or three times daily, and are required to exercise but slightly to get it. Frequent disturbances of digestion, largely due in one way or another to engorgement, is the result.

Obstruction of the Beak

This condition is very rare. Cases have been noted in which an object, such as a sunflower-seed, has become wedged between the rami (branches) of the inferior maxilla (lower portion of the beak), and serious trouble has resulted from this pressure; for example, paralysis of the tongue, inability to eat, starvation and death.

A bird with obstruction of the beak will shake its head and scratch at its beak. Upon noticing such symptoms in a fowl the caretaker should examine its mouth and remove the obstruction.

Pip

Among poultrymen one often hears of "pip" as a disease of fowls, particularly of chickens. It is one of those names like "hollow horn" or "loss of cud," in cattle, which signifies no specific disease or condition, but merely a symptom of some ailment, real or fancied.

In some of the respiratory diseases, particularly in roup and pox, the nostrils may be closed by an exudate and the birds compelled to breathe through the mouth, and if, as is usually the case, the bird has an abnormally high temperature (fever) at the same time there is a tendency for the mouth to become very dry and the mucous

membrane may crack and bleed. Owing to its dryness, the epithelium of the tongue may not exfoliate normally, and, being retained, may form a transparent "beak or horn" on the end of the tongue. This dryness of the mouth and the resultant changes are what is known as pip.

Treatment.—In such cases the treatment consists in the first place of measures directed at the primary cause; that is, the condition which is producing the dryness of the mouth. The hardening and drying of the membranes of the mouth may be relieved by the application, several times daily, of a mixture of equal parts of glycerin and water.

If cracks and ulcers have formed they should be bathed in a solution of potassium chlorate and water, twenty grains of the former to the ounce of the latter. This is best accomplished by dipping the bird's beak into a vessel containing this solution five or six times and repeating every hour or two. If pus has formed in the ulcers, they may well be cleaned with a few drops of hydrogen peroxide before the potassium chlorate solution is used.

Stomatitis—Sore Mouth

The ulcerative form of sore mouth, due to fungi (molds), has been described under external parasites. (See thrush, aphtha, page 56.) Quite frequently in cases of avian diphtheria or roup we find diphtheric patches in the mouth and over the tongue, as illustrated in Fig. 48. This is described under respiratory diseases. (See page 151.)

Simple catarrhal inflammation of the mouth is not common. It may be caused by some irritants, or by bacterial (germ) invasion of an injured part.

Treatment.—A saturated solution of boric acid should be used for bathing the affected parts. If ulcers are present they should first be cleansed with full-strength hydrogen peroxide.

Impaction of the Crop—Crop Bound

Obstruction of the crop is generally due to swallowing bodies that cannot pass readily from the crop through the second portion of the esophagus to the stomach and gizzard, that is, to an obstruction of the second portion of the esophagus. Hog bristles, small feathers, straw, etc., are usually the cause of the obstruction. Of the cases examined in the author's laboratory some have been due to each of the agents named. Two incubator-hatched and brooder-raised chicks, just beginning to feather, were given potato parings, after which they died. There was found, in each crop, a potato paring, extending from the crop through the second portion of the esophagus into the stomach.

By referring to Plate I these organs and their relations can be seen.

A second cause of impaction of the crop is due to low vitality of the bird; as a result of acute disease, e. g., cholera, or from improper nourishment the thin muscular walls of the crop may become paralyzed or so weakened as to be unable to force its contents onward into the proventriculus.

Treatment.—Surgical interference is the only treatment for this condition likely to be effective. Having diagnosed the case, it is not difficult to clip away the feathers, clean up the surface with mild antiseptics and with a sharp knife open the crop and remove the obstruction. The crop and

the skin should then be sutured, and the bird allowed only soft food for a week.

Where the obstruction is due to a weakened condition of the walls of the proventriculus, its contents may sometimes be forced back through the gullet and out of the mouth by careful manipulation with the hands.

Tympany of the Crop (Gaseous Crop)

This is due to a gas-forming germ, which sets up putrefaction of the contents of the crop. It is usually accompanied by an inflammation (catarrh) of the crop which interferes with its normal function. Birds have been noted to have at times enormously distended crops, which, upon examination, proved to be filled with gas. Usually these crops contain very little feed. This condition often affects young chicks as well as older birds.

Treatment.—Give intestinal antiseptics, such as one part of carbolic acid to two hundred parts of water, or mercuric chloride (corrosive sublimate). one part to ten thousand parts of water, or sulphocarbolates compound.

Immediate temporary relief may be given by liberating the gas through an aspirating needle or a small canula. The crop may then be irrigated, through the canula, with a mild antiseptic solution. Follow with two teaspoonfuls of castor oil and feed sparingly on easily digested food.

Enlarged Crop

The crop may sometimes become very much enlarged, slack and pendulous. This condition is mainly due to injudicious feeding.

Pendulant crop causes little inconvenience to

the bird and is incurable except by resection of a portion of its wall. This operation is simple and easily performed.

Gangrene of the Crop

This condition has been observed several times by the author. It resulted fatally to the birds affected in all the cases studied. Upon opening the crop a very offensive odor is noted, the mucous lining will be found in a necrotic state (sloughing) and appear as a dark, sometimes a greenish, caseous mass.

Treatment.—In the earlier stages there may be given, in the feed or water, salol, subnitrate of bismuth or sulphocarbolates compound. If the condition becomes prevalent in a flock, the runs, yards and henhouses should be thoroughly disinfected or the birds completely changed to new grounds, and in any case given clean food and drink. The sick should be separated from the well birds and the dead should be burned.

Catarrh of the Crop

Irregular feeding, a distended crop and irritating and indigestible feed, such as feathers, putrid meat and irritant chemicals, may be mentioned as causes of this condition, which is essentially a more or less chronic inflammation of the mucous membrane, lining the crop. If the crop be overdistended the strain on the muscles may be so great that paralysis results. In these cases there is noted a crop filled with a pulpy, soft, more or less gaseous mass.

Treatment.—If the crop be distended with a dough-like mass, grasp the bird by the legs, holding the head downward, gently press out the mass,

then by introducing water through the mouth and then forcing it out as before, the crop, in this way, may be washed out.

Give bland substances, such as gruel and mild antiseptics, such as salol, subnitrate of bismuth or sulphocarbolates compound.

Depraved Appetite

This may be due to a disease of the digestive organs or it may be a vice learned from others. Hens learn to eat eggs by finding them broken or by seeing an egg-eating hen and copying as a cribbing horse acquires the habit from his mate, or as one hog may learn to eat chickens from seeing another eating one.

Feather eating (plucking) is another habit that may be acquired from mimicry. Obstruction of the gizzard, lack of grit, insufficient or unsuitable food and catarrh of the crop are factors of greater or less importance in causing a depraved appetite. Kill the bird; the habit cannot be broken.

Chicken Cholera—Fowl Cholera

Fowl cholera is caused by a germ (*Bacillus avisepticus*), and is a blood-poisoning (septicemia). The germ is rather short, plump, and stains at the poles or ends deeper than the middle, with aqueous fuchsin, hence it is called a polar-staining bacillus. Fig. 26 shows the germ, magnified 1,000 times. This drawing was made from a blood smear from an outbreak among turkeys and chickens, which was one of several outbreaks that have been studied in the author's laboratory. The large objects are various kinds

of blood cells. One of these, a white-blood cell (phagocyte), has taken up one of the germs.

Mode of Spread.—Birds often contract this disease from others at shows, and when taken back home infest the remainder of the flock and the premises, or a bird recently purchased from an infected flock, or eggs from an infected flock, or chicks recently hatched in infected surroundings, or infected droppings carried on the feet of men and animals, from hen-

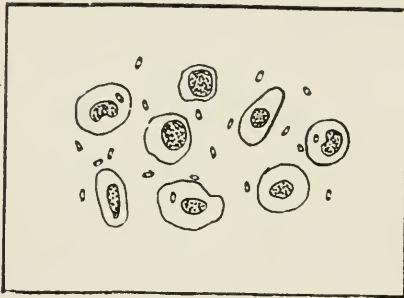


FIG. 26. BLOOD SMEAR FROM CASE OF CHOLERA

Showing red blood cells, thrombocytes, mononuclear leucocytes, polymorphonuclear neutrophils and many of the polar staining germs (*Bacillus avisepticus*) of the disease.

houses where the disease exists, or carried by streams or irrigation ditch water, dried and carried by the wind as dust, or carried by wild birds, may be the means of introducing this disease among healthy birds. Even insects have been known to carry the contagion. Buzzards are common carriers of this disease.

The germ of fowl cholera retains its power to produce disease for weeks, and even months, about premises where it has occurred, unless they be thoroughly disinfected. The germs have been kept in test tubes, experimentally, for two years and still proved to be virulent, that is, still capable of producing disease. It resists, for a long time, both drying and zero weather.

Cholera may affect chickens, turkeys, ducks, geese, pigeons and many wild birds. The period of incubation (the time elapsing from the entrance of the germs into the body of the bird until the

appearance of the first symptoms of the disease) is given as from twelve to forty-eight hours.

In our experimental work, in which the virus (germ) was introduced into the peritoneal cavity this period was six to twelve hours; when the virus was given by the mouth it required twenty-four to thirty-six hours to produce the disease. The birds died twelve to seventy-two hours later.

Symptoms.—The onset of this disease may be so sudden that its signs pass unobserved, and finding the dead birds in the nests or under the roosts may be the first notice that the owner has of the existence of disease in his flock; or the birds may have fowl cholera in a more chronic form and live for six to seven days.

In the protracted cases there is noted loss of appetite, great prostration, staring feathers; the bird mopes or sits around with tail and head down, giving so-called "ball" appearance, the comb is dark, the gait swaying, and there is trembling, convulsions, thirst, and severe diarrhea, with passages of a greenish-yellow color. There is high fever and the bird rapidly becomes emaciated.

The percentage of loss in the flock, if not treated, is very great. The disease spreads rapidly through a flock. Pure-bred birds are more susceptible than scrubs. In an outbreak of cholera among ducks, studied in the author's laboratory, the disease progressed very slowly. Only one to five or six ducks died in the course of a week in the flock of 500.

Postmortem Findings.—Upon opening the abdominal cavity one will first note that the liver is greatly enlarged, very dark in color and tears easily (inflammation, congestion and cloudy swelling); we have found livers that weighed as much

as 120 grams, or three times the normal weight. The intestines are congested and contain a frothy material, dark in color. There is an occasional hemorrhage in the lining (*mucosa*) of the intestines. The spleen may be enlarged and its contents soft. Small hemorrhages (*petechia*) may be found in the heart, its coverings and other parts. The kidneys are dark, enlarged and soft (active and passive congestion and cloudy swelling). The blood does not coagulate readily and is found, upon microscopic examination, to be teeming with the germs causing the disease (*Bacillus avisepticus*).

Case Report on Fowl Cholera

A dead duck was sent to the laboratory from the outbreak referred to above. The anatomical lesions found in the carcass were as follows: Hemorrhagic areas in heart and epicardium; inflammation and congestion of the ceca, and congestion of the other portions of the intestines; the liver enlarged, weighing eighty grams, and very dark in color.

Two glycerin agar slants were inoculated from the heart blood and from the liver. Stained smears from the heart blood showed the typical polar-staining *Bacillus avisepticus*. Pure cultures were obtained from the inoculated tubes. A pullet weighing two pounds was given an intraperitoneal injection of the twenty-four-hour agar-slant growth. Twenty-four hours later she appeared sick, showing ruffled feathers, loss of appetite, dullness, head and tail down and temperature 108.2 degrees F.

An examination of the blood revealed the following: Hemoglobin, 90 per cent; erythrocytes, 2,520,000; leucocytes, 6,000 (hypoleukocytosis), thrombocytes, 184,000. The differential count showed: eosinophiles, 37 per cent; neutrophiles, 2 per cent; lymphocytes, small, 52 per cent, large, 5 per cent; mononuclear lymphocytes, 4 per cent; mast cells, none.

This bird died at the end of sixty hours. At the autopsy there was noted a fibrinous peritonitis; some petechia on mucous membranes; the liver enlarged, dark and weighing seventy-two grams (thirty-five grams is the normal weight for a bird of the size of this one). From the blood the germ was isolated in pure culture as before.

[Ward found in experimental cases of fowl cholera there was a destruction of red blood cells and in some an increase of white blood cells (leukocytes).]

In describing this outbreak among ducks the owner wrote in part, as follows:

"Regarding the success I have had in the treatment of cholera among the ducks with the sulpho-carbolates of sodium, calcium, zinc and copper, I will, as best I can, give you an idea as to how the results and the conditions under which we had to work."

"To begin with we had a large number (about 500) to handle and had to send away for the tablets, which delayed us in beginning the treatment of the disease, and of course, conditions were pretty bad when we did get started.

"Next we ran into a long stretch of cold weather, the feed froze up nearly as soon as we put it out in the troughs if it was moistened and the drug mixed with it, same thing happened with the water, so we were sure that the ducks were not getting enough of the sulphocarbolates. However, the death rate dropped down about one-fourth in two weeks. As soon as the weather warmed up several snows fell at intervals of about a week, so that the pens were wet and it was hard to disinfect them and difficult to keep the ducks from drinking the water that stood about in the pens. In this way they avoided getting the drug that was dissolved in the water in their drinking fountains. We finally got around that by sprinkling the yards heavily with some coal-tar dip, so that the ducks would not drink this water, but would go to the fountains. This was made rather expensive for the water from the outside would run into the pens and soon dilute the dip already out so that the ducks would soon be drinking this water again. This meant more dip, and the cost of the dip was soon an important item. A considerable quantity of the sulphocarbolates used under these conditions was wasted, for when the feed or water would freeze we had to chop it out of the troughs and thus lose some. The cost of what we used amounted to seven cents per duck.

"If we let up using the drug the ducks would begin dying again, but I do not think it had a fair trial during the first part of the treatment. As soon as the weather got better the death-rate was lowered, and now I believe we have the disease under control. Under favorable conditions I believe this means of controlling cholera would work very nicely. That it will render a flock immune for any length of time I rather doubt. I gave my chickens a three weeks' round of the treatment and for a month now they have been all right, but this morning I noticed a few of them acting as if they were in the cholera business again. I fed a few of them some 'medicated charcoal' that a poultry-food firm puts out and this seemed to check the disease and put them back in good condition. This checks the diarrhea they have within a day or so and they soon get well."

Treatment: Eradication.—The germs are found in the discharge from the bowel and are carried on

the feet into feed and water troughs, or are picked up from the ground with the feedstuff. Birds should be fed out of troughs frequently disinfected with a five per cent solution of carbolic acid, and the water they drink should be similarly guarded. Sick birds should be immediately removed from the flock and the dead ones cremated. The henhouse and nests should be cleaned thoroughly each day and sprayed with whitewash to which sufficient crude carbolic acid has been added to make it five per cent of the whole, or creso, zenoleum or creolin should be used, of the same strength.

A type of spray pump convenient for applying this whitewash is shown in Fig. 9. The henhouse may also be disinfected with formaldehyde, as follows: Close tightly all doors, windows, cracks and other openings, and for each 1,000 square feet of space in the building, use twenty ounces formalin (forty per cent formaldehyde) and sixteen ounces permanganate of potash. Place these two materials in a vessel and place in the middle of the room and leave for several hours. The yard should be cleaned every day. If the yard be small it may be disinfected by covering it with straw and burning the straw.

For the birds intestinal antiseptics are indicated; the sulphocarbolates compound* has given us by far the best results. Other intestinal antiseptics are hydrochloric acid, one teaspoonful to each quart of water, one per cent of copperas and potassium permanganate.

The following is an account of three of the tests which the author made of the 30-grain sulphocarbolates compound tablets.

"One flock consisted of sixty birds. Several were sick at

*Manufactured by the Abbott Alkaloidal Co., Chicago.

the time treatment was commenced, and four had died. The discharge from the bowels was of a greenish-yellow color, somewhat simulating fowl cholera. One tablet was dissolved in a pint of water, and this fluid mixed with bran and corn chop. The mixture was then fed in clean troughs. In this way each bird got approximately one-half grain. This was repeated night and morning. No additional birds became sick; only two of the sick died; and the rest recovered.

"Another flock consisted of 175 baby chicks. As soon as these birds were taken from the incubator they were fed the unhatched eggs that had been cooked and chopped. This mixture was reported to possess an offensive odor. The birds began dying, with symptoms of diarrhea, white, pasty vent; weakness, dullness, droopy wings, etc.; one-half the flock died before treatment was commenced. One-half tablet was dissolved in warm water and the bread saturated with it. The birds immediately quit dying.

"Still another flock consisted of 200 birds, including a few turkeys. Cholera had appeared on the premises the fall before. The outbreak was studied in the field and in the laboratory. The cholera germ (*Bacillus avisepiticus*) was isolated. In the last outbreak, fourteen birds had died and several were sick. Treatment similar to that described above was used. Water, containing the sulphocarbolates was kept constantly before them. No more birds were taken sick and no more died after the sixth day."

Vaccination with a vaccine made from the germs producing the disease, has given excellent results.

Scholbe states a serum has been prepared, but that it renders immunity only for about two weeks.

Entero-Hepatitis (Blackhead)

This is essentially a disease of turkeys, among the young of which it is quickly fatal. It has practically annihilated the turkey-raising industry in sections where it was formerly profitable and carried on extensively. Although the turkey is more susceptible to blackhead than any other bird, serious losses among chickens sometimes occur.

Cause.—This disease is claimed by Dr. Theo. Smith, formerly of the Bureau of Animal Industry, to be due to a protozoon (*Ameba meleagridis*)

microscopic in size, which is found in the diseased areas in the ceca (blind pouches) and liver of affected birds, which are chiefly turkeys and rarely chickens. Others attribute the disease to a coccidium.

Mode of Spread.—As will be seen later, the protozoon escapes from ulcers in the ceca and passes out with the feces.

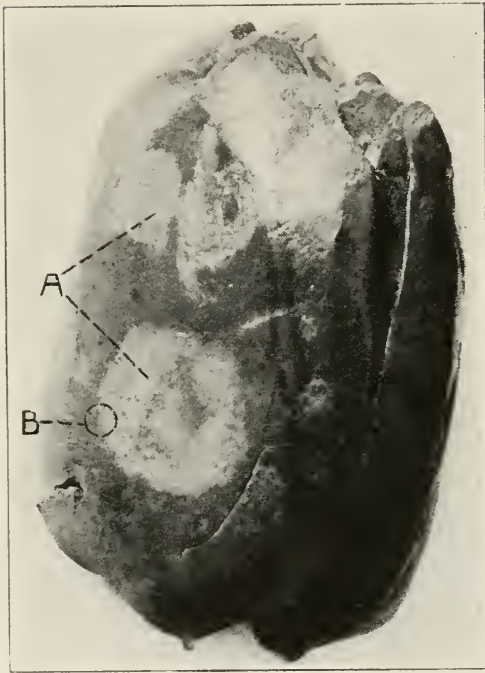


FIG. 27. ENTEROHEPATITIS IN A TURKEY
A, Yellowish-white necrotic areas. This liver weighed 452 grams, nearly one pound.

Food or water contaminated with the excrements carry the disease germ to other birds. Chronic cases (carriers) in older turkeys or chickens may keep the premises infected for a long time. These germs entering the liver and the mucous membrane lining the ceca, cause inflammation and degeneration. Usually the ceca become infected first

and later the liver is invaded and inflammation of its structure ensues.

Postmortem Findings.—Upon first opening the abdominal cavity one's attention is attracted by the enlarged liver with areas of dead tissue (caseation necrosis). Fig. 27 shows a liver about three-fourths natural size, weighing nearly one pound.

The ceca (blind pouches; see Plate I, No. 12), one or both, are noted to be enlarged, the enlargement is usually a short distance from the point. Upon opening the ceca, ulcers and areas of dead tissue (caseation necrosis) are observed in

the mucous lining. There will also be noted a straw-colored fluid (edema, dropsy) in the loose tissue about the heart.

Fig. 28, taken from an area in the edge of the necrotic portion marked B, in Fig. 27, illustrates the condition. A illustrates the liver cells as they are first affected (cloudy swelling); B, the cells farther along in the disease process in which it may be noted that the nucleus has disappeared and the cell is disintegrating (necrosis); C, the congested vessels (passive congestion); D, white blood cells (eosinophiles) referred to above. There may also be noted in these areas giant cells.

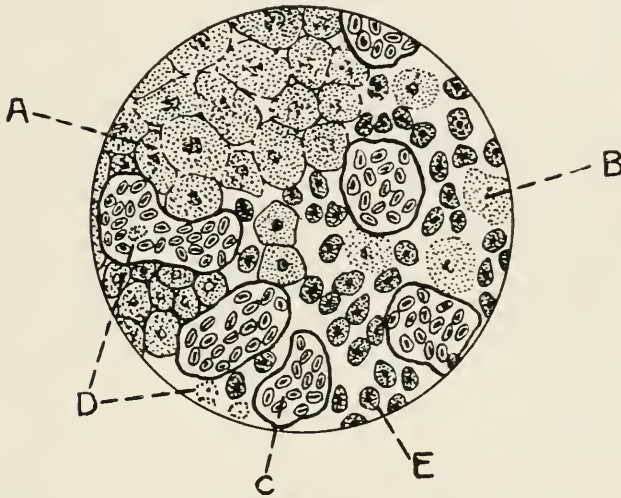


FIG. 28. CLOUDY SWELLING DUE TO ENTEROHEPATITIS
This is a Section from "B" in Fig. 27 (magnified 900-
times).

A, Liver cells (cloudy swelling). B, liver cells under-
going disintegration, necrosis. C, congested blood
vessel. D, white blood cells, eosinophiles abundant
in this disease. E, protozoa causing the disease.

Fig. 29 illustrates a giant cell. E, protozoa causing the disease. A like microscopic examination of sections from the kidneys indicates that poisonous products have been taken up by the blood, for in these sections we find degenerative changes (congestion, cloudy swelling and focal necrosis).

Fig. 30 shows a microscopic field from a blood smear from a turkey affected by entero-hepatitis with the disease. It will be noted that there is an intense eosinophilia. Fig. 31 shows a field from a portion of the kidney, in a state of cloudy swelling and focal necrosis—evidence of absorbed poisonous substance. Fig. 32 shows one of the ceca with a small ulceration caused by the protozoa.

Symptoms.—Entero-hepatitis is most common in turkeys between the ages of one month and one

year, although I have seen the disease in birds that were much older. Several outbreaks have been studied in this laboratory. Only one case was found in the hen. It has been reported in the peacock.

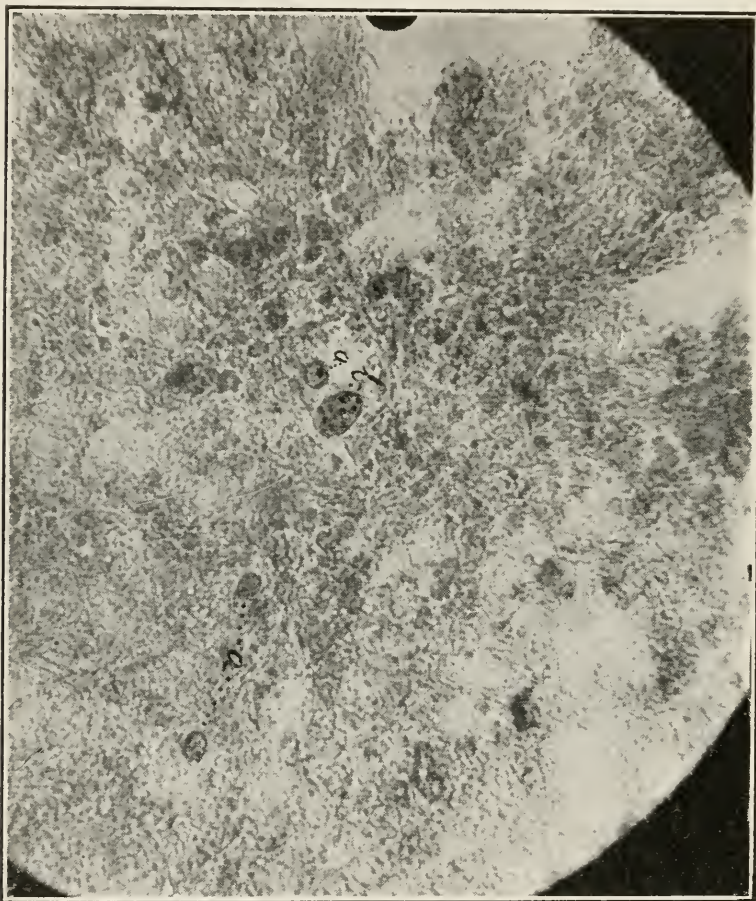


FIG. 29. SECTION OF THE LIVER (from a Case of Blackhead)
a, Protozoa causing the disease. b, a giant cell.

The symptoms are not manifest till the disease has progressed to a considerable extent. The bird is first noticed to be dull, later the wings and tail may droop; the feathers become ruffled and the bird sits around much of the time; diarrhea supervenes, the discharge being of a greenish-yellow

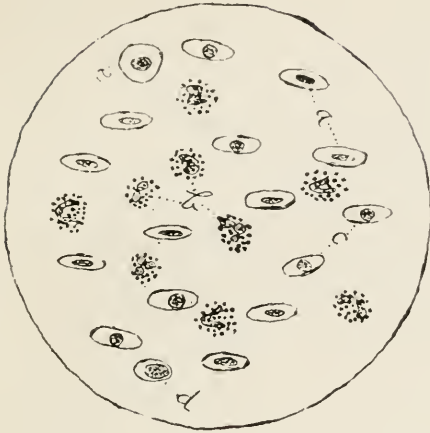


FIG. 30. BLOOD SMEAR (from a Case of Blackhead)

Showing intense eosinophilia. a, Red blood cells. b, eosinophiles. c, thrombocytes. d, lymphocytes. e, mononuclear leucocytes.

color; there is a loss of appetite; the bird grows gradually weaker and usually dies in from three to ten days after the first symptoms of the disease become noticeable. In the cases that run longer the bird becomes emaciated. A blood examination shows eosinophilia to be present. The head may or may

not turn purple. From the cases in which the head turns purple the disease gets its name—blackhead.

Report of a Case of Blackhead

Of eleven turkeys of the flock, six had died. One of the

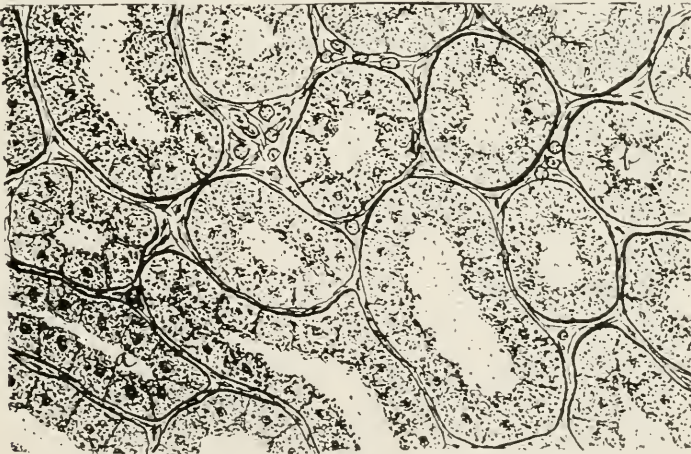


FIG. 31. SECTION OF A KIDNEY

From a turkey that had died of blackhead. a, Cloudy swelling. b, area of focal necrosis.

turkey was brought to the laboratory for further study. The turkey's head was purple; there was a loss of appetite;

a diarrhea was present and the discharge was yellowish-green in color. A blood study showed the following: Hemoglobin, 73 per cent; erythrocytes, 2,000,000; leukocytes, 73,000. Differential count: eosinophiles, 86 per cent; neutrophils, 1

per cent; lymphocytes, 11 per cent; mononuclears, 1 per cent; mast cells, 1 per cent. The bird died and an autopsy was held. The following is a summary of the findings:

Necrotic areas in the liver measuring up to four centimeters (about one and one-half inches, in diameter and of a yellowish-green color. Weight of the liver, 452 grams.

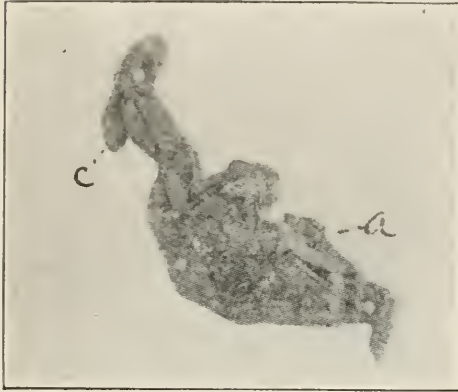


FIG. 32. CECUM SHOWING ULCERATION
From a case of entero-hepatitis (blackhead)
in a turkey.

a, Ulceration. c, blind end of cecum.

end and extending three cm. in length. The outer surfaces of the ceca showed yellowish-green coloration. There was edema in the pericardial region.

Treatment.—Thorough cleaning of henhouse and yard, followed by careful disinfection; care as to feeding and watering, and intestinal antiseptics are indicated as recommended for fowl cholera. The following tablets gave the best results in our experiments:

Sodium sulphocarbolate1 part

Calcium sulphocarbolate1 part

Zinc sulphocarbolate2 parts

Dissolve one tablet in each quart of water. This solution can be given as drink or used to mix soft feed.

Report of an Outbreak of Entero-Hepatitis Treated With Sulphocarbolates Compound

The owner of a flock of turkeys in which a number were affected with blackhead reported to the author on the use of the sulphocarbolates compound, as follows:

"Some of these turkeys were too sick to eat. In these cases a small piece of the tablet, one-half the size of a sweet pea, was dissolved and given twice a day. Nearly all of the birds so treated recovered."

From work done in this laboratory and from the foregoing report and similar reports from other sources, the author is led to believe that a bird may recover if properly medicated, even after some degree of damage is done to the liver by the disease.

Diarrhea—Enteritis—Dysentery

The most devastating form of diarrhea in poultry is an infectious disease due to a bacterium and to a protozoon, and commonly called "white diarrhea." It affects chiefly chicks less than three weeks old and will be discussed under a special head. Under this head I shall discuss those bowel ailments not due to any one specific germ.

A condition of mild diarrhea is chronic in many fowls throughout life. In these cases there are no symptoms of the disease other than the softness or fluid condition of the feces. Though this condition is probably due to a mild form of indigestion and the birds may not thrive or fatten or lay as well as those not so affected, the condition is not serious and ordinarily the poultryman pays no attention to it.

It is when the soft, pasty or liquid excrement has an *offensive odor*, and adheres to the feathers about the vent, staining them yellowish, greenish or brownish, that the matter becomes serious and interferes with the health of the bird. Young stock are much more susceptible to diarrhea from unfavorable conditions, of which the commonest are improper food and exposure to cold, than are adult birds.

When this reaction to external influences (cold) or when the irritation from indigestible matter within the intestine becomes sever enough to set

up an inflammation of the mucous lining of the small intestines, it is termed *enteritis*, and when it extends to the large intestines it is called *dysentery*. In both conditions there is an increased thirst, loss of appetite, high fever and fluid discharge, and in the latter the discharges are streaked with blood.

Cause.—Mouldy, putrid, or too stimulating food, drinking water which contains much organic matter, and hence is filthy and putrid, and exposure to certain unfavorable atmospheric conditions are contributing factors, as is also the injection of irritant substances, such as lye, paint, spray-mixtures, unslaked lime, etc.

Along with diarrhea due to these causes may be mentioned a like condition sometimes caused by the presence in the intestinal tract of certain species of worms and of irritating foods. Exposure in damp coops, cold rains, or draughts often result in digestive derangements of this nature. A bird, during moulting, has poor protection against inclement weather, from lack of feathers, and requires more care than at other times.

Symptoms.—The plumage loses its smooth, well-kept appearance; the bird is depressed and not inclined to move about as much as usual; there may be loss of appetite; the crop is full; digestion is slow; the cloaca is inflamed (red) and sensitive (irritated); the evacuations from the bowels are frequent, the discharges being fluid, offensive and varying in color from whitish-yellow to greenish. In later stages the evacuations are quite spasmodic and forcefully ejected (squirting) and the fluff and feathers near the vent are soiled with feces. The affected bird gradually becomes weaker and there is a rise in temperature. It may

eat little or nothing; thirst is extreme in some cases. The bird may die in two or three days or it may live for two or three weeks.

Postmortem Findings.—In fatal cases the most noticeable alterations are in the intestinal tract and the liver. Upon opening the small intestines, areas of inflammation are noted, and occasionally a small hemorrhage is found. Microscopic examination of stained sections from the vital organs (liver, kidney, etc.) reveals retrogressive changes; cloudy swelling being most marked. Fig. 33 illustrates one of these cases.

Treatment — Give the same treatment as that given for blackhead in turkeys and for fowl cholera. (See pages 90 and 83.)

White Diarrhea

The loss to American poultry raisers from white diarrhea is greater than from anything else, perhaps greater than from all other infectious diseases combined. It strikes at the root of the poultry industry; no one can successfully conduct the business if he is unable to rear a reasonable number of chicks annually.



FIG. 33. HEMORRHAGIC ENTERITIS IN A HEN
A, Small hemorrhages (natural size).

Without treatment the resulting mortality, when white diarrhea has secured a foothold in a poultry plant, is extremely high, often reaching ninety per cent of the season's hatch.* The loss from white diarrhea in dollars and cents is enormous, almost beyond calculation. It is widespread throughout the United States and causes the loss of perhaps ten per cent of all the chicks hatched in this country. By proper measures the disease is fairly easily preventable and a large number of the affected chicks will recover under proper treatment.

Causes.— There are two forms of white diarrhea, due to two distinct causes. A bacillary form due to the *Bacterium pullorum*, a rather short, plump, rodshaped germ with rounded ends; and a protozoal form due to the *Coccidium tenellum*. I have isolated the germ causing the disease from the liver, spleen, kidneys and other organs of chicks dead of the bacillary form of the disease, and in the coccidian form from the ulcers of the cecum and the intestines.

Symptoms: Bacillary Form.— In young chicks there is drooping wings, ruffled feathers, sleepy appearance, huddled together, little or no appetite, abdominal yolk not properly absorbing; whitish or whitish-brown frothy discharge from bowel which adheres more or less to the vent fluff; eyes closed part of the time and apparently no interest in life. "Peeping" much of the time, the appearance in many is stilty, abdomen prominent behind. In these cases after death one finds the yolk unabsorbed or only partially so. The intestines are more or less full. Late fall, winter or early

*A diet of sour milk is said to reduce the loss from white diarrhea fifty per cent, but as the treatment here outlined will reduce it ninety per cent, the sour milk treatment is not worth considering.

spring hatched chicks are freer from the disease than summer hatched. This may be explained by the fact that hens with diseased ovaries gradually become poorer layers as the disease processes advance, and hence, only lay in late spring or early summer, when nature intends reproduction of birds. Finally the hen may cease laying.

Symptoms: Coccidian Form.—The symptoms, as I have seen them, are similar to those of the bacillary form, excepting, as a rule, the heavy death rate takes place later.

Mode of Spread: Bacillary Form.—Ovaries of laying hens, diseased, but still functioning, may be infected by the germ. The germ can be isolated, particularly from the yolk, of at least some of the eggs formed in such an ovary. The chicks from infected eggs, as a result, have the disease more or less developed when they are hatched, as conditions which favor hatching also favor the multiplication of the germs to an extent that toxins (poisons) have already been produced in the young in sufficient quantity for the disease to at least manifest itself in a few hours after hatching, although ordinarily they do not begin to die until they are about a week old.

The whitish, frothy, pasty bowel discharge, more or less sticky and having a tendency to "paste up the vent," from these chicks is laden with the germs, and others of the flock soon become infected from contaminated food picked up from the ground. In the former case, chicks may begin to die soon after hatching, in the latter, in from three to four days, a few dying each day.

The death rate is high, reaching in many cases as much as seventy-five per cent or more. Those

that recover are stunted and do not make satisfactory growth. The greatest loss is from the first few days to, in some cases, two or three weeks. It is probable that the carriers are chicks that have recovered, but which still carry the organism (especially in the ovary) as the human typhoid carriers carry the germs of typhoid fever, in the infected kidneys and in bowel ulcers. These "carriers," having established an immunity, do not themselves succumb to the disease, and they rarely show any outward symptoms of it.

Insanitary conditions, spoiled feed, dirty, stagnant water, improperly ventilated incubators, brooders and building, or badly regulated heat, are factors in weakening the physical condition of chicks and favor ravages of diseases.

Coccidian Form.—The mode of spread of this form is at present problematical. It is possible that a chronic type of coccidiosis occurs in some birds and thus perpetuates and disseminates the protozoa.

Postmortem Findings: Bacillary Form.—The liver in general is usually pale, showing areas of congestion (active and passive congestion and cloudy swelling). The yolk only partially absorbed, congestion of the intestines may or may not be present. Kidneys normal in size, but show congestion and cloudy swelling. Carcass more or less pale and emaciated and anemic.

Coccidian Form.—Upon postmortem examination the conditions are found to be similar to those in the bacillary form, except there will be noted more or less congestion of the intestinal mucosa (lining), and ulcers in the intestines, principally the ceca. The ceca appear to contain considerable ingesta, and to be interfered with functionally.

Fig. 34 shows a transverse section through an ulcerated area. In these areas we find cloudy swelling, followed by necrosis (retrogressive changes and death of the cells). The remains of the dead cells forms a cheesy mass (caseation necrosis). It will be noted in this drawing that only remnants of a few of the glands normally present are yet intact, the remainder of the mucous membrane and in places the

submucous layers are invaded by the germ (protozoon). In Fig. 35 the section B has been magnified 900 times.

As explained under the cut, all stages of the coccidium tenellum are observed in a mass of dying and disintegrating cells—the remains of the diseased mucous lining of the bowel. Repeated examinations have been made of healthy chicks killed for the purpose, and chicks dying from other causes, and thus far no case has shown these conditions.

Treatment.—The most of our experimental work with various remedies has been with the coccidian

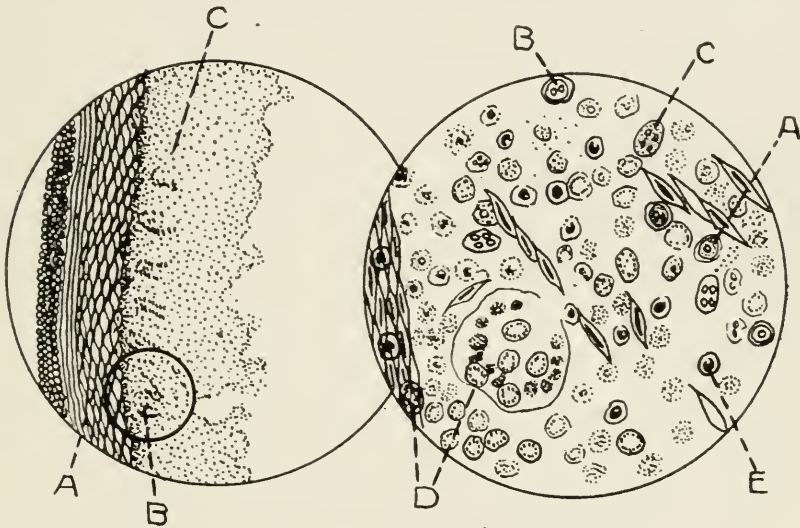


Fig. 34

Fig. 35

FIG. 34. SECTION THROUGH CECUM (Magnified 100 times)
From a chick that had died of coccidian white diarrhea. A, Muscular layer. B, remnant of gland. C, degenerated disintegrating mass. There is complete destruction of the mucous membrane.

FIG. 35. SECTION "B" IN FIG. 34 (magnified 900 times)
Shows various stages of the coccidium tenellum. A, Oocyst. B, Sporoblast, first stage. C, sporozoite, first stage. D, schizont, merozoites within, surrounded by a disintegrating cell mass. E, polymorphonuclear leukocyte.

form. In one outbreak, referred to above, 80 per cent of the first hatch of 2,000 chicks had died. We began trying to improve sanitary conditions, and administered various dilutions of permanganate of potash, copperas and carbolic acid. The loss was unaffected. By this time the writer had examined many dozen birds in his laboratory, and in about fifty per cent of the cases, the *Bacterium*

pullorum was isolated from the heart, blood, liver, spleen and kidneys, and in every case the coccidian ulcers, described above, were observed.

These chicks began dying in numbers at about ten days of age, very few had died before that time, and from this period to the end of the third week the great loss occurred. After this time but few died, but those having the disease in light form were stunted and did not make satisfactory growth. With this data now before me, I now began on another line of treatment.

During the past ten years I have used, to a greater or less extent, dilutions of mercuric chloride (corrosive sublimate) as an intestinal antiseptic in chickens. This was used, in this outbreak, in a solution of 1 : 10,000, with sulphocarbolates of zinc, sodium and calcium. The latter had not given the satisfactory results when used alone that it had in treatment of diarrhea in colts and calves.

Jones (Cornell) has shown that a solution of 1 : 1,000 (one-tenth of one per cent) bichloride of mercury, will kill the *B. pullorum* in thirty seconds; a one per cent carbolic acid solution requires five minutes in which to kill this germ; one per cent creolin requires five minutes; three and one-third per cent lactic acid kills it in five minutes, and five per cent carbolic acid kills it in thirty seconds. Mercuric chloride is therefore fifty times as effective against this germ as is carbolic acid.

Instructions were given for the incubators (containing also the nursery trays) to be tightly closed and fumigated with formaldehyde gas, as recommended under chicken cholera, before filling with eggs.

After the chicks were hatched they were not to receive any feed for forty-eight to seventy-two hours, as the yolk contained in their abdominal cavity will furnish food for that length of time, and an engorgement of the intestines might impinge on this part and interfere with its absorption by pressing on the absorbing vessels.

The following solution was to be kept before them from the time of hatching to four weeks of age, and then given twice a week for the next few weeks: Zinc sulphocarbolate, fifteen grains, sodium and calcium sulphocarbolate, of each seven and one-half grains, bichloride of mercury, six grains, and citric acid, three grains. This quantity was dissolved in a gallon of water. The result was that eighty per cent of the next hatch was saved.

Blastomycosis of the Pigeon

There is a condition in pigeons in which there is a nodular mass in the upper portion of the esophagus, due to a kind of yeast-like germ. It is termed blastomycosis, and is well illustrated in Fig. 37. The squabs become affected early, and as the diseased or tumor-like area becomes larger, the bird is unable to eat or swallow. The loss in some breeding establishments



FIG. 36. BLASTOMYCOSIS IN A PIGEON
A, Necrosing mass containing yeast-like bodies.

is considerable. The disease area manifests itself as a lump in the throat or neck, which is easily felt.

Treatment.—It will be necessary to keep the premises thoroughly clean, constantly disinfected, washed with an antiseptic. The trays after each batch of squabs need to be cleaned and disinfected, as, in fact, does the entire building.

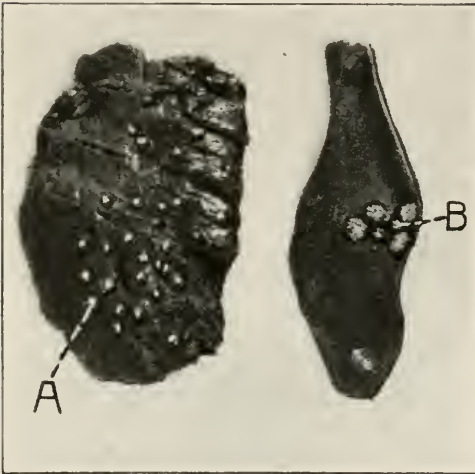


Fig. 37.

Fig. 38.

FIG. 37. PULMONARY COCCIDIOSIS IN A DUCK
A, Nodules in lung caused by the coccidium (natural size).

FIG. 38. INTESTINAL COCCIDIOSIS IN A DUCK
B, Ulcers caused by the coccidium (natural size).

Some good results have been obtained by treating these squabs early with a solution of sulphocarbolates compound. Also other antiseptics recommended for chicken cholera. In squabs it will be

necessary to use a medicine dropper and inject the solution into the mouth several times a day. If the disease has progressed very far, it is best to kill the squab and cremate it.

Coccidiosis in Wild Ducks

Two wild ducks (mallards) were sent to the laboratory by the game warden of Colorado during the fall of 1910, with the history that they had been found dead on a reservoir, and that the wild ducks were dying in large numbers. A careful autopsy was held on these birds. There were

small pearl-like nodules throughout the lung of one of the ducks, as shown in Fig. 37. Both showed ulcerations of the mucous membrane of the intestinal tract. These ulcerations were numerous, as many as eight or ten in each bird, and extended the entire length of the intestines. Fig. 38 illustrates this condition. Upon microscopic examination of these lesions, as well as of the lung nodules, coccidia were noted which resembled the *Coccidium tenellum*, one of the specific causes of white diarrhea in chicks.

Other Diseases of the Intestinal Tract

Arsenical Poisoning.—Arsenical poisoning may occur from the birds drinking spray mixtures containing paris green or other arsenical compounds, from eating rat poison, etc. Cases have been brought to our attention where birds had been poisoned by eating grasshoppers. The grasshoppers had been given arsenic in bran, and the birds, devouring large numbers of them, became ill, and many of them died.

Symptoms.—Loss of appetite, black comb, dullness, sitting, moping and unsteady gait, increasing weakness, and death. Judging from the effect of poisonous doses of arsenic on higher animals, the poisoned birds must have been in considerable pain, but they did not show it; birds do not manifest pain as animals do.

Autopsy.—The liver was normal, except that it was a trifle dark in color. There were no noticeable changes in the other abdominal organs, except the intestinal tract. Upon opening the intestines there were noted patches of hemorrhage and areas of congestion and inflammation.

Treatment.—This is scarcely worth while. De-

muculent drinks, as water in which slippery elm bark has been soaked, or even milk, are indicated, after a full dose of castor oil.

Salt Poisoning.—Poisoning among chickens and turkeys from eating common salt or drinking brine is quite common and the losses from it are large. It may occur from eating salt pork, or fish, or from drinking the brine left from freezing ice cream, and in many other ways. The symptoms and treatment vary but little from arsenical and other poisons.

Dr. Geo. H. Glover, Colorado, reports a case in which a lady in baking a cake made a mistake and used common table salt instead of sugar. After the cake was baked and the mistake discovered the young housewife concluded to feed it to her nice flock of chickens, consisting of twenty-three hens and one rooster. All the birds except the rooster died.

It has been determined that twenty-five grains of salt per pound of live weight is sufficient to produce death in birds.

Other Mineral Poisons.—*Saltpeter* poisoning, from eating fertilizer; *phosphorus* poisoning, from eating rat poison, *lead* and *zinc* poisoning, from eating paint, and *copper* poisoning, from drinking bordeaux mixture, have been described; all are infrequent.

Ptomain Poisoning.—Limber neck is one of those convenient generic terms which poultrymen sometimes apply to any ailment in which the bird is too sick to hold up its head. It is a very prominent symptom in all forms of ptomain poisoning.

Cause.—Ptomain poisoning may be due to eating any kind of food in which putrefaction has set in, but is usually the result of eating decaying meat or fish.

Because of the more favorable conditions for the rapid putrefaction of meat in very hot weather,

ptomain poisoning occurs chiefly in mid-summer, and on farms where the fowls have an extended range, including patches of high weeds that effectually conceal dead animals from the caretaker, until the loss of a large portion of the flock compels cutting weeds and a diligent search for the carcass.

The beginning of ptomain poisoning in a flock is usually something like this: During very hot weather a bird dies in the tall weeds, it may be from disease or from violence, and in three or four days its carcass is filled with maggots and in an advanced stage of decomposition; it is found by the other birds and devoured, with the consequent death of many of them, some of them dying in out of the way places and remaining undiscovered by the keeper, and in turn poisoning others, and so on.

Oftentimes the keeper is responsible for the beginning of the trouble by thoughtlessly throwing some small animal which he has killed (opossum, weasel, rat, etc.) where the fowls find it. If the weather conditions are favorable to rapid decomposition, ptomain poisoning in the flock will result and the "vermin" dead will destroy more birds than ten of its kind would destroy during life.

Maggots are usually found in the crops of birds dying from eating putrid flesh, and if the poultryman holds autopsies on the dead birds, he is quite apt to conclude that the maggots have killed them. Such is not the case.

Report of a Case of Ptomain Poisoning

In one flock there were twenty-four hens. A can of spoiled corn that had been left sitting in the basement, in a glass container, with top removed, was given to the birds at 11

o'clock and at 6 o'clock five were dead. At 2 p. m. next day thirteen were dead, with three more showing symptoms of poisoning. A flock of small chicks, with the old hen, as well as three setting hens that had not eaten any of the corn, were not in any way affected. There was no visible evidence of great pain and there were no spasms. The birds had at first an unsteady gait with inco-ordinate movement. Prostration was rapid. They lay on the ground in a relaxed condition with head and neck curled over towards the breast, but not rigid. Whenever a bird was disturbed it struggled. The comb turned black. In some cases diarrhea appeared, with occasionally a small amount of blood. Death occurred in a few hours.

At postmortem the crop and gizzard contained some corn of a sour odor. The only tissue change noted was a congestion of the intestines and of the liver, kidneys (active and passive congestion and cloudy swelling).

Treatment.—Give a tablespoonful of castor oil and one-fifth grain doses of sulphate of strychnine, the latter every four to six hours.

Experiments have been conducted to determine the exact dosage of strychnine for an average-sized hen. It has been found that the dose should be from one-sixth to one-fifth of a grain 3 times a day. The author has given one grain repeatedly without ill effect, but when given in solution and on an empty crop it killed the bird.

Corn Cackle Poisoning.—Chickens eating large quantities of corn cackle, in ground form, incorporated in their feed in the form of mash, have been poisoned.

The seed contains a poison, sapotoxin, which causes a severe inflammation of the entire digestive tract, including the crop. Great prostration and death follow.

Cloacitis

Symptoms.—The anus became red (inflamed), protruded, and later ulcerated. Antiseptics were applied and injected into the cloaca with the view of destroying the germs causing the trouble, but

the bird died. Upon autopsy it was found that acute inflammation had extended the entire length of the rectum. See Plate I for this portion of the anatomy. The latter condition would be called a proctitis.

Treatment.—In these cases apply a solution of sulphocarbolates compound, five per cent carbolized vaseline, or a solution of five per cent carbolic acid in warm water. The solutions may be injected with a syringe and the ointment applied with the finger.

SECTION VI

Blood Diseases

Under blood diseases come the septicemias, as apoplectiform septicemia, septicemia of geese, typhoid of fowls, and spirochetosis, all caused by germs which live and multiply in the blood stream.

Apoplectiform Septicemia in Chickens and Pigeons

This disease is due to the *Streptococcus gallinarum*, which grows in long or short chains. It can be readily grown upon artificial media and does not liquefy gelatin. Experimental inoculations with this organism killed the following animals: chickens, mice, rabbits and swine. It does not kill guinea pigs or dogs. The germ multiplies in the blood.

Symptoms.—Apoplectiform septicemia is rapid in its progress. The bird shows great prostration, feathers ruffled, loss of appetite, and the condition rapidly terminates in death. Often birds die in from twelve to twenty-four hours after the first symptoms appear. Birds in which no symptoms of the disease had been noticed may be found dead under the roosts. This disease often causes great loss to pigeon fanciers.

Postmortem Findings.—The spleen is enlarged, dark and soft; focal necrosis is noted in the kidneys, spleen and liver. Cloudy swelling also occurs preceding this state. Pneumonia may be present. The germs can be isolated in pure culture from any of the organs named.

Treatment.—Observe the rules of sanitation, as directed for chicken cholera. (Page 83.) If possible, separate the well birds from the sick. Vaccination with a vaccine made from the streptococcus gallinarum has given good results. Sulphocarbolates compound may be tried, as outlined in the article on chicken cholera referred to above.

Septicemia of Geese

This disease has been described as being caused by a germ which closely resembles the polar staining germ of chicken cholera. It multiplies in the blood.

Symptoms.—Geese are often found dead without having been noted to have been ill. The majority die very quickly, that is within two or three hours after first symptoms appear. Occasionally a bird may live for several days and finally die.

Postmortem Findings.—Small pinpoint hemorrhages may be noted, especially in the mucous lining of the intestines. Usually the digestive tract contains feed in all stages of digestion, indicating that the disease is very rapid in its onset. Considerable mucus may be found in the mouth and throat. Inflammation may be noted in the liver, pericardium (heart sac), spleen and kidneys.

Treatment.—Sanitary measures the same as those given for chicken cholera. (See page 83.)

Fowl Typhoid. Infectious Leukemia

This is due to a short, plump germ with rounded ends. It is called the *Bacterium sanguinarium*, and is easily isolated from birds dead of the disease. It reproduces the disease in inoculated birds, multiplying in the blood.

Symptoms.—Anemic or blanched appearance of the mucous membrane of the head, with a dull appearance and great prostration, usually ending in death in about four days, is characteristic of this disease. In some cases the affected bird may live three to four weeks. Moore reports a decrease in red blood cells and an increase in white blood cells, the latter principally the *polymorphonuclear leukocytes*.

Postmortem Findings.—The liver is enlarged and mottled with grayish patches, due to areas of leukocytic invasion. The germ can be isolated from the internal organs. The kidney shows congestion, which may be recognized by the minute red lines. The intestines may be congested. The spleen usually appears normal in size and color. The red blood cells gradually diminish and a leukocytosis (an increase of the white blood cells) appears.

Treatment.—Prompt isolation of the well from the sick birds and sanitary measures as given for fowl cholera (see page 83) should be observed.

Thrombosis

A bird was sent to the laboratory with the history that it had been sick for several weeks. There was a partial loss of appetite, finally complete loss; the bird showed weakness and a gradual emaciation. The hen died in about two weeks after coming to the laboratory.

At autopsy there was noted great emaciation. All organs appeared normal except the circulatory system. There was thrombosis (complete plugging) of the right brachial artery (artery to right wing) and the same of the large vessel to the liver, as well as of the iliac and femoral artery

of the left side (artery to left leg). Upon microscopic examination they were found to be white thrombi. Fig. 39 illustrates this condition. It may be seen that the blood vessels are quite distended by the blood fibrin.

Spirochetosis

This is a blood disease (septicemia) due to a spiral-like microscopic germ which is supposed to

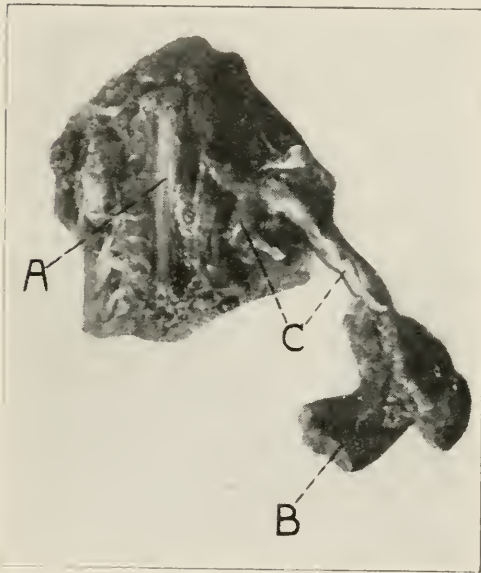


FIG. 39. THROMBOSIS IN A HEN
A, Pelvis bone, central portion. B, muscle
of thigh. C, blood vessel containing
a white thrombus.

be carried from bird to bird by means of the chicken tick; illustrated in Fig. 16. Fig. 40 shows a drawing of the germ. It is the *Spirocheta gallinarum*; the slide from which this drawing was made was kindly sent to the author by Dr. Balfour of Khartoum, Sudan, Africa.

This disease was first recognized in Brazil; it is found in Africa and Europe. A disease occurs in the southern part of the United States, where the chicken tick is abundant, that presents symptoms similar to those of spirochetosis; so far as the author knows, no definite work has been done to determine the true cause of it.

Spirochetosis is most common among chickens, but also infects geese, ducks, pigeons and sparrows.

Symptoms.—There is noted a dullness, loss of appetite, rapid emaciation; the head and tail are down, and the bird stands around in corners or on the roost, with its eyes closed. Fig. 41 shows a photograph of a typical case. Note the attitude of head, tail and body.

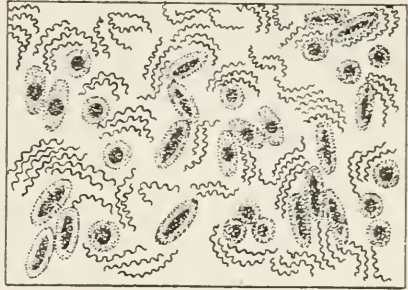


FIG. 40. SPIROCHETA GALLINARUM
This drawing, made from a blood smear, shows red blood cells (oval), thrombocytes and leukocytes (round) and spirochetes (corkscrew-like).

Another form of septicemia in chickens is caused by a comma-shaped germ, the *Spirillum Metchinikovi* or *Vibrio Metchinikovi*.

The symptoms are similar to those of fowl cholera, except that there is no, or at most but slight,

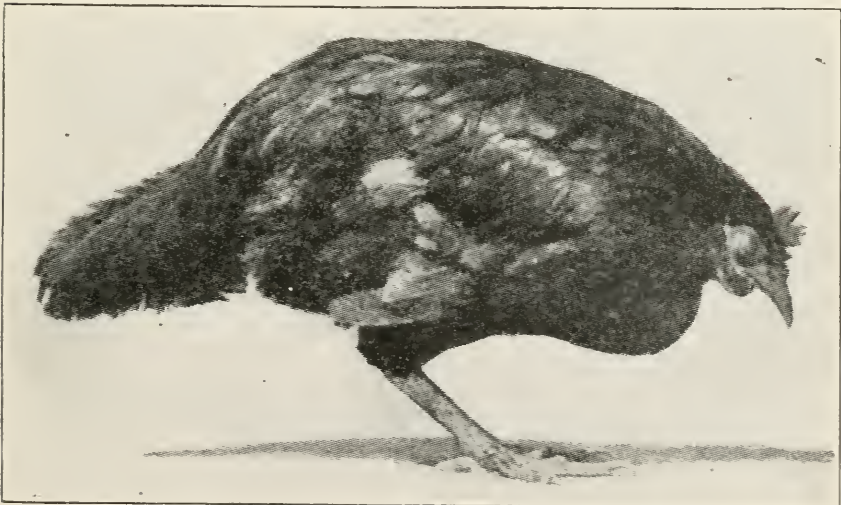


FIG. 41. ACUTE SPIROCHETOSIS (after Balfour)

elevation of the temperature. Diarrhea is constantly present. Inflammation of the bowel and enlarged liver (hepatitis) is noted. The disease

has not been reported in this country. It may exist unrecognized.

Pericarditis

This is an inflammation of the pericardium or heart sac; there is usually an effusion about the heart, and it is often spoken of as dropsy of the heart sac or dropsy of the heart. It is, of course, not strictly a blood disease, but it is often associated with diseases of the blood and of the lungs, as a complication; further than this its cause is not known, but may result from exposure to cold and dampness.

Symptoms.—A diagnosis of pericarditis cannot ordinarily be made during the life of the bird, but is easily demonstrated on autopsy. Tumultuous heart action, extreme exhaustion on exercise, and difficulty of breathing are symptoms observable during life.

Treatment.—Treatment is unsatisfactory; numerous cases occurring in the same flock should lead to the enforcement of better hygienic conditions, especially to better protection from cold and dampness.

Endocarditis

This is an inflammation of the lining membrane of the heart, usually affecting the valves also. Nothing is known of its cause, but it is of not infrequent occurrence during the course of certain diseases of the blood. It cannot be diagnosed during life, and therefore cannot be treated. From what we know of the cause of endocarditis in man and animals, we should expect exposure to cold and dampness to be a factor in the cause of this disease, and as such to be avoided.

Rupture of the Heart and Large Blood Vessels

Internal hemorrhage (bleeding) due to rupture of the heart or large blood vessels is common in overfed fowls. It may be caused by any excitement or overexertion in such birds. It is described in this section because affecting organs of circulation.

Symptoms.—There is a sudden blanching of the comb and mucous membranes followed by great weakness, coma and death. No treatment is practicable.

SECTION VII

Constitutional Diseases

Under this head we class "going light" and tuberculosis.

Both cause considerable loss to the poultryman. There is much doubt as to whether the former should be classed as a disease; certainly this term as usually applied refers merely to a symptom of a disease (often tuberculosis or enteritis) or condition in which there is a progressive loss in the weight of the bird.

Going Light (Asthen)

Those who look upon going light as a specific disease consider it as one that affects chickens and pigeons. It may affect old or young birds. It is called going light because the bird becomes gradually lighter until emaciated. It is a disease that is found in all parts of the United States. A germ called the *Bacterium asthene* has been isolated by one investigator from the intestines of sick birds. It corresponds with the *Bacillus coli communis* always present in the intestinal tract of chickens.

The affected birds have a good appetite; in fact, at times a ravenous one. The loss of flesh is continuous for a few weeks, when the bird dies.

In eleven cases of going light examined by the pathological laboratory of the United States Bureau of Animal Industry three were found to be infected by the *Bacillus enteritidis*. This germ is dangerous to man. It affects cattle and has re-

sulted fatally to those persons eating infected meat.

Postmortem Findings.—Usually on autopsy all organs appear normal so far as gross appearance goes, but extreme emaciation as described above is noted.

The following is the result of a blood study in these cases:

Report of Asthen Cases

Two outbreaks have been investigated by the author. One in a flock of Rhode Island Reds, in which flock there were about two hundred birds which should have weighed about two pounds each. The disease affected a gradually increasing number. The feed consisted of grain, insects picked up from the fields, and plenty of green grass. As it was irrigation time, the birds had access to the irrigating ditches. The henhouse and yard were kept clean. It was advised to change the run and continue giving a variety of good green feed and grain with a good supply of water. The disease finally disappeared from the flock. All efforts at the laboratory to isolate any germ which might have been the cause of the disease were unsuccessful.

The second flock was from eggs that had been produced by birds in which roup had appeared the preceding winter. Five birds about four months old were sent to the laboratory for study with the following history: The birds had good hygienic surroundings, were moved from place to place, given fresh water and good quality of feed, with plenty of green stuff, but without success; the birds not only did not thrive, but continued to lose flesh and finally died, notwithstanding that most of them had a ravenous appetite.

Chick No. 3.—Hemoglobin, 65 per cent; erythrocytes, 2,920,000. Leukocytes, 28,000. Differential count: Polymorphonuclear neutrophiles, 39 per cent; eosinophiles, 30 per cent; lymphocytes, 29 per cent; mast cells, 2 per cent.

Chick No. 4.—Hemoglobin, 65 per cent; erythrocytes, 2,600,000; leukocytes, 14,000. Differential count: Eosinophiles, 31 per cent; mononuclears, 8 per cent; lymphocytes, 60 per cent; basophiles, 1 per cent.

Chick No. 5.—Hemoglobin, 75 per cent; leukocytes, 34,000; erythrocytes, 3,000,000. Differential count: Polymorphonuclears neutrophiles, 4 per cent; eosinophiles, 50 per cent; basophiles, 3 per cent; mononuclears, 4 per cent; lymphocytes, 39 per cent.

Chick No. 6.—This bird was about four months old, stunted in growth, "going light," and had contracted roup from another bird. The blood study shows the following: Hemo-

globin, 60 per cent; leukocytes, 16,000; erythrocytes, 3,600,000; thrombocytes, 436,000. Differential count: Eosinophiles, 3 per cent; mononuclears, 4 per cent; lymphocytes, 89 per cent; mast cells, 4 per cent.

All efforts to isolate germs from the liver, spleen, kidneys and heart-blood were unsuccessful.

More study must be done on this disease to determine the true cause, before rational treatment can be outlined.

Treatment.—The birds should receive one-fourth to one grain ferrous sulphate once a day in soft feed. The prognosis is not hopeful.

With our present knowledge we will look to sanitary surroundings for the control of this condition—clean coops and yards, good feed and water. A tablespoonful of powdered ginger to each dozen hens may be given once or twice a day in soft feed.

Tuberculosis

This is a disease of great importance to the poultryman, not only on account of its destructiveness to his flock, but also on account of its relation to the health of himself and family; for while fowls are not very likely to contract tuberculosis from domestic animals or from man, yet fowls that have the disease are a serious menace to the other animals on the farm as well as to the poultryman and his family.

Cause.—The *Bacillus tuberculosis*, which was discovered by Koch in 1882, is the cause of this disease. There are four principal types of this organism. The one most commonly infecting man is designated as the human type. The one peculiar to cattle is designated as the bovine type, and the one peculiar to fowls the avian type; and there is still another type of the tubercle bacillus which affects fish and other cold-blooded animals.

While there are some differences in the shape

of the organisms grown for considerable time in the various animals and some differences (bio-chemically) when grown in artificial media after isolation, yet the type peculiar to any of the warm-blooded animals will grow in any of the other warm-blooded animals, that is, the types are interchangeable, which means that the bovine type may cause tuberculosis in man and the human type may cause tuberculosis in birds, etc. Most authors consider that while the chicken has considerable resistance to the human type, it will and does become infected with this type.

It has been found that a large percentage of hogs fed swill from houses where tuberculous persons have expectorated into it, become tuberculous, and when slaughtered, there is a considerable loss from condemnation of those badly affected. (Busman.)

Tuberculosis among chickens is rare in some portions, and is very common in other localities in the United States. Although it is widespread throughout the United States and Canada, it was first reported in this country in 1900 and received but slight attention until 1903. It also occurs in turkeys, pigeons and pheasants, and two cases in wild geese were reported at the Ontario Agricultural College. The loss from this disease seems to be increasing.

Mode of Spread.—In the progress of tuberculosis of chickens at times there is noted a diarrhea. In these cases there are found tubercular ulcers of the mucous lining of the intestinal tract. In these cases the spread is very rapid through the flock, as birds are continually picking feed from the ground and floors where contamination is sure to have taken place.

If scraps be fed to which tuberculous sputum has found its way or if the birds are allowed to devour parts of an animal dead of the disease, there is a liability of their contracting tuberculosis.

There is also a possibility that birds, by following tuberculous cattle, may become infected, as do hogs. It has been argued that the temperature of the bird is so high (105° F. to 107° F.)

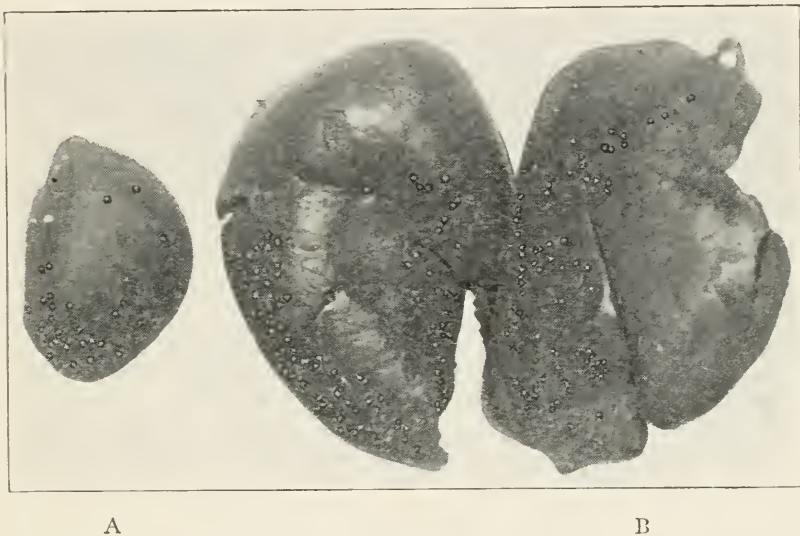


FIG. 42. TUBERCULOSIS IN A HEN
A, Spleen showing miliary tubercles.
B, liver showing miliary tubercles.

that it furnishes an unfavorable field for the human and bovine types of germs, which thrive at temperatures close to 98° and 101° F., respectively. It has, however, been found that these germs soon adjust themselves to such changes in temperature and to a certain degree to differences in food.

One case, a hen, was sent to the laboratory with the history of having had access to the sputum of a person afflicted with tuberculosis. Upon autopsy small pearl-like nodules were found throughout the liver (See Fig. 42), in the lung substance and over the serous lining covering the intestines and

abdominal cavity. A microscopic examination of the lesions revealed the bacillus of tuberculosis. It more closely resembled the human than the avian type.

Symptoms.—An absolute diagnosis cannot be made during life, as the symptoms observed are common to many conditions, especially in the early stages when there are no positive external symptoms by which it can be recognized. The bird becomes emaciated. The rapidity of emaciation, like in other animals, depends on the progress of the disease; that is, the susceptibility of the bird, as well as the degree of infection.

The comb appears pale, the bird becomes dull and sleepy, has “no life.” If the joints become affected there will be lameness in case the affection is in the legs and swollen joints, and often in affection of the skin and visible mucous membranes is noted there is ulceration (sores). This latter condition has been noted especially in parrots. These skin areas are made up of a cheesy material (caseation necrosis), which is covered by a thick, rather hard, crust, whitish in color. At times it is noted that these crusts become rather horny in nature.

The red blood cells in a tuberculous fowl may be greatly reduced (as low as 1,000,000), and the hemoglobin as low as thirty-five per cent. White blood cells are slightly increased.

Postmortem Findings.—Owing to the fact that most birds are infected with tuberculosis through contaminated food, we find most of the lesions in the abdominal organs. Of these the liver is most often diseased. Next in frequency comes the spleen and the serous lining of the cavity, as stated in report above.

As indicated above, the areas may appear as

pearly, grayish-white nodules varying in size from a pin-head to a pea, or even larger. In these larger nodules there will be noted a cheesy mass which, as the lesions become older, they become impregnated with calcium (lime) and then cut like gritty material. In healed tubercles there may be a solid calcareous (stony) mass. Usually the diseased organs are enlarged. Fig. 42 illustrates a liver and spleen studded with pearly tubercles of pin-head size. This liver was from a hen afflicted with tuberculosis.

Upon opening the intestine of a tuberculous bird there may be noted ulcers, usually small in size, and a thickening of the wall. The abdominal lymph glands (kernels) are tuberculous. At times these show small tubercles from the size of a pin-head to larger, at other times a cheesy mass (caseation necrosis), and in still older areas an infiltration with lime salts. Small tubercles may also be found in the lungs and other adjacent tissue.

Like in the higher animals, the bones become tuberculous, there is noted swelling tubercles and caseation; later calcification.

Treatment.—Treatment of the affected bird is not to be thought of. As shown above, the germs of the disease are so often spread through the droppings that the only sure means of eradicating the disease from a flock is to kill all the birds in the flock and if possible move the henhouse to a new location and have new runs. If this is not practicable, thoroughly disinfect with five per cent carbolic acid or five per cent creolin, all fences, feed troughs, watering tanks and buildings, as indicated under cholera.

Birds from an infected flock should not be sold

for breeding purposes, and the birds from such a flock that are killed for food should be inspected by a competent veterinarian, so that none may be used for food purposes that are diseased to such an extent as to render the food unfit for human consumption.

All birds in a flock infected with tuberculosis that die should be cremated to prevent further spread of the disease from that source. All droppings and cleanings from the henhouse and runs should be disinfected with calcium chloride, a five per cent solution of carbolic acid or other reliable disinfectant before spreading on the fields.

SECTION VIII

Diseases of the Liver

Inflammation and necrosis of the liver as seen in many of the infectious diseases have already been referred to under the discussions of these different diseases, as chicken cholera, blackhead, tuberculosis, etc. Aside from diseases of the liver due to infection, the commonest cause of ailments of this organ is improper feeding. It is with great difficulty that diseases of the liver can be recognized except upon postmortem examination. Treatment, as a rule, is useless.

Fatty Degeneration

This is a condition in which there is a disease process in the protoplasm of the liver cells, by which the normal secreting cells of the liver are to a greater or less extent replaced by fat cells. The liver is smaller than normal, unless fatty infiltration is also present; it appears slightly yellowish, and when cut through the blade of the knife will have a greasy appearance, due to the fat that adheres to it.

Symptoms.—Birds affected with fatty degeneration of the liver show varied symptoms, but usually they are dull, eat little and the comb turns dark to black. They gradually become thin in flesh and finally die. Usually the bird will live from two or three weeks to three months after the symptoms first appear. On autopsy all organs usually appear normal except the liver.

Treatment.—There is very little that can be done

for this condition. Podophyllin in one-grain doses every three days may be given with some hope of relief.

Fatty Infiltration

This condition may be a physiological or normal process until the accumulation of fat occurs in such quantities as to interfere with the function of the liver cells.

The liver is one of the so-called storehouses of the body for fat. In it is stored a surplus until needed by the body for use (for combustion for the production of heat and energy).

Overfed hens, or those closely housed and not forced to work, or fed too heavily on carbohydrates (starchy feeds) store up much of the surplus nutrition in the liver as well as in other portions of the abdomen, especially in the mesentery and in the abdominal walls.

In these cases, on autopsy, the liver will be found to be enlarged, brownish or grayish-brown in color (mottled), friable (tears easily), and when cut through appears "greasy," much fat adhering to the knife blade. In these cases rupture of the liver often occurs when the hen is stepped upon by a large animal, is thrown or jumps a long distance on hard ground or a concrete floor. Heavy hens with clipped wings are prone to this injury.

In the liver, in which excessive fat is stored up, there is, after a while, an encroachment upon the protoplasm to such an extent that the cells cannot properly functionate and then death of the bird may occur. In these cases a microscopic examination shows the nuclei of the cells to be pushed to one side, and the protoplasm atrophied

and disappearing. This is a pathological condition.

Rupture of the Liver

In cases where the liver is excessively congested with blood or is overly filled with fat, as mentioned above, violence may result in rupture.

One case that may be of interest came to the laboratory, and at autopsy was found to be ruptured, with considerable blood (hemorrhage) in the abdominal cavity (among the intestines). The rupture or tear was about three-quarters of an inch long and on the left lobe. The organ was double its normal size. Upon microscopic examination it was found to be congested and occasional small ruptures (hemorrhages) were found throughout the liver substance.

This bird was in a yard with a horse and it is supposed to have been kicked or stepped upon, as the left side was bruised.

Congestion of the Liver

There are two kinds of congestion of the liver, active and passive. Active congestion precedes inflammation and is a state in which the capillaries, arterioles and arteries are engorged with blood. It is caused by local irritation.

Passive congestion of the liver is usually due to a weak heart or a leaky valve between the two cavities of the right side. The blood backs up into the liver, and the central veins of the lobules and capillaries, between the columns of liver cells, become engorged. It gives the cut surface a peculiar yellowish mottled appearance called "nutmeg liver," from a fancied resemblance that it bears to the sectional surface of a nutmeg.

Inflammation of the Liver

Inflammation of the liver may be the result of absorption of poisonous products from the intestines. These products (toxins) lodge in the liver, or the inflammation may be due to infection

(germs) as in chicken cholera. The irritation causes active congestion followed by a migration of great numbers of polymorphonuclear leukocytes (white blood cells) and thrombocytes, constituting inflammation. The liver is enlarged, dark, and easily torn; it appears very full of blood.

In many, and in fact most, of the contagious diseases inflammation of the liver (hepatitis) occurs.

The following case report will serve to illustrate these cases:

A valuable rooster was sent to the small animal ward of the Division of Veterinary Medicine of the Colorado Agricultural College for treatment. The bird had been sprinkled with some proprietary lice killer and had immediately taken ill. There was a loss of appetite and it had become weak in the legs and remained so till its death. Late in the course of the trouble the bird was not able to stand at all, but lay on its side. It became emaciated and lived only about three weeks after it was taken sick.

On autopsy the liver was found to be enormously enlarged, weighing 176 grams (normal weight would have been about forty grams for a bird of that size). The surface had a grayish mottled appearance. Upon microscopic examination these pale gray, irregular areas proved to be liver areas packed with leukocytes (white blood cells) and thrombocytes—an aggravated case of hepatitis (inflammation).

Another similar case was brought to the laboratory, except that it did not have the history of having been sprinkled with an insect powder.

Enterohepatitis

This is a disease of turkeys and to a less extent of other birds, which extends from the intestine to and involves the liver. It is discussed under diseases of the liver. (See page 85.)

Unimportant Diseases

Abscesses and tumors of the liver appear to be very rare in chickens and other fowl. Sarcomas and carcinomas (cancers) of this organ are usually associated with similar tumors of the ovary.

Jaundice is very rare, and appears to result from a long-continued mild congestion of the liver.

Cercomoniasis (spotted liver) is a type of disease of the liver due to infection (*Monocercomonas gallinarum*) that may be associated with severe diarrheas.

Aspergillosis is a disease due to a fungus (*Aspergillus fumigatus*, and sometimes other species). It commonly affects the lungs (Pneumomycosis, which see), but may, and occasionally does, affect the liver.

SECTION IX

Disease of the Ovary and Oviduct

Prolapse or Eversion of the Oviduct

This is a common ailment of laying hens. Over-feeding and aggravated constipation have been found associated with this condition. When the eggs are large and considerable straining takes place during their passage, and in inflammation of the mucous lining of the oviduct or egg canal prolapse or a protruding of the mucous membrane through the cloaca may be observed. In constipation, the bowels becoming gorged, and this in addition to the obstruction when the egg canal contains one or more developing eggs, and the ovary, being active, is larger and adds to the bulk, predisposes to prolapse.

This condition is most often seen in hens that are heavy layers. It perhaps occurs most often in old hens. If the prolapsed or protruding mucous membrane is allowed to extend through the anus, it soon becomes inflamed from exposure to the air and infection (germs). Later the parts may become ulcerated as a result of mechanical injuries or the attack of germs.

Treatment.— Wash off the accumulated material on the vent feathers with clean, soapy, warm water. After cleansing the hands, replace the protruding mass, using on the fingers carbolized vaseline, three to five per cent strength. Keep the hens on a light diet for several days so that

the parts may have a rest and the irritation causing the trouble subside. It is best to give only soft feed and liquids. Give the hen a tablespoonful of olive oil and plenty of clean water.

Obstruction of the Oviduct (Egg Bound)

This is a common ailment of laying hens, perhaps the commonest of all discussed conditions of the oviduct. The poultry raiser calls it "egg bound," by which he means there is something in the oviduct which the bird cannot force out.

The upper portion of the oviduct, or that part which receives the ovum (yolk) as soon as it is fully formed in the ovary and delivered, is lined with secreting cells. In this part the albumin which surrounds the yolk is formed. Further along the glands secrete the shell or calcium layer after forming around the mass a fibrous membrane or sac. It can be readily seen, for all this to be brought about, means an abundant blood supply. An inflammation of the egg duct (usually the result of infection from the digestive tract by way of the cloaca) means an arrest of function of these glands. There are other cells that secrete mucous which lubricates the passage way, and these, too, are arrested in their function. The result is a stoppage of the egg.

Other causes are: Eggs of too large size, exhaustion of the bird and atony and paralysis of muscular walls of the oviduct and vagina, volvulus or twisting of the oviduct and stricture of the oviduct. Weakened muscles, the result of disease, improper nourishment and overwork are contributing factors.

Symptoms.—The hen goes frequently to the nest and repeatedly makes expulsive efforts but can-

not lay. If the obstruction is well along in the egg canal the egg may be felt as a hard object in the posterior part of the abdomen. In many cases the obstruction is so far up the oviduct it cannot be felt or seen and we must depend for diagnosis upon the action of the bird, which suffers acutely under these conditions.

Treatment.—First be sure that the bird will not lay the egg unaided. Allow her to remain quiet and alone for a couple of hours; she will often relieve herself unaided. If it is evident that the bird must be given help, wash the hand carefully with soap and water and lubricate the fingers with three to five per cent carbolized vaseline, which can be secured at any drug store, pass the fingers through the anus and cloaca into the egg canal and remove the egg. At times the egg is large and it may be necessary to break the shell in order to remove it. If the egg is broken, make sure that all parts of the shell are removed. By referring to Plate I the relations of these organs may be seen.

After the removal of the egg give the hen a tablespoonful of olive or castor oil and place on a light feed for a few days. Recovery usually occurs in the simple uncomplicated cases which form the majority; in complicated cases death is often the result.

Rupture of the Oviduct

This is usually a complication of obstruction of the oviduct. It is frequently fatal in a very short time and in such cases can be diagnosed only upon postmortem examination.

Cause.—Vigorous contraction of the muscular walls of the egg canal in expulsion efforts some-

times results in a rupture of the wall. When this occurs the usual sequel is peritonitis (inflammation of the serous lining of the abdominal cavity) and the death of the bird. Disease processes sometimes so weaken the wall that it gives way under the stress of natural contraction.

Symptoms.—The hen ceases to lay, the abdomen becomes larger and often one or more eggs can be felt by palpating the lower portion of the abdomen. Often the hen is noted to sit up penguin-like-fashion, walking with tail and posterior portion of the abdomen dragging the ground. There is nothing to do except to kill the bird. At autopsy there will be found many yolks in the abdominal cavity, possibly one or more with shells and possibly an inflammation of the lining of the cavity (peritoneum).

Broken Eggs in Oviduct

Eggs in the oviduct, as well as ova still undelivered, are often found broken as a result of a kick of a large animal or of the hen being stepped upon. Death usually follows, if not immediately from the injury, which breaks the egg, after several days as a result of complicated obstruction of the oviduct resulting from the fibrous exudate thrown out about the broken yolk.

We have also studied cases of ruptured ova due to heavy hens roosting on high roosts and by jumping upon the hard floor, causing rupture of the larger forming yolks or ova or of eggs in the egg canal.

Prolapse of the Cloaca

This may occur in heavy laying hens that roost on high perches and fly a long distance to the

ground, and especially when the wings are clipped. If these birds are allowed low roosts and put on a light diet they recover. Some of these conditions have been studied in the author's laboratory and the trouble overcome by observing this rule.

Abnormal Eggs

Many different kinds of abnormal eggs are produced by fowls owing to various diseased or other abnormal conditions of the generative apparatus. Because of the rarity of their occurrence such eggs are of little importance to the practical poultry raiser, but they possess much interest for the scientific investigator.

Soft-shell Eggs.—This is a condition where eggs are laid without a sufficient amount of shell substance covering the shell membrane. The commonest cause is overfeeding, another cause is the lack of sufficient shell-making material in the feed; still another cause is fright, which may cause a premature detachment of the yolk.

The cause should be remedied and the condition will disappear without further treatment.

Yolkless Eggs.—These are small eggs, in which the albumen and shell is formed about a small portion of detached yolk, a minute piece of hardened albumen or a bit of coagulated blood instead of the normal yolk.

Double and Triple Yolk Eggs.—These eggs with two yolks are common. They are caused by two yolks getting into the oviduct and being enclosed together in the albumen and shell. Three-yolked eggs, which are rare, have a similar origin.

Bloodspecks, Blood Rings, Egg Inclusions.—These have little significance; particles of coagulated blood, due to hemorrhage when the ovum (yolk)

is discharged from the ovary, are most common, but lumps of bacteria, worms, fecal matter, etc., have been found.

Blood clots may be found in either the yolk or white (albumen).

If hemorrhage occurs in the yolk, the clot has formed in the ovary before it was delivered into the oviduct. If the clot is in the white it has occurred in the upper portion of the oviduct.

SECTION IX

Tumors

Tumors of various kinds affect birds, but are less common than in higher animal life. There is



FIG. 43. HEMATOMA OF OVARY IN A HEN (natural size)
A, Diseased ova. B, sectioned surface of two of the blood tumors.

almost no literature on the subject. The following reports from the author's laboratory are given

for their interest, rather than their utilitarian value.

Hematoma, Blood Tumors

Occasionally considerable hemorrhage takes place in the ova as they are in process of formation. These fail to find their way into the oviduct and become hematoma, or blood tumors. - Fig. 43 illustrates one of these cases, natural size. The sectioned surfaces of two of the tumors is shown.

Exciting causes, like those that cause inflammation and congestion, are present. A rupture of a small, congested vessel causes the clot. Ergot in small quantities should be given to combat the condition.

Multiple Tumors of the Ovary

One of the commonest of tumors consists of yolks, or ova, which have formed, but failed to enter the oviduct. Later these masses become hard and irregular in shape, yellowish in color, and consisting of dried (inspissated) yolks forming concentric layers. Fig. 44 illustrates one of these cases, natural size.

Cystic Ovary

Cystomas, or cysts, are found at times in the ovaries. These cysts are apparently imperfectly developed ova varying in size, and contain a colorless liquid. They are attached to the ovarian mass by pedicles.

Sarcoma

Sarcomas are a type of malignant tumors; that is, they spread much in the manner as cancers (carcinoma). They are fatal in time. The flesh of birds affected with sarcoma should not be eaten.

A case of sarcoma was studied by the writer, in

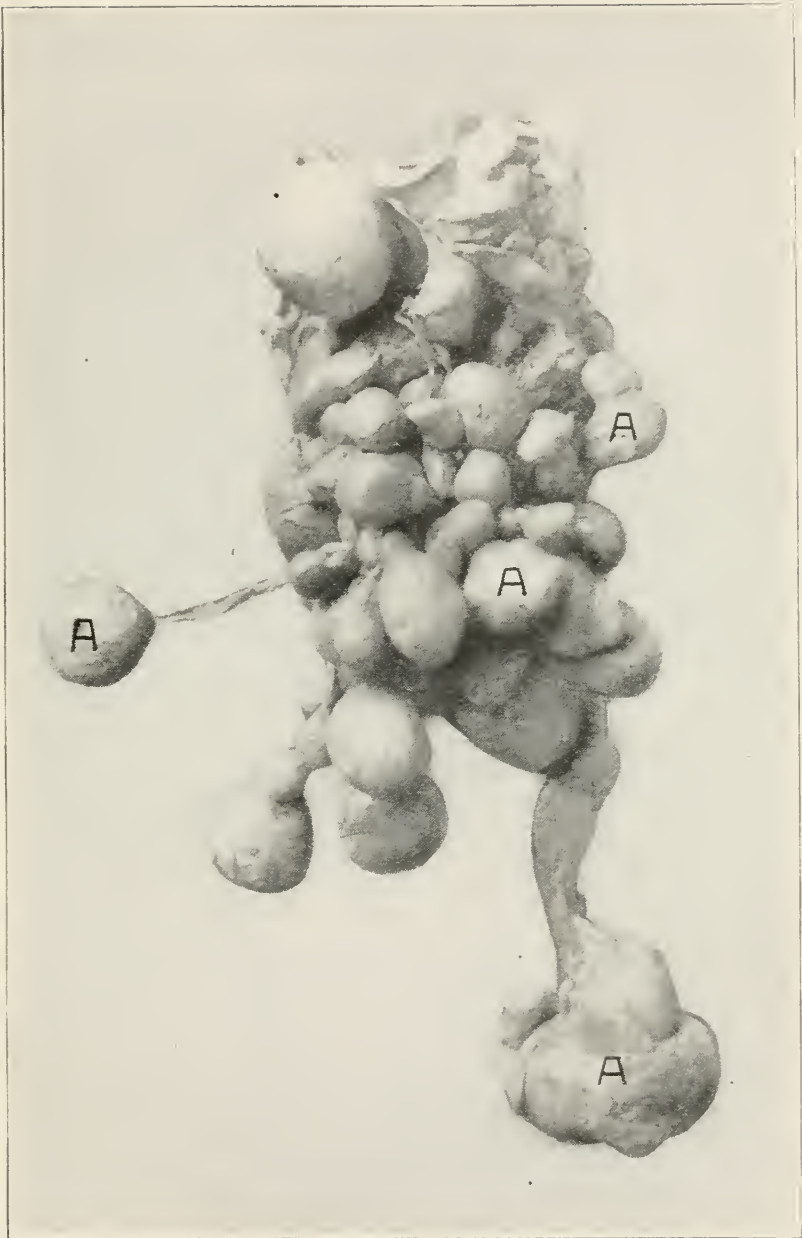


FIG. 44. MULTIPLE TUMORS OF OVARY IN A HEN (natural size)
A, Ova that have undergone degeneration. Note the pedicle-like structure joining to the ovarian mass.

which the tumors involved the ovary, intestines, peritoneum (lining of the abdominal cavity) and the liver. These tumors vary in size, are whitish-yellow, and soft when sectioned.

Adenoma

An adenoma is a tumor that has some resemblance to a normal gland. It is made up of connective tissue and asini, or cavities, lined by columnar or cuboidal cells. One tumor of this type affecting the spleen of a hen was sent to the laboratory. The spleen was about twice normal size.

Lymphosarcoma

This is a malignant type of tumor. One case, affecting the heart of a chicken was sent to the laboratory. The heart was about normal size, and when cut showed small, roundish, clear areas. These proved to be small tumors that come under this heading.

Epithelioma

This is a type of cancer. One hen was brought to the laboratory with the history that she had a "growth" on the side of the head for several months. The tumor was flat and about one inch in diameter. A microscopic examination revealed it to be an epithelioma.

SECTION XI

Diseases of the Respiratory Passages

In the fall, winter and spring, these diseases are a scourge to the poultry raiser, unless strict sanitation is observed.

Obstruction of the Trachea

This is uncommon, except as a result of gape-worm infestation. Fig. 45 illustrates a case that was sent to the laboratory with the statement that it had "gapes." This bird would extend its head high into the air, gasping for breath as one whose trachea is obstructed by gapeworms; it was weak and unable to stand squarely upon its feet. It was destroyed for examination. A piece of a grain of corn was found in the trachea, surrounded by an accumulation of mucus caused by the irritation its presence in the trachea caused. The foreign body and the accumulated mucus were obstructing the passage of air to the lungs; hence, the asphyxiation.

Catarrh, Colds

Cause.— Sudden changes in the weather, cold, damp weather, roosting in draughts, and chilling by getting wet in cold rains is often a factor in the production of catarrh among birds. Such affections are more or less contagious, but bad sanitation plays an important part in their spread. Weak stock and poorly nourished birds are predisposed to this contagion.

Symptoms.—The appetite may be somewhat diminished. The bird sneezes, throws its head and may expel some mucus. The discharge at first is watery and later becomes more or less thick (muco-purulent). The eyes may show more or less inflammation (conjunctivitis) and the eyelids



FIG. 45. OBSTRUCTION OF THE TRACHEA

A, Showing depression (drooping wings, inability to stand, etc.) from partial asphyxiation. B, same chicken shown in "A," just before death.

may become adherent. The characteristic offensive odor of roup is absent.

Treatment.—The same treatment as outlined under roup (see page 153) has given us uniformly good results.

The following report of one of the experiments by Mr. Coulton, under the direction of the author,

illustrates the course and treatment of colds in birds:

With the advent of cold weather, early last fall, a large number of our chickens contracted colds, which was extremely discouraging, to say the least. We had over one hundred chickens, besides turkeys, and fully twenty-five per cent were affected at one time. In addition to the colds which affected the throat, nostrils and eyes, many were affected with canker in the mouth. The ordinary remedies, kerosene, roup cures, etc., were all used, with little effect. We finally secured from the drug store (at the suggestion of Doctor Kaupp) some sulphocarbolates compound tablets and used them, but the improvement was not very marked. Later tablets furnished by the Pathological Laboratory of the Colorado Agricultural College (sulphocarbolates compound, thirty grains, with six grains bichloride of mercury to the tablet) were tried. This was not only placed in the drinking water, but a solution was used in a syringe to wash out the nostrils and mouth. This treatment was marvelously effective. It acted like a charm. The catarrhal condition continued, however, until the following treatment was used (also at the suggestion of Doctor Kaupp):

The nostrils were washed out with a twenty per cent solution of common baking soda; then with peroxide of hydrogen, and finally with the following preparation: Oil of eucalyptus, twenty drops; oil of thyme, one dram, and petrol oil, two ounces. A warm solution of the soda was always used and the other materials were warmed by setting the bottles in hot water. This treatment was also applied to the eyes, and the ulcers in the mouth were swabbed with it. The results were remarkable. It was almost impossible to make a record of these cases, as a large portion of the flock were affected. Furthermore, it was impossible to give them all the daily treatment prescribed. Sometimes they would go several days without treatment. In mild cases, however, from two to three applications affected a cure.

March 17th we found a young cockerel in a very rousy condition. He had been hatched late in the fall and had never been very vigorous. His eyes were swollen shut, nostrils discharging badly, and, with all, his was not a promising case. We isolated him and gave him the regulation treatment, as described above. Notwithstanding that it stormed severely and he was not well feathered, the next day he was showing a decided improvement, and after three treatments, covering about five days, all evidence of the trouble had disappeared and to-day he is apparently in better condition than at any time during the winter.

A day or two later we found two others belonging to the same brood in about the same condition and after one treatment there was evidence of improvement, but after a few days, not having been able to give them careful attention

or regular treatment, they seemed to be worse, and we used the hatchet treatment. I am satisfied, however, from our experience, both with chickens and the turkeys, when taken in time and treated regularly, it is seldom necessary to lose one. We estimated that we saved ninety-five per cent of those affected, by this treatment.

Bronchitis

In some cases we have noted catarrh commencing in the head, principally the nasal chambers, extend down and involve the trachea (wind-pipe), and even to the bronchi (branches of the trachea leading to the lung tissue). Sudden changes in the weather, dampness and roosting near a crack in the henhouse so that a cold wind blows upon them, or, in fact, in any draught, are the principal causes of bronchitis.

Symptoms.—A rattling sound may be heard in the region of the trachea and bronchi (neck and anterior part of the thorax). The bird may be seen to gasp for air by extending the head upward. This is due to an accumulation of mucus in the air passages which partially closes them, thus preventing the bird from getting enough oxygen into its lungs. The affected bird coughs, and there may be dullness and partial loss of appetite.

The condition may pass off in a few days, may respond to treatment, or may last for several weeks and end in recovery or in death. In the latter case there is marked emaciation; in the former the bird coughs up mucus for a long time, but otherwise appears well.

Treatment.—A tablespoonful of castor oil, to which 5 to 10 drops of turpentine have been added, and if catarrh be present, treatment as outlined under roup. Give one-grain doses quinine sulphate three times a day. Place the bird in warm, clean, comfortable quarters, free from draughts.

Give plenty of clean water and soft feed (bread or middlings moistened with milk), to which has been added 2 grains of black antimony for each bird. Feed twice daily.

Congestion of the Lungs

This is an engorgement of the blood vessels of the lungs. Congestion of the lungs is quite apt to develop into pneumonia, of which it may be said to be the first stage. It has been observed in young birds and in birds during their moulting season, when they are poorly clad with feathers and exposed to inclement weather.

Young chicks that are allowed to run out in the early morning and become wet with cold dew, and chicks allowed to become wet with the cold spring rains and become chilled, are likely to suffer from congestion of the lungs and pneumonia.

A contraction of the blood vessels of the skin and periphera forces an abnormal amount of blood to the internal organs, and congestion is the result. Improper feeding and lack of exercise are also contributing factors. Birds having this ailment will be noted to be sleepy and stupid, and to breathe rapidly. In some cases the breathing is difficult. The comb becomes bluish and the bird may die because it cannot get enough air into the lungs (asphyxiation). Upon postmortem examination the lungs will be found engorged with blood.

The pressure of the blood in the engorged blood vessels of the lungs may close the smaller air passages which they surround, or may burst their thin walls and fill the bronchi with blood. In either case rapid asphyxiation occurs.

Treatment.—Congestion of the lungs runs an exceedingly rapid course, terminating in recovery,

pneumonia, or death. Treatment is impractical. The ailment should be prevented by good feeding and adequate protection from cold or wet weather.

Pneumonia—Inflammation of the Lungs

Bronchitis, described in the foregoing, often terminates in pneumonia (broncho-pneumonia). It has been the experience of the writer that broncho-pneumonia, following an attack of bronchitis, is the commonest form of the disease.

The causes of pneumonia are the same as the causes of colds and bronchitis, except that the exposure is often more severe. There is also a type of pneumonia mentioned under the discussion of internal parasites that is due to a mold—usually the *Aspergillus fumigatus*; the condition it produces is technically known as *aspergillosis*.

Symptoms.—There is an entire loss of appetite, with thirst and constipation. The bird stands with the head drawn in, drooping wings and ruffled feathers; breathing is rapid and painful, and there may or may not be coughing. There is usually a discharge of thick, adhesive mucus from the nostrils; the eyes may be inflamed and water freely. The bird has every appearance of severe illness.

Treatment.—Except in the case of birds of unusual value, treatment is wholly impractical, owing to the amount of care and nursing necessary and because of the doubtful outcome.

If treatment is undertaken, the birds should be warmly housed and the best of ventilation maintained. Spirits of camphor, 2 drops, and brandy, 10 drops, should be given hourly in a teaspoonful of warm milk; if the comb becomes dark, add digi-

talis, one drop of the fluid extract to the medication.

Autopsy.—Upon opening the bird that has died from pneumonia, the affected part of the lung will be found to be dark red, and when cut through it is liver-like in appearance and texture. Serum (yellowish fluid) and blood may exude from the surface.

Pneumomycosis — Aspergillosis

This disease is due to a fungus belonging to the genus *aspergillus*, an organism similar to the common green molds. The species that usually affects the lungs of birds is the *Aspergillus fumigatus*.

Symptoms.—The affected birds are sluggish and stay apart from the remainder of the flock; they sit about on the roosts, or in some corner; are very weak, and later become unable to stand. There is a loss of appetite; the feathers have an unkempt appearance; the wings are drooping and the eyes partially closed. The respiration is accelerated and there is a rattling of mucus in the trachea and bronchi. Fever is present, and there is ordinarily considerable thirst. The affected bird usually dies after a prolonged illness.

Postmortem Appearance.—Whitish or yellowish nodules, varying in size up to a pea, will be noted in the affected parts; which may be the trachea, bronchi, lungs and the various air sacs. The fungus may grow upon the surface of the mucous membranes forming, at first, a feltlike whitish mass which takes on color according to the species of the fungus as it fruits (forms spores). This membranous material, to the naked eye, resembles a fibropurulent exudate. The obstruc-

tion of the air sacs causes the difficult breathing and asphyxiation.

Inflammation is evident in the diseased areas. Sections through these areas of disease show the mycelia (thread-like branches of the mold) and the characteristic fruit (spores). Focal necrosis, preceded by cloudy swelling, is noted in the kidneys and other vital organs. A secondary invasion of pus-producing organisms may take place and on autopsy abscesses may be found in the liver, kidneys, spleen and other organs.

Treatment.—This is a difficult problem. Placing the affected birds in a close box and smoking them with tar has been advocated. Efforts should be made to eradicate the disease from the premises by cleaning and disinfecting them as for roup and other infectious diseases. (See pages 24 and 153.)

Swell-Head in Young Turkeys

The most characteristic symptoms of this ailment is swelling of certain parts of the head, especially in the region of the maxillary or infraorbital sinus, which becomes filled with a gelatinous, colorless substance. (For location of this sinus see Plate I, No. 31.)

These swellings may disappear in a few days or weeks or may remain for several months. In the latter instance the swelling may contain a cheesy material of foul odor, and in some cases cause death.

Treatment.—Open the swollen part and allow the morbid collection to drain out. In addition, use the same treatment as outlined under roup. (See page 153.)

Chickenpox—Contagious Epithelioma

This disease affects chickens, turkeys, pigeons and geese.

Cause.—Some investigators claim that it is due to an ultra-microscopic virus (germ) and that the same germ is also the cause of avian diphtheria, or roup. (An ultra-microscopic germ is one that will pass through the pores of porcelain filters and cannot be seen with the microscope or grown in visible quantities upon culture media.) There are just as many investigators who are certain that their results show that the germ causing these (pox and roup) are not the same, and that the infection one time will not produce roup and at another chickenpox (contagious epithelioma). Our experiments do not lead us to the conclusion that they are the same disease; that is, caused by the same germ.

In structure the nodules resemble an epithelioma, described under that heading in the section on tumors, and in that contagious chickenpox can be transmitted from an emulsion of the material of a pox nodule, by inoculating the face and comb of a healthy bird.

It has been proven that a maceration of the scrapings from the pox in physiological salt solution and injected subcutaneously, will render immunity against further inoculation of the disease by sacrifice and introduction of the virus in the face and comb.

One investigator has claimed that chickenpox is due to a protozoon (an animal parasite microscopic in size), but other investigators have failed to find this organism.

Symptoms.—The disease appears as small nodules, varying pin-point size up to the size of a pea,

or even much larger. It may be accompanied by roup; in fact, we have studied both diseases in the same flock, an occurrence which is not uncommon. The question naturally arises, are both due to filterable viruses (germs so small that they pass through porcelain filters, and too small to be seen through a microscope), and are both present in

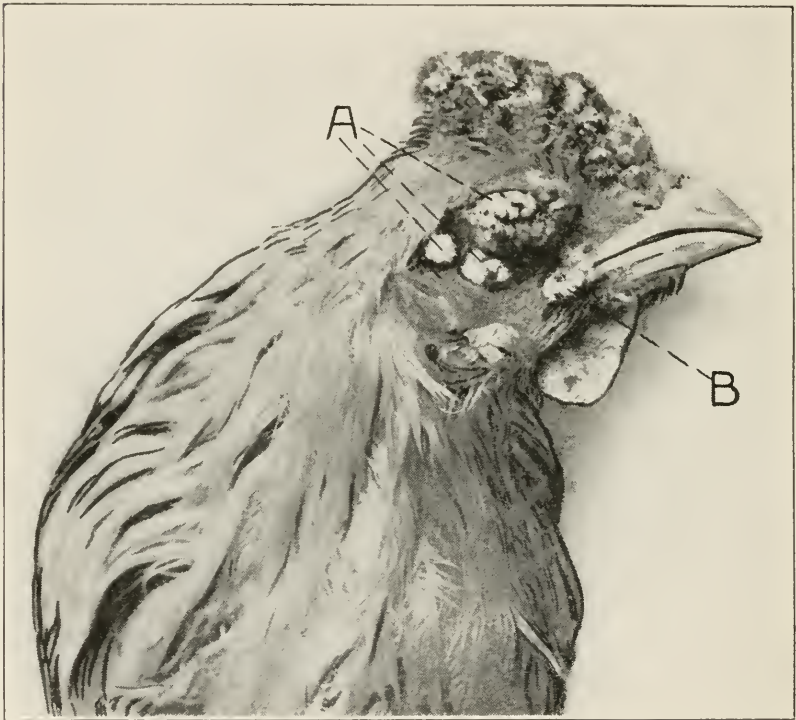


FIG. 46. CHICKEN POX
A, Epithelial, tumor-like nodules. B, an ulcer.

the same outbreak, or are both due to the same cause? At the present time there are conflicting reports by scientific men. Fig. 46 illustrates a case of this disease.

One investigator has reported that immunity against chickenpox does not confer immunity to roup.

Haring and Kofoid have shown that there is a specific antibody developed in birds affected with chickenpox. By

the use of the complementfixation method (a test similar to one used in the diagnosis of glanders) the blood from the diseased fowl exhibited fixation of the complement not shown by normal fowl blood. Thus showing that it is a specific germ disease. The antigen was prepared both from the tumors on the head and from the liver of birds sick of the disease.

Treatment.—The same sanitary regulations should be put into force as under fowl cholera. No birds should be sold from the flock while the disease exists among them. Cleaning of yards and houses and keeping them clean, as well as frequent disinfection, is essential. Antiseptics, as recommended under cholera, may be given in the feed and water. The head of the affected bird should be bathed in an antiseptic solution.

Roup—Diphtheric Roup—Swelled Head

The cause of this disease seems to be far from settled. European investigators have claimed it due to an ultra-microscopic germ (one so small it cannot be seen under the microscope). With a view of determining whether or not the type existing in Colorado is due to an ultra-microscopic organism, two sick hens were secured for experiment.

Report of Outbreak of Diphtheric Roup

These birds had swollen eyes with an accumulation of catarrhal or inflammatory product in the maxillary sinus (cavity below and in front of the eye) and a discharge from the nostrils of an offensive odor characteristic of roup. There were also the characteristic yellowish-white diphtheric membranes in the mouth. Material from all the lesions of both birds was made into a suspension with physiological salt solution and filtered through a Pasteur filter calculated to take out all germs that can be seen by aid of the microscope or grown on artificial media.

The fluid that passed through this filter was used in inoculating experimental birds. These birds were from flocks in which no roup had appeared. In all fifteen inoculations were made. Tubes of culture media were inoculated with the

filtrate and incubated seventy-two hours and no growth of germs occurred on any of the tubes; this shows that all visible germs were taken out. Smears of the filtrate were made and stained and an examination of these likewise gave negative results. In none of these inoculations did roup appear. So far as this one experiment goes, it appears that our type of roup is not due to an ultramicroscopic germ. This type of roup is quite contagious.

Marx produced a yellowish-diphtheritic membrane by injecting pox emulsion into the mucous membrane of the mouth and eye of a bird.

The report of the United States Bureau of Animal Industry for 1910 an account of the isolation of the *Bacillus necrophorus* from the ulcers in one outbreak (this is the germ that causes necrotic stomatitis in hogs and sheep, gangrenous dermatitis in horses, diphtheria in calves, and many other pathologic conditions in other animals), in another outbreak the *Bacillus avisepticus* (the germ of fowl cholera) was found, and in still another outbreak a *coccidium* appeared to be the cause. The *Bacillus pyocyaneus* has also been isolated by another investigator as has also a short, rod-shaped germ with rounded ends called the *Bacillus cacosmus*. It would thus appear that several germs play a more or less important part in the causation of roup. Other germs have been reported from time to time as having been associated with this disease, so that with the reports before us from scientific laboratories we cannot point, as yet, to any certain germ as the cause.

Mode of Spread.—This disease is spread by birds introduced into a flock from infected premises, and by exposure, as at poultry shows. A chronic type of the disease in one or more birds (carriers) in a flock may serve to infect others when they are weakened by predisposing causes, as by exposure to cold or dampness, or by roosting in a draught, or in badly ventilated buildings.

Symptoms.—There are three forms of the disease, that is, three forms of lesions. Any or all may be present in the same bird.

1. *The nasal type.*—This type is characterized at first by a thin, watery discharge with an offensive odor characteristic of roup. Later the catarrhal product becomes somewhat thicker (mucopurulent) and the nostrils become occluded (glued

slut), and quite frequently there is a bulging of the sinus (cavity) in front and below the eye. This is due to an accumulation of the inflammatory products in this sinus. Fig. 47 illustrates this common swelling.

2. *The diphtheric type.*—This type affects the mouth. This often accompanies the nasal form. Fig. 48 illustrates these diphtheric ulcerations, which are yellowish or yellowish-white in color.

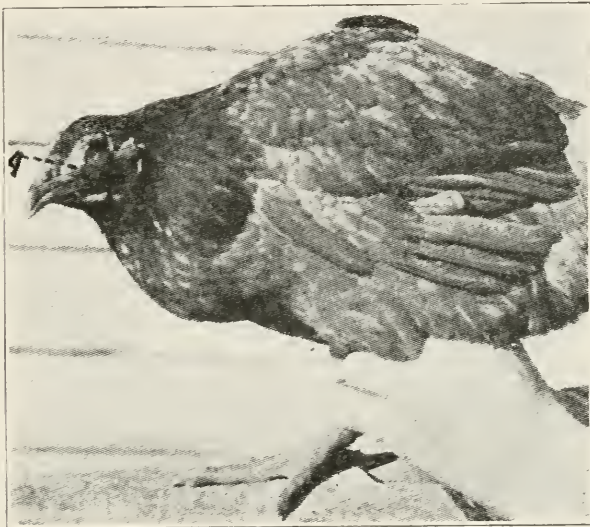


FIG. 47. ROUP IN A CHICKEN
A, Bulging of infraorbital or maxillary sinus.

From these necrosing patches the disease receives its name, avian diphtheria.

3. *The ocular type.*—In this form there is first noted an inflammation of the mucous membrane covering the anterior portion of the eyeball (conjunctivitis). As the disease progresses, the catarrhal product accumulates as a watery, clot-like mass, whitish in color. The eyelids stick together and hold the material as it accumulates, till the part bulges outward.

There is noted sneezing, shaking the head, and

expulsion of mucus. There is a loss of appetite, the bird appears weak, walks unsteadily, and becomes emaciated rapidly. At times breathing is difficult, and there is often a diarrhea.

Three stages then follow: catarrhal, characterized by a mucus, or muco-purulent, discharge; the diphtheric, affecting the mouth and throat and



FIG. 48. DIPHTHERIC ROUP IN A CHICKEN
 A, The yellowish-white diphtheric patches on upper surface of tongue and lower jaw (natural size).
 B, diphtheric patches on hard palate and upper jaw.

characterized by the formation of a membrane on the surface which may be followed later by sloughing (formation of a mass of dead tissue); and the conjunctival, affecting the eyes, and often causing a destruction of the eyeball.

Postmortem Appearance—The toxin (poison) from the areas of disease is very destructive, as

the rapid emaciation of the bird following a severe attack, shows. Upon examination of the membranes that have formed in the mouth, it will be found that when they are removed there is left a raw, granular appearing surface. Upon microscopic examination, cellular infiltration is seen, with a destruction of cells of the mucous membrane underlying the diphtheric patch. An examination of the maxillary (suborbital) sinus (see Plate I, No. 31) will reveal it to be filled with a purulent material, which is often cheesy-like in consistency. The wall over this part is very thin and can be easily opened with a knife.

A microscopic study of sections of the head, through the inflamed area (the mucous lining of the nasal passage) shows considerable thickening and an acute inflammation (invasion of *polymorphonuclear leukocytes*); at times the entire passage is "plugged" with the mucus.

On examination of the eye and mucous membrane surrounding the anterior portion of the eyeball, there may be seen a cloudy condition of the cornea, the anterior portion of the ball (*keratitis*). There is also an acute inflammation of the mucous membrane of the eye (acute conjunctivitis).

In cases studied in this laboratory it has been found that the acute inflammation extends to the iris and ciliary muscles and their surrounding structures.

Treatment.—Correct any bad sanitation or hygiene, which may be a predisposing cause. The henhouse should be well ventilated, but should allow no draughts on the birds, and should be kept clean and free from dampness. It should be cleaned and disinfected daily with some of the mixtures heretofore described and recommended

for this purpose. If the bird is not a valuable one, kill and cremate it, the head as well as the body.

Medicinal treatment differs, with the location of the lesion. For the ulcers, or diphtheric patches, in the mouth, nothing is better than burning with stick silver nitrate (lunar caustic). A solution cannot be used, as the fluid will run down and burn other parts of the mouth and throat.

With the thumb and finger press open the eyelids and with clean absorbent cotton remove the white catarrhal material, then apply the same remedy as for injection into the nostrils. The following has given good results in our experimental work and with those to whom we have recommended it:

Wash out the nasal passage with a twenty per cent solution of sodium bicarbonate (common baking soda), using a medicine dropper or, better, a small syringe, as the material must be forced so as to pass through the nasal passage into the mouth (refer to Plate I, Nos. 29 to 33, and to Fig. 50). Then inject, in like manner, peroxide of hydrogen. The soda dissolves and removes the mucus, and the peroxide of hydrogen cleans out the cavity. The parts should then be cleansed with essential oils, which may be applied directly to the inflamed mucous membranes. Inject a quantity of the following:

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Oil of thyme.....	1 dram
Oil of eucalyptus.....	20 drops
Oil of petrol.....	2 ounces

In aggravated cases, repeat this treatment three times a day. Give an abundance of clean water and soft, easily digested feed.

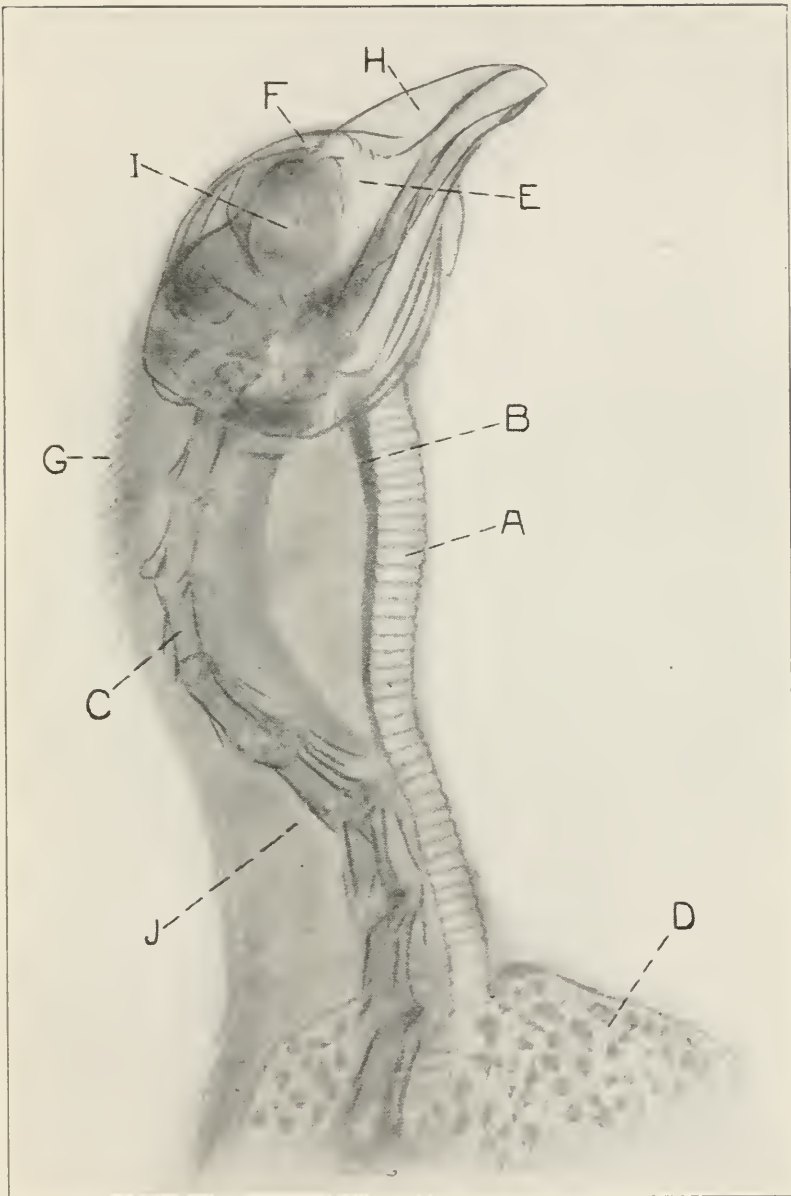


FIG. 49. SKIAGRAPH OF HEAD AND NECK OF CHICKEN
 A, Trachea. B, esophagus. C, vertebra. D, crop, filled with grains
 of wheat. E, infraorbital or maxillary sinus. F, frontal sinus.
 G, feathers. H, nostrils. I, eyes. J, musculature.

Conjunctivitis: Inflammation of the Eye

Most inflammations of the respiratory passages extend to and involve the eye structures also. These affections of the eye have been described under catarrh, roup, etc.

There are many causes of inflammation of the mucous membrane of the eye aside from the specific germs heretofore mentioned. A chick was brought to the laboratory with one eye very much swollen. Upon examination, there was found a piece of straw about one-fourth of an inch in length lodged in the conjunctival sac. Upon removal of this piece of straw, and the application of a one-per-cent solution of zinc sulphate, the inflammation subsided in the course of a day or two.

The number and variety of foreign bodies that may gain access to the eye structures and set up inflammation are numberless. In most cases their careful removal and washing the eye with a saturated solution of boracic acid or a solution of zinc sulphate and water, 1 to 100, is all the treatment that is required.

Similar washes are indicated for conjunctivitis due to injuries, spurring, picking blows, etc.

SECTION XII

Diseases of the Legs and Feet

Leg-Weakness

This is a condition in which the birds cannot bear their own weight, or have difficulty in doing so. It occurs in young as well as in old birds. Knowledge as to the causes of leg weakness, so common at times in certain localities, is imperfect. The conditions are being investigated, however, in several laboratories.

Causes.— Improperly heated brooders, too much bottom heat, damp and badly ventilated houses, heavy cockerels, kept constantly on wooden floors, are among the conditions which bring about leg weakness. In some cases it is probably a rheumatic condition, and there are some forms which no doubt are due to a lack of lime salts in the bones and other tissues.

Symptoms.—At times this disease appears suddenly, at other times it develops slowly. It may affect only one, or at most, a few birds, or it may affect many. There is unsteadiness in walking, and in badly affected cases the bird sits around much of the time. Finally it is unable to rise, and may even lie on its side.

Treatment.—Give one sixth-grain doses of strychnine sulphate, dissolved in water, three times a day; also two-grain doses of salicylate of soda in the same manner. Give one tablespoonful of castor oil in severe cases in adult chickens.

Have the quarters properly ventilated, clean, free from dampness, and supply the birds with good feed and water. If the cause be a lack of lime salts (*rachitis*), milk and lime water should be given freely.

Foot Abscesses

This condition is not rare in fowls. Fig. 49 shows an abscess due to a Russian thistle thorn having punctured the soft structures between the toes. A indicates the opening, through which a cheesy pus was removed by the aid of a curette (pus scoop). No treatment other than liberation of the pus is ordinarily required.

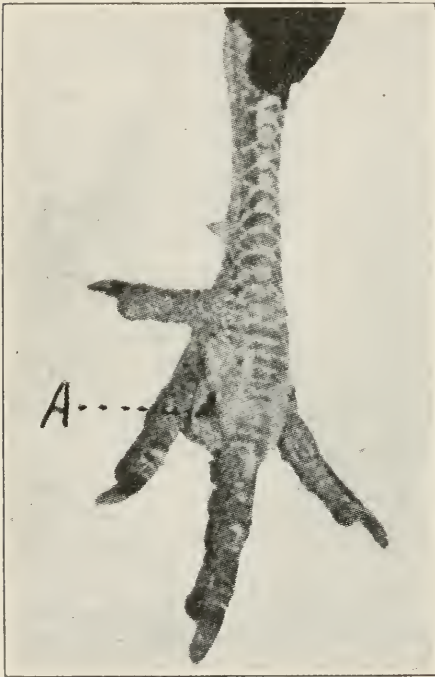


FIG. 50. THORN ABSCESS
A, Opening through which cheesy pus was liberated.

Bumble Foot

This condition is similar to the foregoing. Birds often receive a "stone bruise" on the soft structures of the bottom of the foot; a thick or cheesy pus accumulates, producing the condition known as bumble foot. The pus should be allowed to escape by opening the abscess and scraping it out. Place the bird in a clean, dry place, preferably on straw, so as to keep dirt out of the sore; wash out with a weak solution of carbolic acid.

Bumble foot is usually caused by jumping from high roosts onto hard floors. The roost should be lowered, to obviate further trouble from this source.

Gout

Hutyra and Marek describe a gout affecting the feet of birds. This condition is evidently rare.

SECTION XIII

Diseases of the Brain

Dizziness—Vertigo

Affections of the brain are comparatively rare in birds. Vertigo has been known where the brain is congested, especially in very fat, plethoric birds. Excessive heat in hot summer weather; absorption of poisonous substances (toxins) from the intestinal tract; irritation due to intestinal worms; injury to the head, as by a blow, etc., are the chief causes of dizziness in birds.

Symptoms.—The bird throws its head upward, backward, and to one side. It may walk sideways or backward, and have an unsteady walk—staggery. The bird may be drowsy, and even have epileptiform symptoms.

Treatment.—Place the affected bird in cool, well ventilated, comfortable quarters, free from drafts, and give thirty grains of Epsom salt, dissolved in warm water. Give also two-grain doses strontium bromide every hour. Thorough purging is one of the first essentials.

In case of limber neck (due to eating rotten meat) and prostration, give one-fifth grain strychnine three times a day. (See page 102.)

Hemorrhage of the Brain

This condition is technically called apoplexy. It may be due to over-straining, as in egg-laying, in very fat birds. Injury to the head and over-stimulating food are also causes.

Symptoms.—The hen may be found dead on the nest. The symptoms are of short duration: the attack comes on suddenly, as the hemorrhage soon presses on the brain structures so that the function of that part stops and the animal is seen to stagger, fall, and die immediately.

Postmortem Findings.—Upon opening the brain cavity and examining the brain, there will be found hemorrhages (clots) in the brain substance.

SECTION XIV

Bacteria of the Intestinal Tract of Chickens

The bacterial flora of the intestinal tract of birds has been receiving considerable study during recent years. The alimentary tract of man and animals contains many millions of bacteria, of many varieties. Many of these are constantly present and constitute what is known as the normal intestinal flora. In the newly-born child or animal the intestinal tract is sterile, that is, it contains no germs, but as soon as it partakes of food and water the intestines are seeded and ever after contain bacteria in large numbers. The same can be said of the chick.

Some of these germs are not harmful, but give off ferments similar to the cells of the accessory glands of digestion; these ferments may aid in splitting up foodstuffs and in preparing it for absorption. Ferments of this kind have been called organized ferments, but we have now learned that such ferments do not in any way differ in action from those secreted by the stomach, pancreas or intestinal glands. It is their ferments, and not the germs themselves, that cause the splitting up of the food nutrients.

Some of the bacteria are at times injurious, and often times pathogenic organisms (disease germs) gain access to the intestinal tract and may produce disease, if the bird is susceptible. There are also, at times, protozoa present, especially those belonging to the coccidia group.

The following germs have been found as normal inhabitants of the duodenum, or first portion of the intestines, of birds:

Bacillus mesentericus, *Bacillus subtilis*, *Bacillus ramosus*, *Bacillus cereus*, *Bacillus asterosporus*, *Bacillus fusiformis*, *Bacillus coli communis*, *Streptococcus lacticus*, *Bacillus lactis aerogenes*, *Bacillus prodigiosus*, *Sarcina aurantiaca*, *Sarcina lutea*, *Sarcina ventriculus*, *Clathrodrix asteroides*, *Micrococcus rosettaceus*, brown, white, and green molds, coral and white yeasts, *Micrococcus roseus* and *Clamydothrix ferrugenes*.

In the third portion of the intestines, or ileum, may be found green and white molds, *Cladothrix asteroides*, *Bacillus cloacæ*, *Bacillus ramosus*, *Sarcina lutea* and *Sarcina aurantiaca*, *Staphylococcus pyogenes albus* and *citreus*, *Staphylococcus cereus albus*, *Bacillus fluorescens liquefaciens*, *Micrococcus asterosporus*, *Streptococcus lacticus*, *Bacillus lactis aerogenes*, *Bacillus coli communis*, *Bacillus prodigiosus*, *Bacillus mesentericus*, *Bacillus cereus*, *Bacillus megatherium*, *Bacillus fusiformis*, *Bacillus subtilis*.

Practically the same microorganisms are to be found in the cecum. The same may be said of the cloaca, with possibly the addition of the *Bacillus aerogenes capsulatus* and *Staphylococcus pyogenes aureus*.

It must be remembered that the intestinal flora is probably not the same for all birds, as different surroundings or environment, different sources of food, as well as different food and water, play a part in carrying germs to the intestinal tract.

SECTION XV

The Egg

Composition

An average-sized hen egg weighs about two ounces, of which eleven per cent is shell, thirty-two per cent yolk, and fifty-seven per cent white. The principal chemical constituents of the egg are as follows: Ash (mineral matter) nine per cent; fat (hydrocarbon) nine and three-tenths per cent; proteids (nitrogenous matter) eleven and nine-tenths per cent; and water, sixty-five and five-tenths per cent.

Animal Parasites in Eggs

Reports have been made that worms have been found in eggs. The author has not had the good fortune to examine any of these worms for the purpose of classification, but it is probable that the *Ascaris inflexa* or *Heterakis papillosa* and other round worms, normally inhabiting the intestines, may find their way up the egg canal and be incorporated with the egg as it is formed. By referring to Plate I, it will be seen that a live worm, possessing power of movement as these worms do, passing into the cloaca (16) from the rectum (15) can pass up the egg canal (23) and thus be incorporated in the albumen of the egg, as it is formed around the yolk. These conditions are rare.

Bacteria of Eggs

Several investigators have, of recent years, devoted much time to the investigation of the bac-

terial flora of eggs. It is needless to say that all understand that the spoiling of eggs is due to the multiplication of bacteria in them, when the egg is brought under proper temperature. The cold storage of eggs holds them under conditions unfavorable for the rapid growth of these bacteria. When eggs are kept cold the bacteria within them are in a more or less dormant state and hence by reason of this retardation of germ growth the eggs keep longer.

Eggs can be successfully desiccated (dried) and such powdered product is on the market. The moisture in it is so reduced that germs do not grow and, like any other dried product, it keeps well. This desiccated product retains the qualities of the fresh egg for a long time. One pound represents about three and one-half pounds of raw egg or an amount obtained from thirty eggs. The egg contains considerable fat and because of this the dried product gradually undergoes a change at warm temperatures, much as butter does, finally giving off a rancid fishlike odor.

It is not probable that the yolk or ovum becomes infected while it is being formed in the ovary, unless the ovary, from which it develops, be diseased. It has been shown that birds that have had white diarrhea while chicks and recovered, grown to maturity, and commenced laying, have diseased ovaries, ovaries which harbor the *Bacterium pullorum*, the cause, or at least one of the causes, of white diarrhea, and this germ is incorporated within the yolk of the egg. Chicks which hatch from such infected eggs develop white diarrhea soon after hatching. This is an important means of spreading this disease and one before which sanitation is powerless.

Ordinarily the internal organs, as the ovaries, kidneys, spleen, etc., are sterile unless diseased, as just stated. However, Conradi maintains that he has found bacteria in these supposedly sterile organs in seventy-two cases out of one-hundred-sixty-two.

The germs that have been alluded to under intestinal flora of chickens can easily find their way into the cloaca and up the oviduct, as illustrated in Plate I. The yolk or ovum when fully developed in the ovary is delivered, in a similar manner, as in higher animal life, into the first portion of the oviduct (uterus), which at its free extremity is rather funnel shaped and is called the *ostium infundibulum*. This egg canal which can be likened to the uterus of higher animals is about eighteen to twenty inches long and is lined with tubular glands which secrete the albumen, and in the posterior portion the shell. This material is formed from foods carried by the blood, which is very abundant in these walls. As the egg traverses the cloaca in being passed out (layed) it is exposed to contamination by microorganisms which may be taken up into the oviduct with the male element (spermatozoa) after copulation. Bacteria are not so common in non-fertilized eggs as they are in fertilized eggs, a fact that supports this theory.

Many of the organisms (germs) found in eggs are nonmotile, so that they must find their way up this canal by extension by growth or be carried mechanically. Among the bacteria that have been found in eggs are: *Micrococcus nonliquefaciens*, *Staphylococcus pyogenes aureus* and *albus*, *Bacillus prodigiosus*, *Bacillus violaceus*, *Bacillus putridis*, *Bacillus mesentericus*, *Bacillus*

fecalis alcaligenes, Bacillus putridus nonliquefaciens, Streptococci, Micrococcus leteus, Micrococcus candicans, Micrococcus flavus tardigradus.

The colon bacillus is ever present in the intestinal tract of chickens and is found on the outer shell, yet contamination of the egg content by it does not occur. This has led some to think that there may be a substance present in the egg canal bactericidal for this germ and the matter is being investigated at present.

Poppe claims that among those germs which find their way through the pores of the egg shell after it is layed is the *Bacillus paratyphosis*, the cause of paratyphoid in man.

SECTION XVI

Isolation of Non-Layers

The problem of isolation of non-laying hens, the hens that are not in the earning class, is a perplexing problem to the poultryman. Books have been written and column after column published in the various poultry journals on this subject. Only a thought or two will be given here.

There are three plausible methods: 1. The X-ray. 2. The public-bone examination, and 3, the trap nest plan.

The X-Ray

During the past three years the author has experimented with several X-Ray machines, in an effort to determine whether such examinations are feasible. Fig. 51 shows a skiagraph of a laying hen. B shows the shadow of an egg fully developed and lying in the posterior portion of the oviduct. It is ready to be laid. A shows the active ovary. It is located just back of the ribs (thorax, see plate I).

It is questionable whether the time required to become experienced enough to be proficient in such examination will pay, besides the X-Ray machine cannot be handled carelessly, as too much exposure of the hands and other parts of the body causes the so-called X-Ray skin disease.

Pubic-Bone Examination

Two small, slender, flat, narrow bones extend down backwards from the flat shell-like portion of the back (pelvis). These are the pubic

bones of the chicken and are attached by ligaments to the other bones of the pelvis from which they extend. The exact location of these bones in a laying hen are illustrated in a skiagraph, Fig. 52. By a little practice these bones can be located. In non-laying hens these bones are found close together, so that perhaps only one finger can be introduced between them. As the hen begins to

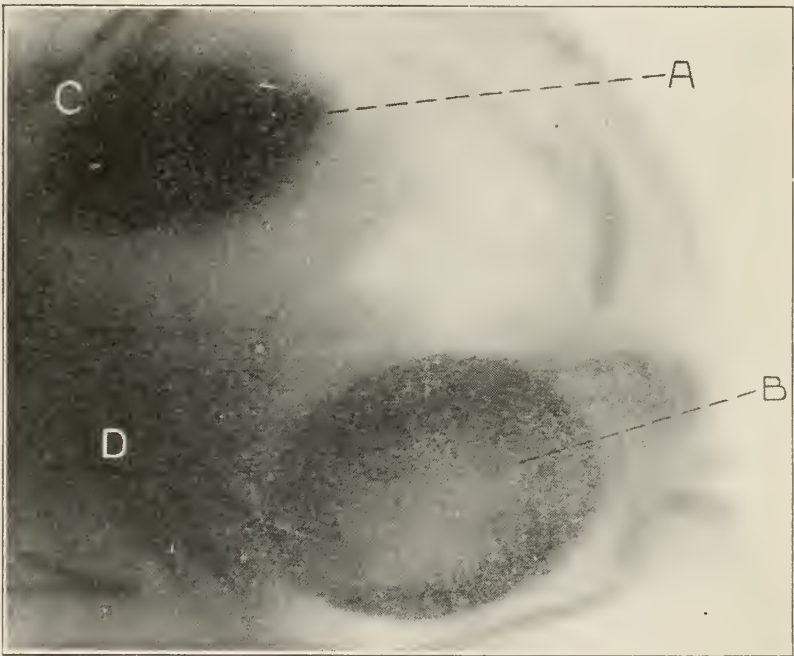


FIG. 51. SKIAGRAPH OF POSTERIOR PART OF ABDOMEN OF A HEN
 A, Functionating (active) ovary. B, egg in posterior part of egg canal (fully developed). C, femur (thigh bone). D, tibia (leg bone).

enter a laying period they become more widely separated, until instead of being only a finger's breadth apart, two, three and at times even four fingers can be forced between them. As the laying period comes on the ligaments relax and allow the necessary separation to permit the passage of the egg. It will be noted, also by referring to Plate I, that the ovary lies against the backbone

(vertebra) and just back of the ribs (thorax); that the tortuous oviduct or egg canal in which the egg develops lies close to the back. This means when a laying period is on more room is needed by the ovarian mass, as well as by the active oviduct. Consequently the abdominal organs settle more to the bottom of the cavity and the shape of the body of the bird changes. A



FIG. 52. SKIAGRAPH OF NORMAL HEN
A, Pubic bones. B, femur (pulled back). The distance between the pubic bones indicates whether or not the bird is laying.

laying hen is a good feeder. Out early in the morning, late to go to roost, red comb, always hunting bugs and other food, singing, happily disposed and usually has a full crop. The non-layer does not brave the storm and rain, goes to the roost early, leaves it late in the morning, is a poor feeder and not happily disposed—a sort of drone.

Trap Nest

Fig. 53 illustrates the trap nest. The birds are placed in one yard, the nest arranged between the two and the rooster placed in the second. A hen going into the nest tilts the trap so that there is only one yard for her to go in after she is through laying and that is the one in which the rooster is found. After she leaves the nest the

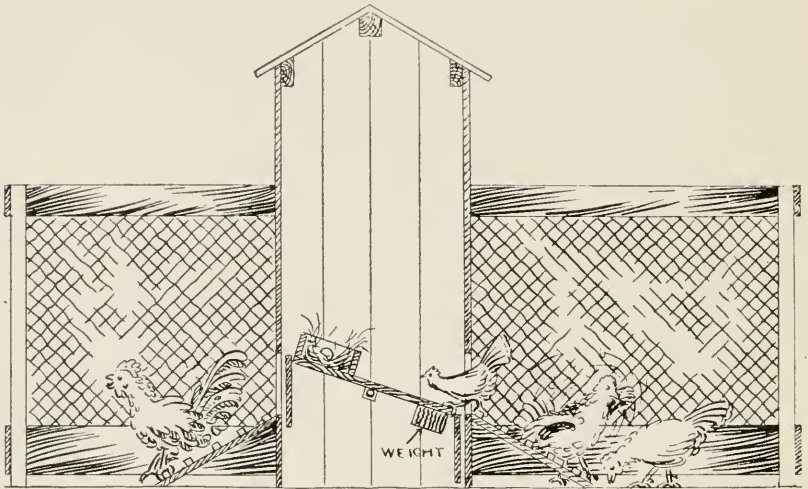


FIG. 53. TRAP NEST

The hens are confined in one pen and the cockerel in another, separated from the first by a small building, in which the nests are placed. When a hen gets on the nest her weight causes the weight shown to rise and close the entrance. When she leaves the nest she goes through the exit, which is open while the nest is lowered, into the pen with the cockerel. Relieved of the weight of the hen, the nest rises, closing the exit and again opening the entrance to the building.

weight on the trap again opens the nest to the first yard. A criticism has been raised that a hen goes on a nest often times when she does not want to lay and is a non-layer. Perhaps she does, but, notwithstanding, I have seen excellent results obtained by this method.

Non-laying may be due to old age or disease of the ovary or other of the egg-developing organs, but is much oftener due to improper feeding

or lack of exercise. Of course it is understood that hens normally have a longer or shorter period of rest between egg-laying seasons.

Trap Nest That Stays in Order

The Storrs Station (Connecticut) describes the trap nest, illustrated by the accompanying drawing, as "one that stays in order."

The upper figure in perspective shows five nests arranged side by side. By making the nests in a series considerable lumber is saved. Swinging

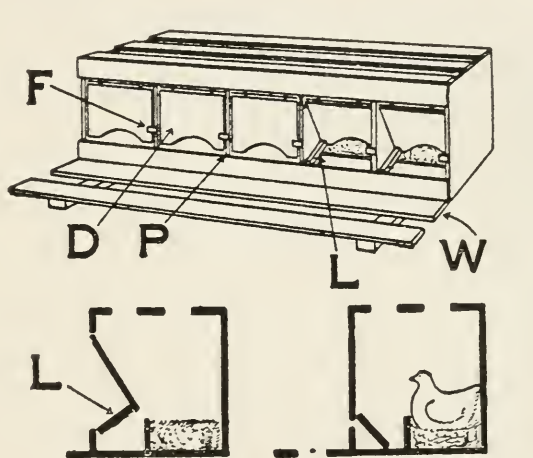


Fig. 54

doors (D) are fastened to a rod running the entire length of the box. Stops (F) prevent the doors from swinging outward. L is a lever pivoted to the partition (P) so that one arm is about five times as long as the other. The lower cross-section sketches show how the lever and door are arranged.

To enter the nest the hen flies onto the walk (W) and crowds under the door (D) which is partly open. In so doing, she lifts the door slightly, and the long end of the lever (L) falls, being heavier than the short end. The door

swings shut passing over the pivot and the shorter end of the lever. When the door is shut the lower end of the lever rests on the floor of the nest, and the short end acts as a stop on the inside, preventing another hen from crowding into the nest. When the egg is gathered the trap nest is set again by raising the long end of the lever and propping back the door. The two right-hand nests in the upper sketch show the position of the doors and levers before the hen enters. The other nests show the traps closed.

SECTION XVII

Malformations

Malformations among birds are occasionally observed. A complete discussion of the dozens of various forms of malformations that may be found cannot be given here for lack of space, but a few facts will be given.

In higher animal life, including man, malformations have been attributed to the following causes:

External mechanical influences, such as falls, blows, or severe shock of any kind, by affecting the general health of the pregnant female, may have power to arrest, retard, or otherwise disturb the normal development of the embryo or fetus.

If the above should hold true in the human or even animals, obviously it cannot do so for birds.

The so-called spontaneous amputation, in utero, by a coil of the umbilical cord finding its way around a part of the fetus and causing pressure and amputation, cannot hold with chickens nor will acute and chronic placentitis, causing adhesions, hardly hold for birds.

The percentage of malformations in the human family is one to three or four thousand births; in the lower animals and birds the percentage is much smaller.

During the formation of the fetus an *arrest of development* of the bud which forms the wing may result in a malformed wing; the same can be said of any other part, as the leg, beak, etc.

If the *arrangement of the groups of cells*

during development does not follow the normal type, then malformations, as atresia, imperforate anus, or other natural openings may result; abnormal position of viscera, a failure of the closure of the abdominal or thoracic plates may take place.

The germ or embryo is first developed as a manifold membraneous expansion, the free mar-

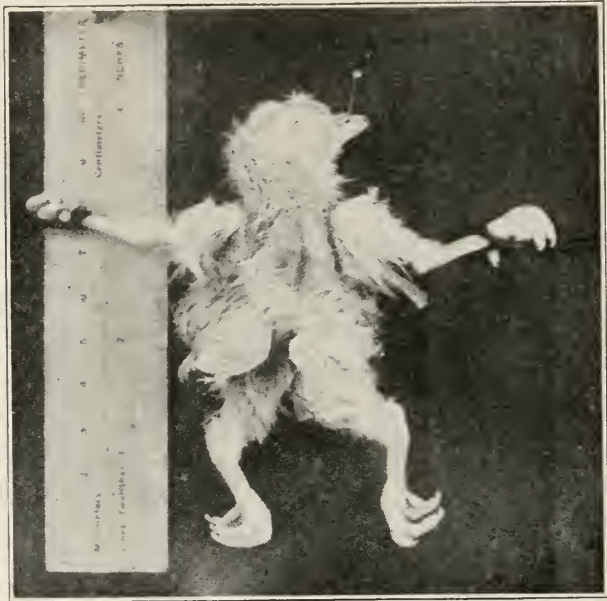


FIG. 55. MONSTER CHICK (dipygus tetrabrachium)
Showing two bodies, four legs, four wings and
one head.

gins of which incline towards each other, and eventually meet to form two cavities. A *failure to meet* results in malformation. *Fusion of parts* may also take place.

Those malformations in which there are super-numerary parts or duplications of almost an entire body are sometimes called composite or compound malformations and monsters.

Hermaphroditism is a complete duplication of both male and female genital organs; i. e., a single individual possessing

both male and female genital organs. Pseudo-hermaphroditism is a condition in which the duplication is only partial. It is desirable that more scientific observations be made along these lines, in birds, and recorded.

The double-yolked eggs, in cases where two ova have been delivered into the oviduct at the same time, and both being surrounded by albumen and finally one shell, have been supposed to produce double monsters, but there is a scientific record in which eighty such eggs were incubated (all from the domestic fowl) and in each separate twins were produced, in some both males, in others females, and in others one of each sex. In one case out of the eighty one yolk developed a single chick and the other a double monster.

Thompson made a study of a double embryo in the egg of a goose, which had been incubated five days. This study showed a double primitive trace is actually formed on a single blastodermic membrane proceeding a single vitellus and vitelline membrane. This same work has been corroborated by others so fortunate as to find these monstrosities in early stages of development.

Compound monsters proceed from single germs which have subsequently undergone different degrees of dichotomy. They are

governed in their development by certain fixed and invariable laws among which are unity of sex, homologous fusion and bilateral symmetry. In each case there is single sexuality.

The various forms of duplex development are determined by the extent to which the primitive trace is cleft, and also by the limitations of the dichotomy to the cephalic or caudal extremity of the neural axis. Either or both extremities may become bifid. The cephalic or head extremity may become bifid alone and a double head, or still further bifid and the posterior extremities single or the posterior extremity become bifid and the anterior single.

Figs. 55 and 56 illustrates a duplication of the legs. The rudimentary legs are perfect, but not so well developed as the other two. This is *polymelus*.



FIG. 56. POLYMELUS (natural size)
A, The two supernumerary legs.

SECTION XVIII

Fractures—Wounds—Anesthesia

Fractures

Fractures or broken bones among birds in the poultry yards are of rather common occurrence, especially where birds are allowed the run of the farm or ranch, as is the usual custom.

Fractures of the legs below the thigh are easily set and with good results. The materials needed for this procedure are glue, a strip of muslin from one-fourth to one-half inch wide and from one to two feet in length, and in case of large birds, narrow strips of stiff pasteboard or small pieces of wood, as tooth picks or matches.

Warm the glue and smear a light coat of glue over the leg for some distance above and below the fracture (break in the bone), adjust the broken bone and apply one layer of tape, then a thin layer of glue, then tape and so on until sufficient has been applied to hold the broken parts firmly. In the case of large bones, as in adult birds, the splints should be placed in the glue between the layers of tape. Too much glue between the layers should be avoided, as it does not dry readily. Adhesive tape cut in narrow strips has given good results also.

The repair of broken bones in birds takes place rapidly. In the course of two to three weeks, depending on the age of the bird and size of the bone, the cast may be removed. To do this, where

glue has been used, wet until the cast has become thoroughly soaked with warm water and remove. The adhesive tape can be easily removed from the leg.

Wounds

Birds possess a high immunity to pyogenic infection (the germs that ordinarily infect the wounds of animals); and wounds, whether accidental or surgical, unless very serious, heal with great rapidity. The degree of tolerance of infection that the peritoneum (lining of the abdominal cavity and covering of the abdominal organs) of birds possesses is probably not equalled by the peritoneum of any domestic animal or of man. For example, birds rarely die from infection after caponizing. Death when it occurs as a result of this operation is ordinarily due to hemorrhage. Man and animals (except the dog) survive abdominal operations only when made under aseptic precautions.

Anesthesia

Unlike their reaction to infection, birds are far more liable to die from the effects of anesthetics than animals or man. The relatively large surface of the air cells of the lungs and of the air sacs, and the high temperature and active metabolism render them peculiarly susceptible to anesthetics and very liable to die from their use.

R. Pearl and Frank M. Surface in an article in the *Journal of the American Medical Association*, volume 52, pp. 382 and 383, report satisfactory results in anesthetizing birds by the following method:

Immediately before beginning the administration of the anesthetic a 1-200 grain atropine sul-

phate tablet is dissolved in 1 cc. of warm normal saline solution. The salt solution with the dissolved atropine is then injected subcutaneously in the axilla. Ether is used as the anesthetic. It is administered from a small improvised mask which admits of the condition of the comb being seen during the operation. Depending on how hard the ether is pushed, the bird is ready for operation in from fifteen to twenty minutes after the anesthesia is begun.

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