INTERNAL PARASITES of POULTRY
AND COMMON INTERMEDIATE HOSTS
•• WITH DIRECTIONS FOR PARASITE ERADICATION AND CONTROL ••

Circular 469
UNIVERSITY OF ILLINOIS • COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION AND EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS
ACKNOWLEDGMENT

THE information in this circular has been compiled with the help of many persons. For lists of intermediate hosts and suggestions with reference thereto, the authors are indebted to Dr. Maurice Hall, Chief, and Miss Eloise B. Cram, Zoologist, of the Zoological Division of the Bureau of Animal Industry, U. S. Department of Agriculture. For loan of cuts, photographs, and original specimens of intermediate hosts, they are indebted to Professor W. P. Hayes, Department of Entomology, University of Illinois, and to Professor W. P. Flint, Chief Entomologist, Agricultural Experiment Station and Illinois State Natural History Survey. For aid in the identification of intermediate hosts and the determination of their presence in Illinois, they are indebted to Professor H. J. VanCleave and Professor Emeritus Frank Smith, Department of Zoology, University of Illinois; to Mr. F. C. Baker, Curator of the Museum of Natural History, University of Illinois; and to Dr. H. H. Ross, Systematic Entomologist, Illinois State Natural History Survey.

Sources to which the authors are indebted for illustrations are specifically stated below such illustrations. The literature drawn upon is included in the references on page 50.

For the drawings of intermediate hosts on the cover the authors are indebted to Dr. C. O. Mohr, Assistant Entomologist of the Illinois State Natural History Survey.
CONTENTS

INTRODUCTION ................................................................. 5

FLATWORMS ................................................................. 9

FLUKES ........................................................................... 9

TAPEWORMS ..................................................................... 11

General Characteristics .................................................. 11

Most Common Kinds of Tapeworms .................................. 12

Symptoms of Tapeworm Infestation ................................. 16

Prevention and Treatment ............................................... 17

ROUNDWORMS ................................................................ 18

LARGE ROUNDWORM ....................................................... 18

SMALL ROUNDWORMS ...................................................... 22

COMMON CECAL WORM .................................................... 23

GAPEWORM ..................................................................... 25

GIZZARD WORM ............................................................... 27

MASON'S EYE WORM ......................................................... 28

GLANDULAR STOMACH WORM .......................................... 29

CONTROL AND PREVENTION ............................................ 31

ADDENDUM

INTRODUCTORY NOTE ...................................................... 37

OUTLINE OF PRIMARY AND INTERMEDIATE HOSTS ............ 38

INTERMEDIATE HOSTS (Illustrations) ............................... 44

REFERENCES ..................................................................... 50

INDEX TO PARASITES ....................................................... 51

Urbana, Illinois

Printed in furtherance of the Agricultural Extension Act approved by Congress
May 8, 1914. H. W. Mumford, Director, Extension Service in Agriculture and Home Economics, University of Illinois

March, 1937
INTERNAL PARASITES are the most widespread cause of poultry maladies in Illinois and probably one of the most important factors in reducing poultry profits. They not only lower the vitality of fowls and reduce egg and meat production, but they increase susceptibility to bacterial and protozoan diseases and serve as mechanical carriers for these and other diseases.

SANITARY MANAGEMENT is the most effective weapon against these flock enemies. On heavily infested farms these parasites may never be completely exterminated, but clean houses, clean ranges, pure water, and clean, properly balanced rations are essential in preventing their spread.

WORM REMEDIES do not take the place of sanitary management, despite frequent claims to the contrary. Medicines properly selected and administered may expel part of the worms in the intestinal tract, but if treated fowls are allowed access to infested quarters, reinfestation promptly follows. Medicines of unproved value, or of known merit but improperly administered, often give owners a false sense of security. Improper treatment, such as overdosing, may be injurious or even fatal.

Sanitation Is the Best Remedy
Internal Parasites of Poultry

By ROBERT GRAHAM, J. P. TORREY, J. D. MIZELLE, and VIOLA M. MICHAEL*

THE MOST EXPENSIVE poultry houses, ventilation systems, equipment, and breeding stock cannot assure freedom from internal parasites. Such investments may in fact be a total loss unless proper management methods are followed. Since internal parasites of poultry develop from microscopic eggs in the droppings of infested fowls, effective control measures consist of preventing fecal contamination of feed and water and minimizing ground, house, and intermediate-host contamination by proper management.

Under farm conditions the presence of internal parasites may best be prevented or reduced by frequent cleaning of houses, by frequent removal of poultry to fresh ground, and by prompt removal of all sick fowls. In fact illness of any character should be a warning to the flock owner to check and improve his methods of management, while the cause and nature of the malady should be promptly determined by autopsy of typically sick fowls. Veterinarians equipped by training and experience have rendered valuable service in the diagnosis of different diseases of poultry and have guided many Illinois flock owners in the suppression and control of internal parasites of poultry.

The presence of internal parasites in fowls, as demonstrated at autopsy, is proof that the premises are infested with worm eggs and that faulty management practices have been employed. Each infested flock and premise, however, presents a separate problem or group of problems which must be met in different ways according to the conditions encountered. On some premises, old ground, unclean houses, contaminated feed, or a combination of different management factors may be at fault. A correct diagnosis of the type of parasitism, accompanied by a survey of the premises to note the extent of the practical predisposing cause or causes, is the first step in their correction.

Prevalence in Illinois.—During recent years there has been a noticeable increase in the number of Illinois farm flocks which have

*Robert Graham, Chief in Animal Pathology and Hygiene; J. P. Torrey, formerly Assistant Animal Pathologist, and J. D. Mizelle, Assistant Animal Parasitologist, State Department of Agriculture, assigned to the Laboratory of Animal Pathology and Hygiene, University of Illinois, to assist in diagnostic work; and Viola M. Michael, formerly First Assistant in Animal Pathology.
The increasing prevalence of internal parasites in sick poultry received by the diagnostic laboratories at the College of Agriculture, University of Illinois, gives warning to flock owners that better control measures must be applied. Records on 8,568 fowls received in 1929-1934 furnish the data for the above graph.

August, September, and October are the high points of parasitic infestation, according to autopsy records of the University of Illinois for 1929-1934. This seasonal incidence may be correlated with the greater susceptibility of young chickens to internal parasites as compared with the susceptibility of mature fowls.
FIG. 2.—Distribution of Diseases and Parasitic Infestations in 6,800 Autopsy Specimens of Poultry

In 6,800 birds submitted from farm flocks for autopsy examination during the four years July 1, 1931, to June 30, 1935, 7,951 disease entities were found. More than one-third (34.4 percent) were primary or secondary infestations with internal parasites.

FIG. 2a.—Distribution of More than 2,700 Parasitic Infestations in 6,800 Autopsy Specimens of Poultry

Almost half the infestations were tapeworms, more than one-fourth were ascarids, and about one-sixth were species of Capillaria. Thus almost 20 percent of the poultry-disease problem in Illinois, as observed on the autopsy table, is traceable to tapeworm infestations.

been found infested with internal poultry parasites. In some localities internal parasites of poultry are so prevalent that farmers and flock owners believe that it is impossible to raise poultry "free from worms." Partial support of this contention is supplied by autopsy records at the University of Illinois Laboratory of Animal Pathology and Hygiene. During recent years the incidence of this type of parasitism in autopsied fowls has increased from 21 percent annually to 32 percent (Fig.
1). Since autopsies during this period were made in order to determine the primary cause of illness or death in different flocks throughout the state, not all specimens were examined for the presence of parasites. It therefore seems reasonable to assume that the percentage of infested fowls determined by routine laboratory examination may not fully represent the percentage actually existing in Illinois farm flocks.

Later data, shown graphically in Figs. 2 and 2a, further emphasize the seriousness of the internal-parasite problem in Illinois flocks.

**Injury From Internal Parasites.**—By producing toxins, absorbing nutrients, and irritating the intestinal tract, parasitic worms not only devitalize fowls and cause a decrease in egg and meat production, but they also lower the resistance of fowls to bacterial, filterable-virus and protozoan diseases and may serve also as mechanical carriers for these diseases. Un thriftiness, lowered egg yield, and even death may result from internal parasites any time of year, but the heaviest losses from un thriftiness and death associated with internal parasites occur in August and September (Fig. 1a). On many farms, however, chronic parasitism in mature fowls may cause greater losses in feed, egg yield, and meat than that incurred by death in young stock.

The increase in un thriftiness and death losses in young stock in the late summer may be due to the fact that young fowls are more susceptible to the effects of parasites than are mature fowls, and in August and September the young stock on many farms is moved from ranges that are relatively free from the eggs of internal parasites to ground that has been infested with parasites by long usage.

**Internal Parasites Survive in Soil.**—Probably no single factor contributes as much to the development of parasites in the average farm flock as does the continuous use of the same ground year after year. Unclean and overcrowded houses without board or concrete floors or dropping boards, insanitary feed and water containers, poorly drained worm-infested ground, all promote the development and spread of internal parasites; while the purchase of infested, although apparently healthy, breeding stock may introduce parasites as well as contagious bacterial, protozoan, or filterable virus diseases.

The persistence of worm eggs and larvae in the top soil of the poultry range, although influenced by many factors, is especially favored on many Illinois farms by an abundance of organic matter and moisture in the soil. On such farms vigorous methods are necessary to prevent and suppress these parasites.
How to Detect Internal Parasites.—Symptoms of un thriftiness, anemia ("watery blood" manifested by paleness of comb), weakness, lowered egg yield, and loss of weight are suggestive but not absolute evidence of internal parasites. Until an autopsy examination has been made, one cannot be certain of the nature of a malady characterized by un thriftiness.

For autopsy purposes several typically affected fowls should be taken to a qualified veterinarian. Autopsy on a single fowl may not disclose the entire nature of the malady, and accurate knowledge of the nature of a disease is necessary for effective treatment and prevention.

The carcasses of fowls that die or are killed for autopsy purposes should be burned. Sick fowls that have been isolated for observation and then apparently recover should never be returned to the flock.

Two General Classes of Internal Parasites.—Poultry may suffer from internal parasites of various types. The parasitic worms that may infest poultry on Illinois farms are of two general classes: FLATWORMS (flukes and tapeworms), and ROUNDWORMS (ascarids, capillarids, gapeworms, etc.)

FLATWORMS
FLUKES

Description.—Flukes (trematodes) are small, flat worms, usually oval in outline and unsegmented. They more or less resemble a leaf in shape. At present they are not of common occurrence in domestic fowls in Illinois, but they should be kept in mind as of possible importance in the future, particularly in localities where the land is low and where there are lakes and marshes.

The genus Prosthogonimus, of which several species are found in chickens, has a relatively broad, flattened body, the greatest width of which is considerably behind the middle. Two species are known to occur in the United States. The most common, P. macrorchis Macy, is somewhat red in color, \( \frac{1}{4} \) to \( \frac{3}{4} \) inch long, and usually occurs in the cloacal region tho it may invade the oviduct and ovary and cause injury to these organs. Because it does sometimes invade this region it may occasionally be found in eggs laid by infested hens. The life cycle of this parasite is shown in Fig. 3.

Another fluke, Collyriclum faba (Bremser and Schmalz), has been found in cysts in the skin, especially on the abdominal surface and in the cloacal region, of chickens and turkeys. Cysts are \( \frac{1}{25} \) to \( \frac{1}{25} \) inch in diameter and each has a central orifice thru which the eggs of the
worm escape. Each cyst contains two worms, which lie with their ventral surfaces opposed. These worms are usually of different sizes, the smaller apparently functioning as a male and the larger as a female. They measure $\frac{3}{25}$ to $\frac{3}{25}$ inch in length and $\frac{3}{50}$ to $1\frac{3}{50}$ inch in width. Cases of heavy infestation in young birds may lead to ex-

![Diagram of the life cycle of Oviduct Fluke, Prosthogonimus macrorchis](image)

**FIG. 3.—LIFE CYCLE OF OVIDUCT FLUKE, Prosthogonimus macrorchis**

From hen to snail, to dragonfly, and back to fowls. From the fluke egg passed by an infested hen hatches the young worm, which develops partially in the snail. Leaving the snail as a tailed form, it swims around and burrows into the body of the naiad of the dragonfly, which lives in the water. Here it becomes encysted. When the dragonfly is fully grown and is eaten by the chicken, the worm develops to its adult form, fluke eggs are passed by the chicken, and the cycle begins again. *(Redrawn from Macy)*

treme emaciation, anemia, paralysis and death. Not only is the general health of the fowl injured, but the blisters which are formed in the skin reduce the market value of the fowls. The parasite occurs in English sparrows and is probably spread by them. The life history is unknown.

Another fluke is found in the intestines of ducks *(Cotylurus sp.)*
and another in the liver (Amphimeres sp.) of turkeys, but these are not of economic importance in Illinois.

_Treatment and Prevention._—For the oviduct fluke repeated doses of carbon tetrachlorid (1.5 to 1.7 cubic centimeters per dose) are recommended. This drug may be given in liquid cereal. Prevention, however, is more satisfactory than cure and can be accomplished by keeping fowls away from wet places where dragonflies are found, especially in the early morning when the flies are cold or inactive and easily picked up and eaten by the fowls.

**TAPEWORMS**

**General Characteristics**

Tapeworms (cestodes) are long, flat, segmented, white worms varying greatly in size. When present in large numbers, they cause a disease designated as _taeniasis_. Some species cannot be seen without magnification; others may be as much as 12 inches long.

The “head” or scolex of the tapeworm possesses a number of hooks or suckers, or a combination of both, by which it attaches itself to the intestinal wall of the host (Fig. 4). Next to the head, in some species, there is a narrow region or “neck” which continually grows and forms new segments; the segments farthest from the head are therefore the oldest and most mature. All tapeworms have a growing region next to the head, but only some forms have the neck. Since each mature segment contains both male and female sex organs, it is a complete unit within itself. These segments are filled with eggs which, when they become “ripe,” break off from the worm and are excreted in the droppings.

The eggs are then eaten by the intermediate host (stable fly, housefly, snail, slug, earthworm, cladoceran or water flea, copepod, amphipod, ostracod, or grasshopper). In the body of the intermediate host the tapeworm egg hatches, liberating a small larva, which later develops into a bladder-worm stage. When the intermediate hosts are eaten by fowls, all except the heads of the bladder worms are digested; these heads attach themselves to the mucous membrane of the small intestine of the host, where they develop segments and start another generation (Fig. 4). During this stage they irritate the walls of the intestines and absorb nourishment directly from the intestinal contents, thus robbing the host of nutrient material.

So far as is known, each type of poultry tapeworm must pass one stage of its life in an intermediate host before it is capable of infesting
a fowl. Different species of tapeworms require different intermediate hosts; these are discussed in connection with each parasite. (A table summarizing the known intermediate hosts of poultry tapeworms and illustrations of many of these hosts are given on pages 38 to 49.)

![Tapeworms Attached to Inside Wall of Intestine](image)

**FIG. 4.—TAPEWORMS ATTACHED TO INSIDE WALL OF INTESTINE**

These worms could not be seen from the outside of the intestine but were immediately visible when the intestine was turned inside out. Natural size.

Some species of tapeworms appear to be most numerous in the fall and early winter. This is to be expected since flies and beetles, which are known to be the intermediate hosts, congregate in poultry houses when the weather becomes cool, and in the sluggish state produced by the lowered temperatures are easily caught and eaten by the fowls in larger numbers than during any other months.

**Most Common Kinds of Tapeworms**

At least ten different species of tapeworms are found in chickens in the United States, an equal number in turkeys, and several other species in other domestic birds such as ducks, geese, pigeons, and guinea fowls. Only the more common species will be discussed.

*Raillietina cesticillus* (Molin) is probably the most common poultry tapeworm found in Illinois. The frequency with which this parasite is observed may be partially due to the fact that it is one of the larger tapeworms and is therefore very easily detected. It varies from 1 to 6 inches in length and from $\frac{1}{20}$ to $\frac{1}{10}$ inch in width (Fig. 5). The head is short and broad and is provided with a double crown of microscopic hammer-shaped hooks which may disappear after a short time. There is no neck. The first segments are very short and broader
than the head, while the last segments are nearly as long as they are broad.

This tapeworm is generally found in the forepart of the small intestine. One stage (cysticercoid) of the life cycle may be spent in the housefly or in some species of beetles.

**Raillietina cesticillus** (Meig.) approaches *R. cesticillus* very closely in frequency of occurrence. *R. tetragona* is the larger of the two tape worms, measuring from $\frac{1}{2}$ to 10 inches in length and from $\frac{1}{25}$ to $\frac{3}{25}$ inch in width (Fig. 6). The neck is long; the head small and tetragonal; the first segments are very short and the last quadrangular and somewhat overlapping. It is found most frequently in the posterior part of the small intestines. The life histories of these two parasites are approximately the same, *R. cesticillus* utilizing houseflies and beetles as intermediate hosts, and *R. tetragona* infesting houseflies and ants.

**Raillietina echinobothrida** (Mégnin) is also one of the larger poultry tapeworms, varying from 2 to 10 inches in length and from $\frac{1}{20}$ to $\frac{1}{6}$ inch in width (Fig. 7). When infestations with this parasite occur, nodules varying from a pin point to the size of a pea appear on the outside and on the mucous membrane of the intestines. This condition is known as "nodular taeniasis." The nodules develop at the point at which the head of the tapeworm is attached to the inner surface of the intes-
tine. The contents of the larger nodules consist of greenish yellow necrotic material, while the smaller ones contain a substance resembling pus. Some of the nodular areas in the mucous membrane are marked by small ulcers.

Very often nodular taeniasis is confused with tuberculosis, but it may be differentiated by the absence of nodules in the liver and the presence of tapeworms in the intestine. If the affected intestine is opened and the mucous surface washed carefully in a gentle stream of water, the small worms will be observed hanging to the mucous membrane.

The toxic effects of *R. echinobothrida* seem to be more pronounced than those of many of the other species of tapeworms; the course of the disease is therefore more acute.

This tapeworm occurs in chickens, turkeys, and pigeons. Ants and land snails serve as intermediate hosts.

*Davainea proglottina* (Davaine) is one of the smallest known tapeworms in poultry. It is \( \frac{1}{60} \) to \( \frac{3}{25} \) inch in length and is composed of
two to five segments which gradually increase in length and breadth; the last segment may be larger than all the rest of the parasite. Because of its small size this tapeworm is frequently overlooked; microscopic examination is therefore important for a correct diagnosis.

This tapeworm is found in the small intestines of chickens and turkeys. Slugs and snails are the intermediate hosts.

**FIG. 7.—ANOTHER OF THE LARGER TAPEWORMS OF POULTRY, RAILLIETINA ECHINObothrida**

"Nodular taeniasis" is caused by this parasite, which measures from 2 to 10 inches in length. Turkeys and pigeons, as well as chickens, are affected. The intermediate hosts are ants and probably some species of snails. Above worms are natural size.

**Hymenolepis carioca** (Magalhães) is 1 1/6 to 3 1/6 inches in length and about 1/50 to 7/50 inch in width (Fig. 8). It is threadlike, very fragile, and delicate, the segments breaking apart easily when handled. It may occur in large numbers in the small intestine of chickens and turkeys and is most common in the latter part of summer and earlier weeks of autumn.
Like other tapeworms, this species requires an intermediate host for the completion of its life cycle; in this case stable flies and dung beetles are utilized.

**Symptoms of Tapeworm Infestation**

Poultry of all ages may be infested with tapeworms, but losses are most severe in the young. Tapeworm infestation in chickens is accompanied by a group of symptoms such as general unthriftness,
of the infestation, species of tapeworm, the age of the fowl and its
degree of resistance. Excessive appetite and thirst may be observed.
The droppings frequently are yellowish brown due to hemorrhages
in the alimentary tract caused by the worms. Segments of worms may
also be seen in the droppings. These symptoms, as well as loss of
weight, grow progressively worse as the degree of infestation increases.
Twisting the neck, turning the head back over the body, and lameness
followed by paralysis in one or both legs may be observed.

The practical way to determine whether a fowl is infested with
tapeworms is by making post-mortem examination, paying particu-
lar attention to the contents of the small intestines. Microscopical ex-
amination is necessary to detect the small species of tapeworms.

Prevention and Treatment

Prevention.—The spread of tapeworms among poultry may be pre-
vented by disposing of the droppings in such a way that the known
intermediate hosts of the parasites, such as beetles, flies, slugs, snails,
and earthworms, are kept from eating eggs or segments passed in the
droppings of infested fowls. Frequent removal of the droppings, re-
moval of all trash, boxes, and other refuse material, plowing or spading
of poultry yards, filling in low places, and moving poultry to new
ground will aid in the control of tapeworm infestation. Lime and
ashes scattered over the droppings under the roosts will also help to
destroy intermediate hosts.

Treatment.—Many treatments have been advocated for tapeworms
in poultry, but in official tests made in recent years none have proved
entirely satisfactory. Kamala, a brownish powder usually sold in 1-
gram (15-grain) tablets or capsules, is probably the most widely used
remedy for tapeworms in poultry, notwithstanding the absence of
experimental data in support of its value in removing the heads of
tapeworms. For many years kamala was regarded with favor in the
treatment of poultry for tapeworms, but its value has been questioned
as the result of critical tests reported by the Federal Bureau of Animal
Industry and by the Ohio Agricultural Experiment Station. The tests
show that kamala removes only 1 percent or less of the heads of tape-
worms, and that its efficacy in removing segments may vary from zero
to 100 percent. Evidence of the ill effect of kamala on egg production
has been noted by the Florida Station. At the Illinois Station pullets
given repeated doses of kamala failed to show a significantly lower
incidence of tapeworm infestation than untreated control birds kept
under the same conditions; and fowls from privately owned flocks,
autopsied following treatment, have been found heavily infested with tapeworms.

The unsatisfactory results obtained in critical tests with kamala suggest that a variety of factors may influence its efficacy. While all such factors cannot be definitely measured, it is known, for example, that the active principle of kamala may vary from 5 percent to 50 percent in different lots, which fact indicates the necessity of purchasing the drug only from reliable sources.

One tablet (1 gram) of kamala is the prescribed dose for an adult chicken. Since kamala occasionally produces a toxic effect, it should always be administered with caution. Before treating an entire flock, a few of the fowls should be treated experimentally and the effect noted. Weak birds or birds affected with other diseases should not be treated until they are stronger or they should be given a smaller dose. Young chickens should be given doses adjusted to their size. Mass treatment of a flock is never very effective because the weaker birds get too small a dosage in the amount of food consumed.

Kamala should be administered to turkeys very cautiously since they are exceptionally sensitive to its toxic effect. A trial dose of one gram should be given to a few fowls before treating the entire flock.

In administering kamala, it does not appear necessary to subject fowls to a period of fasting before treatment. Neither is a laxative or a purgative necessary after treatment, since kamala itself has a purgative effect.

Treated birds should always be confined in a house with a concrete floor until the effects of the kamala have subsided. The droppings should be removed and burned and the floor scrubbed thoroughly with lye water (1 pound of lye to 20 gallons of water).

ROUNDWORMS

Roundworms (nematodes) are usually long and cylindrical. Their location is more varied than that of tapeworms, different species being located in different parts of the body. The three most commonly known species are probably the large roundworm or ascarid, the crop worm or Capillaria, and cecal worms. Other species less well known to poultry raisers are the gapeworm, gizzard worm, eye worm, crop worm (Gongylonema ingluvicola), and proventricular worm.

LARGE ROUNDWORM

Description.—The large roundworm (Ascaridia lineata) (Schneider) (Fig. 9) is probably the roundworm most commonly seen in the small
INTERNAL PARASITES OF POULTRY

FIG. 9.—A COMMON LARGE ROUNDWORM OF POULTRY, *Ascaridia lineata*

This parasite is found in the small intestine of chickens. It may infest turkeys, geese, ducks, and pigeons also. (The magnifications are shown on the illustrations.)

intestine of chickens. This parasite may also infest turkeys, geese, ducks, and pigeons. It is white or yellowish white, cylindrical, pointed at the ends, and is 1 to 4½ inches long. The worms are often so
numerous that they completely plug the portion of the intestine which they inhabit. Occasionally this worm wanders from its normal intestinal habitat up the oviduct and becomes enclosed in an egg which is being formed.

*Life History.*—The life history of *A. lineata* is direct. The eggs are deposited in the intestine of the host by the female worm, and it has been estimated that a single female worm may lay more than 50 million eggs. The eggs are then expelled with the droppings, after which they must pass thru a period of development before they can infest another fowl. If the weather is favorable, the eggs develop within two weeks. They are very resistant to heat and cold, especially when protected by droppings, trash, boxes, etc., and may live for a indefinite time.

When fully developed, the eggs are infective, and if eaten by a susceptible fowl they hatch in the small intestine, liberating young larvae which bury themselves in the wall of the intestine. Within ten to twenty days the larvae emerge into the lumen of the intestine, and under favorable conditions develop to maturity.

*Symptoms.*—Chickens may be heavily infested with roundworms before any evidence of their presence is noticed. Birds less than three months old are most commonly affected. The symptoms are general unthriftiness, drooping or sagging of the wings, paleness of head, and emaciation. Loss of appetite occurs only in advanced stages. Emaciation and lowered egg production are often noted in mature fowls but the other symptoms are not so marked as in young growing stock.

*Prevention.*—Strict sanitary measures, including the cleaning of houses and removal of sick fowls, are effective in preventing the spread of roundworms. The elimination of wet spots in the yards and houses is also important, for these places serve as incubators for worm eggs. Low places should be either filled or drained. Drinking fountains should be placed on latticed boxes so the fowls cannot get to the damp ground beneath. The elevation of feed troughs 10 or 12 inches above the ground is also helpful.

The yearly rotation of lots and runs which have been properly plowed and seeded with oats, rye, or wheat is an effective method of ridding the soil of parasite eggs. Direct sunshine is also unfavorable to the development of roundworm eggs. Chicks less than three months of age should not be placed in pens or on ranges with older chickens. A balanced diet containing the proper vitamins and minerals is helpful in building up the resistance of fowls.

*Treatment.*—A treatment which has been frequently recommended
for removing roundworms consists of dosing each bird with carbon tetrachlorid or tetrachlorethylene. One cubic centimeter is an adequate dose for an adult bird. Smaller doses, graduated according to the size of the bird, should be given to young fowls. The drug is most easily given in gelatin capsules. It should never be allowed to get into the lungs.

Nicotine sulfate, or Black Leaf 40, may also be used for individual treatment. A No. 2 gelatin capsule is filled with a mixture made of 6.6 cubic centimeters (7.92 grams) of Black Leaf 40 (40 percent nicotine sulfate) and 16 grams of Lloyd’s alkaloidal reagent, which is a selected fuller’s earth. After the powder is thoroly mixed, it is packed in No. 2 gelatin capsules in sufficient quantities to weigh 350 to 400 milligrams when filled. The dosage is one capsule per bird. Each capsule should be placed well down the bird’s throat, and then with thumb and forefinger it should be located from the outside and moved down to the crop. Since young, or weak, or emaciated birds may be poisoned by overdosing, one-half to one-fourth of the powder should be squeezed out of the capsule before giving it to them. A full capsule is safe for stronger birds over ten weeks of age. Starving is not necessary before treatment. This treatment has also proved effective with turkeys. Mass treatment may be given, but it is never as effective as individual treatment since some birds may be overdosed and others underdosed.

The tobacco treatment recommended by the California Agricultural Experiment Station may also be given. This is for mass treatment and consists of feeding a mash to which has been added 2 percent, by weight, of tobacco dust containing at least 1.5 percent nicotine. The mixture is fed for three to four weeks and may be repeated at intervals of three weeks. Each tobacco-dust treatment should be followed by Epsom salt (1 pound for 100 birds), which may be dissolved in the drinking water. Mass treatment has a disadvantage in that the weak birds, which really need the treatment, get very little of the mash.

When medicine is given to eliminate worms, the poultry should be confined in a house with a wooden or concrete floor or in a small enclosure which can be spaded or plowed and away from which chickens may be kept for a year or more. After the flock has been treated, the house should be cleaned and the droppings burned or placed on ground not used for poultry. It should then be thoroly scrubbed with boiling lye water (1 pound of lye in 20 gallons of water). After the birds are treated, they should be placed on clean ground or ground that has been plowed recently.
SMALL ROUNDWORMS

Description.—Roundworms, *Capillaria* species, are delicate, slender, colorless, hairlike worms, very difficult to see with the naked eye. When microscopic examinations are made, the worms are not always found even tho the eggs are plentiful. The worms are from \( \frac{1}{2} \) to 1 inch long (Fig. 10).

Two species are known to occur in the crop and undilated esophagus, and at least six species have been reported in the intestines and three in the ceca of chickens, turkeys, and game birds. When lodged in the crop, the worms burrow tortuous canals within the wall

![Fig. 10.—A SMALL CROP AND INTESTINAL ROUNDWORM OF POULTRY, Capillaria spp.](image)

and, if present in sufficient numbers, may produce inflammation and thickening of the wall, leading to the formation of a necrotic false membrane. Lesions have also been found in the esophagus, or gullet, extending from the throat to the crop (Fig. 12). The crop of infested fowls may be filled with a milky fluid, which has a very characteristic odor. Intestinal species are found in the lumen of the intestine or threaded in the surface of the mucous membrane (Fig. 11).

Life History.—Wehr has shown two species of earthworms to be intermediate hosts of *C. annulata* (Molin) and suggests the possibility of a complicated instead of a simple direct life history for other species of Capillaria.

Symptoms.—The symptoms shown by a bird infested with Capillaria vary according to the extent of infestation and the species of worm present. In general the symptoms are droopiness, anemia, and muscular weakness. Twisting of the neck and paralysis of the legs have been attributed to this parasite. A foul breath, loss of appetite, and emaciation followed by death may characterize crop infestation.
The pseudomembrane, sometimes three-fiftieths inch thick, interferes with the function of the crop, therefore causing the bird to select soft feeds in preference to grain.

**COMMON CECAL WORM**

*Description.*—The common cecal worm of poultry, *Heterakis gallinae* (Gmelin) (Fig. 13), occurs in the ceca or blind gut of chickens, turkeys, ducks, and geese. It is a small, rigid, white worm with the an-
terior end curved back, from $\frac{3}{10}$ to $\frac{1}{2}$ inch long and may occur in very large numbers, causing a serious inflammation of the ceca, especially in young chicks. This parasite is also believed to carry the protozoan which causes blackhead in turkeys.

**Life History.**—*H. gallinae* has a direct life history. The eggs voided in the droppings become embryonated in 7 to 12 days. When the egg is ingested by a fowl, the young worms hatch in the small intestine, from which they enter the ceca and become encysted in the walls of this organ. After a short time they return to the lumen of the ceca and develop to adults. This entire process of development requires approximately eight to nine weeks. Observations carried out on the duration of the infectivity of eggs in the soil have shown that they are able to produce infestation after a rest of at least twelve months. Earthworms have been observed to ingest cecal worm eggs, and birds may become infested by eating these worms or by ingesting food contaminated with their excreta.

**Symptoms.**—Unthriftiness, emaciation, a pale head, and sometimes paralysis are the symptoms observed in young chicks. Occasionally these worms may cause death of young chicks if present in large numbers.
numbers. Adult birds, however, may be infested without showing any symptoms whatsoever.

Prevention.—General sanitary measures, rotation of yards, and special protection of young chicks prevent the spread of cecal worms.

Treatment.—No treatment for cecal worms has proved entirely satisfactory, for the location of these worms makes their complete removal practically impossible. The California Agricultural Experiment Station recommends the 2 percent tobacco-dust treatment which has been described for large roundworms, page 21; whereas the U. S. Department of Agriculture suggests rectal injections of oil of chenopodium in a bland oil such as cottonseed oil. The dose is \( \frac{1}{10} \) cubic centimeter of oil of chenopodium in 5 cubic centimeters of cottonseed oil for a bird weighing 1\( \frac{1}{2} \) pounds.

**GAPEWORM**

Description.—The gapeworm, *Syngamus trachea* (Montagu), is a small, slender roundworm, reddish in color and varying from \( \frac{1}{12} \) to \( \frac{1}{4} \) inch (male) to \( \frac{1}{6} \) to \( 1\frac{1}{2} \) inches (female) in length. The male worm is so attached to the female that the two worms form a \( \frac{1}{2} \) (Fig. 14). This parasite is found clinging to the inner lining of the windpipe or trachea and air passages of young chickens, turkeys, and wild birds, but it produces different effects in each.

![Fig. 14.—Gapeworm of Poultry, *Syngamus trachea*](image)

(A) Worm attached to trachea (about \( \frac{3}{4} \) natural size). (B) Enlargement of A, showing (1) male and (2) female, about \( 3\frac{1}{2} \) times natural size. This parasite is found clinging to the inner lining of the windpipe and air passages of young chickens, turkeys, and wild birds. (*Redrawn from Neumann*)

Life History.—The gapeworm usually has a direct life cycle. The eggs, which are embryonated when laid, may be present in discharges coughed up by the bird or they may be swallowed and given off in the feces. If the eggs fall into water or moist earth, the embryos develop
and are hatched within 7 to 40 days, depending on the temperature. Poultry may become infested by ingesting eggs or embryos expelled by infested members of the flock. These are often taken in with the food or water, and within a week the young worms will have migrated to the lungs. The worms copulate in the lungs and then work their way up into the trachea, where they become attached and mature within 7 to 10 days.

No intermediate host is necessary, but earthworms, slugs, and snails may be factors in the spread of this parasite. The gapeworm egg or young worm, which has hatched in the soil, may be eaten by one of these intermediate hosts. The young gapeworms then burrow into the body muscles or nerve ganglia of these hosts and may remain there for some time. Taylor, of England, reports that larvae may retain their infectivity (for chicks) in earthworms for as long as three and a half years.

Symptoms.—Fowls infested with gapeworms appear dull, have ruffled feathers, lose their appetites and exhibit the most severe symptoms of gapes. A typical symptom is a peculiar stretching of the neck accompanied by a yawn-like opening of the beak. It is from this symptom that the disease gets the name "gapes." The trachea becomes inflamed, and an accumulation of mucus closes the windpipe, making breathing difficult. There is often a convulsive shaking of the head, a sneezing cough, and an expulsion of frothy saliva from the beak. This effort to obtain air is continued until the chick dies of starvation or suffocation. Mortality is high in young chicks, but older chickens are seldom seriously harmed by these parasites.

The adult turkey appears to be the natural host of adult gapeworms. Infested turkeys may carry these worms throughout life without showing severe symptoms.

Prevention.—Since infested turkeys may be the chief cause of spread of gapeworms to chicks, there should be strict separation of chickens from turkeys at all times. Chickens should not be allowed on ground where turkeys have ranged. A dry sandy soil unfavorable for earthworms is also important in the prevention of gapeworms. On heavy soil where earthworms are numerous, chickens should not be turned out until the ground has dried sufficiently to cause all earthworms to disappear. Affected birds should be isolated so that the gapeworms and eggs which are coughed up will not contaminate food, water, or ground. Bodies of all dead birds should be burned, and feed troughs, water dishes, coops, etc., thoroly disinfected.

Treatment.—There is no satisfactory treatment for gapeworms.
They may be removed by inserting a loop of horse hair down the wind-pipe and rotating it to dislodge the worms from the walls, but this is a slow, difficult, and rather dangerous method. A small feather from which all the barbs except a tuft at the end have been stripped may be used in the same way. A little kerosene or oil of turpentine on the feather will help to loosen the worms.

**Gizzard Worm**

This parasite is widespread throughout Illinois poultry flocks and seems to be increasing rapidly. It is the cause of many deaths.

**Description.**—Gizzard worms (*Acuaria hamulosa*) (Diesing) are found most commonly in chickens and turkeys. They are ¼ to ¾ inch long, cylindrical, and of a reddish color (Fig. 15). They occur in small nodules or in tunnels in the wall of the gizzard. If the worms are present in large numbers, the wall sometimes becomes so badly damaged that it ruptures. Openings are made into the inner surface of the gizzard, thru which the eggs pass. These openings are often surrounded by a rough, brownish-colored area on the inner surface.

**Life History.**—Grasshoppers are the intermediate host of *A. hamulosa*. The larvae which hatch from the eggs migrate into the body cavity of a grasshopper and develop in the muscles. In 22 to 67 days chickens may become infested by eating grasshoppers containing this worm. In about 25 days the worms begin to penetrate the wall of the gizzard.

**Symptoms.**—The symptoms of gizzard infestation are not well defined. The injury and inflammation of the gizzard muscles by these...
parasites undoubtedly interfere with digestion and offer avenues for invasion by bacteria. Missouri workers state that in 70 percent of the paralysis cases examined in the laboratory, the gizzard worm was found imbedded beneath the mucous membrane of the gizzard.

Prevention.—Frequent collection and proper disposal of droppings, so that grasshoppers may not feed on them, will help to control infestation. A range of short, green vegetation rather than high-growing, dry vegetation reduces the number of grasshoppers.

Treatment.—The location of this parasite beneath the lining of the gizzard makes successful treatment very difficult. Two to 5 cubic centimeters of carbon tetrachlorid or tetrachlorethylene given when crop and gizzard are empty has been suggested by workers in the U. S. Department of Agriculture.

**Manson's Eye Worm**

Description.—Altho the parasite known as Manson's eye worm (*Oxyspirura mansoni*) (Cobbold) has not been reported in Illinois, there is always the possibility that it may be present or that it may be brought into Illinois from other areas. It is a small, white, threadlike worm approximately ½ inch long and about as thick as a fine sewing needle. It is thickest in the middle, tapering towards the ends (Fig. 16). It is found in numbers varying from a few to 200 beneath the nictitating membrane (the transparent membrane that passes over the eyeball of fowls in the act of winking). Firm pressure applied to the tear sac

---

**Fig. 16.—Manson's Eye Worm of Poultry, Oxyspirura mansoni**

Altho this parasite is not yet known to be present in Illinois flocks, there is always the possibility that it may be brought in from other areas. (A) Natural size. (B) Slightly enlarged, showing (1) male and (2) female. (Redrawn from van Heelsbergen)
29 INTERNAL PARASITES OF POULTRY

at the inner corner of the eye will cause them to wiggle out over the eyeball, where they can be seen.

Chickens, turkeys, and wild birds may be infested with this parasite.

_Life History._—A cockroach has been shown to be the intermediate host for the eye worm. Cockroaches commonly live under boxes, trash, and along the fences and feed upon the droppings of fowls and upon other organic material. The worm eggs are laid in the eye of the fowl; then washed down the tear ducts to the throat, are swallowed and pass out with the droppings. When eggs are eaten by a cockroach, the larvae develop in its body; then when the fowl eats the cockroach, the larvae are liberated in the crop. They pass up the esophagus to the mouth, then thru the tear ducts to the eye. It takes about 20 minutes for the young worm to make this journey.

_Symptoms._—Constant winking of the eye, frequent rubbing of the head on the feathers of the wing, and the scratching of the eye with the foot are common symptoms. A discharge from the eyes and nose becomes pasted over the feathers. The eyes are puffy and inflamed, sometimes to the extent that blindness results. The eyeball is sometimes destroyed by mechanical injury. This worm may leave the eye, and afterwards a condition similar to ocular roup may develop. In severe cases the fowl dies.

_Prevention._—The most effective control measure for eye worm is the removal of all boxes, boards, and unnecessary objects under which cockroaches may hide. Roaches living in these places are more likely to become infested, and in turn infest chickens that pick them up. Daily removal of droppings will also help to reduce infestation. Affected fowls should be treated or destroyed.

_Treatment._—The following treatment is recommended. Drop into the eye of the fowl 2 or 3 drops of a 5-percent solution of butyn as an anesthetic. Lift the nictitating membrane of the eye and place 1 or 2 drops of a 5-percent solution of creolin directly on the worms. Immediately after applying the creolin, wash the eye thoroly with warm water.

GLANDULAR STOMACH WORM

_Description._—The glandular stomach worm (*Tropisurus americanus*) (Cram) is a small worm less than 1/4 inch long and occurs in the proventriculus, or glandular stomach, of chickens. The male is white, elongate, and cylindrical and retains this shape throughout life. The female is at first similar to the male in form, but after entering the glands of the stomach it changes, becoming globular in shape as the
body fills with eggs, and its color becomes brilliant red with well-marked transverse striations. There are two projections on opposite sides of the globular-shaped female; one is the head and the other is the tail (Fig. 17). The males are free in the lumen of the stomach, whereas the females are partly buried in the gastric glands with their posterior ends protruding.

Another species, *T. fissipinus* (Diesing), has been reported in ducks in the United States.

*Life History.*—This parasite has an indirect life history. The intermediate hosts of the more common species, *T. americanus*, are grasshoppers and cockroaches. The eggs are picked up by these insects and the larvae, when hatched, penetrate the muscles of their bodies. The insects become droopy and inactive and easy prey for fowls. When inside the fowl, the parasites enter the glands of the stomach and develop to maturity. Certain species of fresh-water crustacea may act as intermediate hosts for *T. fissipinus*.

*Symptoms.*—Adult fowls sometimes carry this parasite without apparent injury to their health. In young chickens general weakness, diarrhea, and even death may result from infestation. The drawing is about 10 times natural size. (Redrawn from Baylis)

![Fig. 17.—Glandular Stomach Worm of Poultry, Tropisurus spp.](image)

Adult fowls sometimes carry this parasite without apparent injury. In young chickens general weakness, diarrhea, and even death may result from infestation. The drawing is about 10 times natural size. (Redrawn from Baylis)

Prevention.—Disposal of droppings in such a way that grasshoppers and cockroaches cannot feed on them, and elimination of all hiding places for these insects help to decrease infestation.
Treatment.—There is no effective medicinal treatment for this parasite. Keeping birds in a healthy condition by feeding nutritious rations rich in vitamins increases their resistance to infestation.

CONTROL AND PREVENTION

Clean houses, clean ranges, clean properly balanced rations, pure water, and proper disposal of sick and dead fowls, as well as the avoidance of overcrowding, are important factors in the control of internal parasites. Flock owners too often place unwarranted faith in worm remedies. While medicines may be helpful in the suppression and control of some intestinal parasites, it must be kept in mind that reinfection occurs promptly if treated fowls are allowed to run on infested premises, and that prevention costs less and is more satisfactory than an attempted cure. Worm remedies cannot take the place of sanitation; in fact, in properly managed poultry flocks there is only occasional need for worm remedies.

CLEAN, WELL-BUILT HOUSES AND EQUIPMENT

Poultry spend the greater part of the year in houses. Proper construction, as well as cleanliness, of poultry houses is therefore important in the control of parasites. The most essential points are:

Sunshine and Drainage.—The house should be located on ground sufficiently well drained to insure dryness at all times. It should be so constructed that direct rays of the sun will reach as much of the floor as possible (Fig. 19). Dampness and darkness favor the development of parasites and disease-producing bacteria whereas sunlight is a disinfectant of proven value. Dampness and drafts also help to lower the resistance of fowls and make them more susceptible to colds, roup, parasites, and other diseases.

Floors.—The floors of poultry houses should be constructed of concrete or matched wood flooring; it is impossible to clean and disinfect a dirt floor. Nest boxes, feed troughs, and water containers should be of a removable type so that they can be more easily cleaned.

Protection From Droppings.—Fowls should never be allowed to come into contact with accumulated droppings. This can be prevented very easily by fastening poultry netting to the underside of the roosts above the droppings boards.

Removal of Litter and Droppings.—Litter and droppings should be taken from the house frequently and put where fowls and inter-
mediate hosts cannot get to them. If droppings are stored in wooden containers (boxes or barrels), many parasite eggs will be destroyed because of the heat which is generated and the lack of oxygen. Such storage will also prevent wild birds and intermediate hosts such as flies, snails, cockroaches, etc., from carrying the parasites back to the poultry. In diseased flocks the refuse material should be burned.

Protection Against Flies.—Flies are carriers of disease-producing microorganisms and parasites. Since fowls cannot be kept from eating flies when they are accessible, the next best thing is to screen the houses and in so far as possible keep the flies away from the poultry. Food and water should also be protected from contamination by flies.

Cleansing With Lye Water.—Parasites become packed, along with fecal material, into the crevices of the floor where sweeping or spraying with disinfectants will not reach them. The most effective method of destroying and removing parasite eggs from a poultry house is to scrub walls, dropping boards, and floors thoroughly with boiling hot lye water (one pound of lye to 20 gallons of water).

CLEAN YARDS AND RANGES

Rotation.—The rotating of yards and ranges reduces worm egg infestation. The soil of yards in which parasite-infested fowls are

FIG. 18.—INSANITARY PREMISES SUCH AS THESE FAVOR PARASITIC INFESTATION

Dark, dirty houses, and yards full of trash are excellent breeding places for poultry parasites and their intermediate hosts.
kept soon becomes contaminated with parasite eggs which may infest other fowls. Damp, warm soil serves as an incubator for intestinal parasite eggs. Infective worm eggs may, under favorable conditions, live in the upper layer of the soil for years. The danger of infestation from contaminated ground is greatly reduced if fowls are kept only a few months at a time in the same yard. Systems of management which provide different ranges and at least two yards for each house are helpful in checking intestinal parasites.

Plowing.—The proper plowing of poultry yards and ranges buries the parasite eggs so that fowls cannot pick them up. It also destroys the eggs by reducing their oxygen supply. Plowing is of limited value, however, when strips of unbroken soil are left along fences and in corners, for these are natural congregating places for fowls and consequently are often more heavily infested with parasite eggs than is the open ground.

Location.—If possible, light, sandy, well-drained soil should be selected for poultry ranges. Any water holes and low places should be filled.

If fenced-in runs are not practical, other methods of rotating ranges may be employed. The same results may be obtained by placing poultry houses in separate fields, or by constructing portable houses. A poultry house should never be located in the barnyard adjacent to other buildings; neither should the fowls on range come into contact with other animals.
Soil Disinfection Not Practical.—Disinfection of soil by chemicals is impractical if not impossible. Lime will improve the physical condition of the soil and keep down odors, but it is not a disinfectant and will not kill bacteria nor rid the soil of parasites.

CLEAN FEED AND WATER

Contaminated feed and water play a more important part in the spread of intestinal parasites than most poultrymen realize. Feeds bought from reliable manufacturers seldom, if ever, are a source of infection until after they are put into the feeders and become contaminated by infected droppings. The danger of contamination makes the construction of feeders and watering utensils very important.

The feed trough and water utensils should be so constructed that fowls cannot get into them with their feet and should be elevated above the ground so that they will not be contaminated by droppings. It is best to close the sides of the support on which the water is placed so that the moist ground beneath is not accessible to fowls. Parasite eggs develop very rapidly in damp places. Daily cleaning and disinfection of utensils, particularly the water containers, are very important in controlling both parasitic and germ diseases.

Since vigorous, healthy fowls are much more resistant to parasite invasion than weak ones, care should be exercised to feed properly balanced complete rations to maintain the vigor of the flock. Fowls which have the run of the farm do not always obtain a balanced ration, especially in winter. In addition to protein, carbohydrates, fat, and ash, vitamins are necessary for proper development and normal function.

Five vitamins—A, B, D, E, and G—are considered necessary for proper growth and vigor of the flock. Vitamins are widely distributed in whole grains, forage crops, vegetables and fruits, while cod-liver and other fish oils carry an abundance of vitamins A and D.a

CAREFUL DISPOSAL OF DISEASED FOWLS

Sick fowls are a source of danger and may spread contagious bacterial as well as parasitic diseases. Except in special cases, the isolation of sick fowls for treatment is impractical and expensive. It is more economical to take them to the local veterinarian for autopsy and thus not only remove a serious source of contamination but find out the nature of the malady. If the birds are very valuable or the type of parasite infestation is such that it warrants the isolation of sick indi-

a For further information on this subject see Circular 449 of this Station, "Avitaminoses in Animals."
INTERNAL PARASITES OF POULTRY

35

viduals, they should be removed to a separate building where it is impossible for healthy birds to come into contact with them or their droppings.

Persons passing from isolation houses to healthy fowls should take every precaution to prevent carrying parasite eggs on their shoes, clothing, and hands. If possible, a person who does not come into contact with well birds should care for the sick birds. Quarantined birds should never be put back with the healthy ones even tho apparently cured, for the “cured bird” may be a carrier of the parasite and thus become a menace to the entire flock.

There is only one way to determine definitely whether a flock is infested with parasitic worms, and that is to kill and examine birds which are suspected of being wormy. Fowls are sometimes droopy because of some injury or because of ruptured egg yolks, and such conditions can be easily recognized by autopsy. If a diseased condition is found, a live sick bird should be taken immediately to some person who is capable of making an accurate diagnosis. In obscure conditions laboratory tests may be necessary to establish the character of the malady. Diseases cannot be diagnosed by the color of the head, feet, or by the droppings, or by the amount of swelling in the feet.

DISINFECTION OF HOUSES AND EQUIPMENT

The development and spread of internal parasites can be largely prevented by proper disinfection of houses, troughs, and drinking utensils. Before any surface can be disinfected, however, it must be freed from dirt and fecal material, for otherwise the chemicals used for disinfection may unite with the organic matter (feces, egg shells, bits of food, etc.) and lose their disinfecting value before they come into contact with the parasite eggs and larvae.

The following disinfectants are recommended for use after the houses, etc., are thoroly cleaned:

1. Compound solution of cresol (liquor cresolis compositus, U.S.P.) 4 ounces to a gallon of water; 1 pint and 4 ounces to 5 gallons of water.
2. Crude carbolic acid—7 ounces to a gallon of water.
3. Formalin—13 ounces to a gallon of water.
4. Chlorinated lime (often called “chlorid of lime”)—3 ounces to a gallon of water.

Chlorin disinfectants are very efficient germicides, altho they are somewhat unstable and are not effective when kept long.

The disinfecting solutions may be applied by means of a spray or broom, or in any way that will reach all cracks and corners.

Disinfectants in drinking water do not control or suppress parasite infestations. A false sense of security not infrequently follows the
use of disinfectants in the drinking water for the purpose of counteracting improper care and cleaning of utensils.

**MEDICINES HAVE LIMITED VALUE**

Approved preventive measures are the best line of defense against poultry parasites. Medicines are not a substitute for sanitary measures. They are apt to lead to the belief that flocks can be kept free of parasites by their use and thus to cause owners to neglect essential sanitary measures. They do not destroy worm eggs, but merely expel the parasites or, in the case of tapeworms, portions of parasites.

No worm medicine for poultry should be administered until it has been shown by post-mortem examination that parasites are present in sufficient numbers to justify treatment. Giving remedies on suspicion for undiagnosed poultry diseases often proves an expensive practice. Local veterinarians can identify the different internal parasites and suggest the drug to use. *Drugs effective in removing one parasite may not be of any value in removing others.* For this reason specific treatment has been discussed in connection with each parasite.

Worm remedies even tho of proved value may do much damage in the hands of untrained persons; they must be administered in proper amounts according to the age, size, and general physical condition of the individual fowl. Individual treatment is to be recommended rather than mass or flock treatment with vermifuges mixed with the feed. When the latter method is used, weak or unhealthy birds do not get enough of the medicine to affect the parasites.

*The best control of intestinal parasites has been obtained by those owners who have relied exclusively on preventive measures rather than on curative measures.*

For further information on sanitary care of poultry and on poultry equipment and buildings, see the following circulars:

- Keeping the Farm Flock Healthy. C-374
- Poultry Farm Equipment. C-333
- Building the Straw-Loft Poultry House. C-412
- Building the Illinois Shed-Roof Poultry House. C-368
- A Colony Brooder House That Starts Chicks Right. C-291

Circulars are available also on poultry feeding and on a number of poultry diseases: fowl typhoid, coccidiosis, botulism, tuberculosis, laryngotracheitis, pullorum disease, fowl pox, and fowl cholera. *Address requests to College of Agriculture, University of Illinois, Urbana.*
ADDENDUM

POULTRY PARASITES AND THEIR HOSTS

Some of the difficulties experienced in the control of parasitic worm infestation of poultry are traceable to the number of different hosts in which a single parasite may subsist and to the location of the parasite within the host's body.

The following outline (pages 38 to 43), tho not a complete resumé of all poultry parasites and their hosts, gives some idea of the practical problems confronting the poultryman in the matter of preventing or controlling parasitic infestation. Intermediate hosts which are known to occur in Illinois are marked with a single star.

Illustrations of many of the intermediate hosts are reproduced on pages 44 to 49. All those shown are found in Illinois. While it might not be advisable, even if it were practical, to destroy such hosts as earthworms, snails, and dragonflies, it is well to be aware of their potential danger to fowls and to use measures that will, so far as possible, prevent fowls from eating them.

The illustrations include the following intermediate hosts:

<table>
<thead>
<tr>
<th>Intermediate Host</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dung beetles</td>
<td>44</td>
</tr>
<tr>
<td>Ground beetles</td>
<td>45</td>
</tr>
<tr>
<td>Flies (house and stable)</td>
<td>45</td>
</tr>
<tr>
<td>Dragonflies</td>
<td>46</td>
</tr>
<tr>
<td>Cockroach</td>
<td>47</td>
</tr>
<tr>
<td>Grasshopper</td>
<td>48</td>
</tr>
<tr>
<td>Slugs</td>
<td>48</td>
</tr>
<tr>
<td>Snails (land and water)</td>
<td>48</td>
</tr>
<tr>
<td>Cladoceran (water flea)</td>
<td>49</td>
</tr>
<tr>
<td>Pill or sow bug</td>
<td>49</td>
</tr>
<tr>
<td>Earthworm</td>
<td>49</td>
</tr>
</tbody>
</table>
### OUTLINE OF PRIMARY AND INTERMEDIATE HOSTS

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Primary hosts</th>
<th>Location in body</th>
<th>Intermediate hosts</th>
</tr>
</thead>
</table>
| **FLUKES**
(Trematoda) |
| Prosthogonimus macrorchis Macy | Chickens | Oviduct and Bursa Fabricii | Water snails
*Annicola limosa porata*
(Say)* |
| | Ducks | | Dragonflies
*Epicordulia princeps*
(Hagen)* |
| | Turkeys | | *Erythems simplicicollis*
(Say)* |
| | Wild birds | | *Leucorrhinia intacta*
(Hagen)* |
| | | | *Tetragoneuria spinigera*
Selys* |
| Prosthogonimus rudolphii (Skrjabin)** | Ducks | Bursa Fabricii | Snails*
Aquatic insects?* |
| Collyriclum faba (Bremser and Schmalz) | Chickens | Bursa Fabricii | Snails*
Dragonflies?* |
| | Sparrows | | |
| | Turkeys | Subcutaneous cysts, especially on abdominal surface and in the cloacal regions | |
| | | | |
| | | | |
| **TAPEWORMS**
(Cestoda) |
| Raillietina cesticillus (Molin) | Chickens | Small intestine, anterior portion | Housefly
*Musca domestica* L.* |
| | Guinea fowls | | Darkling beetles
*Tenebrio* sp.* |
| | Quails* | | Dung beetles
*Aphodius* sp.* |
| | Turkeys | | |
| | | | *Aphodius granarius* L.* |
| | | | *Choeridium hieroides*
Web.* |
| | | | Ground beetles
| | | | *Amara aenea* (Deg.)* |
| | | | | *Amara basillus* Say.* |
| | | | | *Amara familaris* (Duft)* |
| | | | | *Amara sp.* |
| | | | | *Anisolarsus agilis* (Dej.)* |
| | | | | *Anisolarsus terminatus*
(Say)* |
| | | | | *Bradycellus collaris*
(Payk.)* |
| | | | | *Calathus erratus* Sahlb.* |

*Found in Illinois. ?Incriminated as intermediate host. ***Not discussed.
<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Primary hosts</th>
<th>Location in body</th>
<th>Intermediate hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Raillietina</em> tetragona</td>
<td>Chickens, Guinea fowls, Quails, Turkeys</td>
<td>Small intestine, posterior portion</td>
<td><em>Calathus ambiguus</em> (Payk.)</td>
</tr>
<tr>
<td>(Molin)</td>
<td></td>
<td></td>
<td><em>Calathus fuscipes</em> (Goeze)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Calathus opaculus</em> Lec.*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Crateacanthus dubius</em> (Beauv.)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Harpalus nitidulus</em> Chd.?*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Harpalus tardus</em> (Panz.)*?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Pterostichus lepidus</em> (Leske)?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Selenophorus ovalis</em> Dej.?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Selenophorus pedicularius</em> Dej.*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Stenocellus debilipes</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Stenocellus rupestris</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Stenolophus conjunctus</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Tripleteatus rusticus</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Housefly</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Musa domestica</em> L.*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Ants</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Tetramorum caespitum</em> (L.)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Pheidole</em> sp.*</td>
</tr>
<tr>
<td><em>Raillietina</em> echinobothrida</td>
<td>Chickens, Pigeons, Turkeys</td>
<td>Small intestine</td>
<td>Land snails</td>
</tr>
<tr>
<td>(Méggin)</td>
<td></td>
<td></td>
<td><em>Helicella carthusianella</em> (Drap.)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Planispira maculosa</em> (Mart.)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Ants</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Tetramorum caespitum</em> (L.)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Pheidole</em> sp.*</td>
</tr>
<tr>
<td><em>Dasainea</em> proglottina</td>
<td>Chickens, Turkeys</td>
<td>Small intestine</td>
<td>Water snails</td>
</tr>
<tr>
<td>(Davaine)</td>
<td></td>
<td></td>
<td><em>Physa heterostropha</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Land snails</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Polygyra thyroides</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Retinella indentata</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Ventridens ligerus</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Zonioides arboreus</em> (Say)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Slugs</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Agriolimax agrestis</em> (L.)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Limax flavus</em> L.*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Limax maximus</em> L.*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Prophysaon andersoni</em> Cooper</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Primary hosts</th>
<th>Location in body</th>
<th>Intermediate hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hymenolepis carioca</em></td>
<td>Chickens, Quails, Turkeys</td>
<td>Small intestine</td>
<td>Stable fly: Stomoxys calcitrans (L.)*</td>
</tr>
<tr>
<td>(Magalhães)</td>
<td></td>
<td></td>
<td>Dung beetles: <em>Aphodioides granarius</em> L.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Choeroidium histeroides</em> Web. *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Hister</em> sp. *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Onthophagus hecate</em> Panz. *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Onthophagus janus</em> Panz. *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Onthophagus pennsylvanicus</em> Har. *</td>
</tr>
<tr>
<td><em>Hymenolepis sp.</em></td>
<td>Ducks, Geese</td>
<td>Small intestine</td>
<td>Crustaceans: <em>Amphipods</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Copepods</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Ostracods</em></td>
</tr>
<tr>
<td><em>Raillietina magninumida</em></td>
<td>Guinea fowls</td>
<td>Small intestine</td>
<td>Dung beetles: <em>Aphodioides granarius</em> L.</td>
</tr>
<tr>
<td>Jones***</td>
<td></td>
<td></td>
<td><em>Amara fallax</em> Lec. *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Amara musculus</em> (Say) *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Amara</em> sp. *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Selenophorus pedicularius</em> Dej. *</td>
</tr>
<tr>
<td><em>Hymenolepis cantaniana</em></td>
<td>Chickens, Pheasants, Turkeys, Guinea fowl</td>
<td>Small intestine</td>
<td>Stable fly: Stomoxys calcitrans (L.)*</td>
</tr>
<tr>
<td>(Polonio)***</td>
<td></td>
<td></td>
<td>Dung beetles: <em>Aphodioides granarius</em> L.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Aphodioides stercorator</em> (Fabr.) ?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Choeroidium histeroides</em> Web. *</td>
</tr>
<tr>
<td><em>Choanotaenia infundibulum</em></td>
<td>Chickens, Turkeys</td>
<td>Small intestine</td>
<td>Housefly: Musca domestica L. *</td>
</tr>
<tr>
<td>(Bloch)***</td>
<td></td>
<td></td>
<td>Dung beetles: Geotrupes stercorosus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scriba</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ground beetles: <em>Cratacanthus dubius</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Beauv.) *</td>
</tr>
<tr>
<td><em>Metroliasthes lucida</em></td>
<td>Chickens, Geese, Turkeys, Guinea fowls</td>
<td>Small intestine</td>
<td>Dung beetles: <em>Aphodioides sp.</em></td>
</tr>
<tr>
<td>Ransom***</td>
<td></td>
<td></td>
<td>Ground beetles: <em>Cratacanthus dubius</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Beauv.) *</td>
</tr>
</tbody>
</table>

*Found in Illinois. ?Incriminated as intermediate host. ***Not discussed.
<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Primary hosts</th>
<th>Location in body</th>
<th>Intermediate hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Amoebotaenia sphenoides</em></td>
<td>Chickens</td>
<td>Small intestine</td>
<td>Grasshoppers</td>
</tr>
<tr>
<td>(Railliet)***</td>
<td></td>
<td></td>
<td><em>Chorthippus curtipennis</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>(Har.)</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Melanoplus femur-rubrum</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>(Deg.)</em>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Melanoplus differentialis</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>(Thos.)</em>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Melanoplus sp.</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Paroxya clavuliger</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>(Serv.)</em>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Schistocerca damnifica</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>(Saus.)</em>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ascaridia lineata</em></td>
<td>Chickens</td>
<td>Small intestine</td>
<td>Earthworms</td>
</tr>
<tr>
<td>(Schneider)</td>
<td>Ducks</td>
<td></td>
<td><em>Eisenia foetida</em></td>
</tr>
<tr>
<td>(large round-worm)</td>
<td>Geese</td>
<td></td>
<td><em>(Savigny)</em></td>
</tr>
<tr>
<td></td>
<td>Pigeons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkeys</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Capillaria annulata</em></td>
<td>Chickens</td>
<td>Esophagus, crop</td>
<td>Earthworms</td>
</tr>
<tr>
<td>(Molin)</td>
<td>Pheasants</td>
<td></td>
<td><em>Alolobophora caliginosa</em></td>
</tr>
<tr>
<td></td>
<td>Turkeys</td>
<td></td>
<td><em>(Savigny)</em></td>
</tr>
<tr>
<td></td>
<td>Bobwhite quail</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ruffed grouse</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Capillaria spp.</em></td>
<td>Chickens</td>
<td>Esophagus, crop,</td>
<td>Earthworms</td>
</tr>
<tr>
<td>(small round-worms)</td>
<td>Ducks</td>
<td>proventriculus, and</td>
<td><em>Alolobophora caliginosa</em></td>
</tr>
<tr>
<td></td>
<td>Geese</td>
<td>intestinal tract</td>
<td><em>(Savigny)</em></td>
</tr>
<tr>
<td></td>
<td>Guinea fowls</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pheasants</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pigeons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkeys</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Heterakis gallinae</em></td>
<td>Chickens</td>
<td>Ceca</td>
<td>(Direct life history)</td>
</tr>
<tr>
<td>(Gmelin)</td>
<td>Ducks</td>
<td></td>
<td>Earthworms may serve as vectors.</td>
</tr>
<tr>
<td>(cecal worm)</td>
<td>Geese</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guinea fowls</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pheasants</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pigeons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkeys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Primary hosts</th>
<th>Location in body</th>
<th>Intermediate hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Harteria</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>gallinarum</em></td>
<td>Chickens</td>
<td>Ceca</td>
<td>White ant or termite</td>
</tr>
<tr>
<td>(Theiler)**</td>
<td></td>
<td></td>
<td><em>Hodotermes pretoriensis</em></td>
</tr>
<tr>
<td><strong>Syngamus</strong></td>
<td>Chickens</td>
<td>Trachea and bronchi</td>
<td>Intermediate host not</td>
</tr>
<tr>
<td><em>trachea</em></td>
<td>Geese</td>
<td></td>
<td>necessary, but the following may be vectors:</td>
</tr>
<tr>
<td>(Montagu)</td>
<td>Pea-fowls</td>
<td></td>
<td><em>Helix aspersa</em> O. F. Müller</td>
</tr>
<tr>
<td>(gapeworm)</td>
<td>Pheasants</td>
<td></td>
<td><em>Chepea hortensis</em> (Müller)</td>
</tr>
<tr>
<td></td>
<td>Pigeons</td>
<td></td>
<td><em>Helicella herpensis</em> Mab.</td>
</tr>
<tr>
<td></td>
<td>Turkeys</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wild birds</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acuaria</strong></td>
<td>Chickens</td>
<td>Wall of gizzard</td>
<td></td>
</tr>
<tr>
<td><em>hamulosa</em></td>
<td>Pheasants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Diesing)</td>
<td>Turkeys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Cheilospiro *</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>ura</em> hamulosa)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(gizzard worm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Oxyspirura</strong></td>
<td>Chickens</td>
<td>Under nictitating</td>
<td></td>
</tr>
<tr>
<td><em>mansonii</em></td>
<td>Ducks</td>
<td>membrane of eyes</td>
<td></td>
</tr>
<tr>
<td>(Cobbold)</td>
<td>Pea-fowls</td>
<td>or orbital and nasal</td>
<td></td>
</tr>
<tr>
<td>(eye worm)</td>
<td>Turkeys</td>
<td>cavities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wild birds</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tropisurus</strong></td>
<td>Chickens</td>
<td>Proventriculus</td>
<td></td>
</tr>
<tr>
<td><em>americanus</em></td>
<td>Quails</td>
<td>(glandular</td>
<td></td>
</tr>
<tr>
<td>(Cram)</td>
<td></td>
<td>stomach)</td>
<td></td>
</tr>
<tr>
<td>(Teirameres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>americana</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(proventricular</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>worm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tropisurus</strong></td>
<td>Chickens</td>
<td>Proventriculus</td>
<td></td>
</tr>
<tr>
<td><em>fissipinus</em></td>
<td>Ducks</td>
<td>(glandular</td>
<td></td>
</tr>
<tr>
<td>(Diesing)</td>
<td>Pigeons</td>
<td>stomach)</td>
<td></td>
</tr>
<tr>
<td>(Teirameres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>fissipina</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(proventricular</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>worm)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Primary hosts</th>
<th>Location in body</th>
<th>Intermediate hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gongylonema ingluvicola Ransom*** (crop worm)</td>
<td>Chickens, Turkeys</td>
<td>Lining of crop</td>
<td>Dung beetles</td>
</tr>
<tr>
<td>Echinuria uncinata (Rudolphi)*** (crop worm)</td>
<td>Ducks, Geese, Swans</td>
<td>Mucosa of esophagus, glandular stomach, and small intestine</td>
<td>Crustacea</td>
</tr>
<tr>
<td>Acuaria spiralis (Molin)*** (Dispharynx spiralis) (spiral stomach worm)</td>
<td>Chickens, Guinea fowls, Pea-fowls, Pheasants, Pigeons, Turkeys, Sparrows, Robins</td>
<td>Mucosa of esophagus, glandular stomach, and intestine</td>
<td>Pill bugs or sow bugs</td>
</tr>
</tbody>
</table>

*Found in Illinois.  **Incriminated as intermediate host.  ***Not discussed.
INTERMEDIATE HOSTS

DUNG BEETLES

**Aphodius granarius.** Intermediate host for tapeworms *Raillietina cesticillus* and *Hymenolepis carioca*. Magnified x 7.

*Ataenius cognatus.* Intermediate host for the tapeworm *Hymenolepis cantaniana*. Magnified x 7.

(Figs. 20 and 21, courtesy Ill. State Nat. Hist. Survey)

**Choeridium histeroides.** Intermediate host for the tapeworms *Raillietina cesticillus* and *Hymenolepis carioca*. Magnified x 4.

**Phanaeus carinifex.** May serve as secondary host for the crop worm *Gonyonema ingluvicola*. Magnified x 1½.

(Redrawn from Blatchley)
GROUND BEETLES

Calathus opaculus. Intermediate host for the tapeworm Raillietina cesticillus. Magnified x 4.

(Redrawn from Blatchley)

Amara sp. Intermediate host for the tapeworm Raillietina magninumida and R. cesticillus. Magnified x 4 1/2.

(From specimen loaned by W. P. Hayes)

FLIES


(Figs. 26 and 27, courtesy Ill. State Nat. Hist. Survey)
DRAGONFLIES

A—Leucorrhinia intacta
C—Tetragoneuria spinigera

D—Erythemis simplicicollis
B—Epicordulia princeps

Approximately ½ natural size.

(28)

(29)

Dragonfly larva magnified x 3

These dragonflies are intermediate hosts for the poultry fluke Proshogonimus macrorchis.
COCKROACH

German cockroach, *Blattella germanica*. Incriminated as an intermediate host for the proventricular worm, *Tropisurus americanus*.

(a) First stage, (b) second stage, (c) third stage, (d) fourth stage, (e) adult, all natural size, (f) egg capsule protruding from body, (g) detached egg capsule. *Approximately natural size.*

GRASSHOPPER

Grasshopper, *Melanoplus differentialis* (shown here), together with *M. femurrubrum*, harbors and transmits intermediate stages of the gizzard worm (*Acuaria hamulosa*) and the proventricular worm (*Tropisurus americanus*). Another grasshopper (*Paroxya clavuliger*) is the intermediate host of the tapeworm *Metrohasthes lucida*. Magnified x 1 1/2.

(Figs. 30 and 31, courtesy Ill. State Nat. Hist. Survey)
Both these slugs are intermediate hosts for the small poultry tapeworm, Davainea proglottina. Agriolimax agrestis is also a vector of Syngamus trachea, the gapeworm.

**LAND SNAILS**

A—Polygyra thyroidea
B—Retinella indentata
C—Zonitoides arboreus
D—Ventrilens ligerus

A and D are approximately natural size. B and C are magnified x 1\(\frac{1}{2}\).

(Re drawn from Binney)

These land snails serve as intermediate hosts for the small poultry tapeworm, Davainea proglottina.

**WATER SNAILS**

Physa heterostropha
Natural size.

Amnicola limosa porata
Magnified x 3\(\frac{1}{4}\).

(Re drawn from Binney)

Physa heterostropha has been incriminated as an intermediate host of Davainea proglottina. Amnicola limosa porata is the first intermediate host for the oviduct fluke Prosthogonimus macrorchis.
CLADOCERAN (Water Flea)

![Daphnia pulex](image)

*Daphnia pulex.* Magnified approximately x 25.

*(Redrawn from Ward and Whipple)*

This small crustacean is the intermediate host for the proventricular worm *Tropisurus fissipinus* and the crop worm *Echinuria uncinata.*

PILL OR SOW BUG

![Porcellio laevis](image)

*Porcellio laevis* (shown here), together with two other isopods (*P. scaber* and *Armadillidium vulgare*), is an intermediate host of the spiral stomach worm (*Acuaria spiralis*). Magnified x 5.

*(Redrawn from Sars)*

EARTHWORM

![Lumbricus terrestris](image)

*Lumbricus terrestris* (shown here) and *Eisenia foetida* are known vectors for gapeworms (*Syngamus trachea*). *Eisenia foetida* is also an intermediate host for the tapeworm *Amoebotaenia sphenoides.* Other species of earthworms serve in the same capacity. One-third natural size.
REFERENCES


2. ALICATA, J. E., and JONES, M. F. The dung beetle *Ataenius cognatus* as the intermediate host of *Hymenolepis cantoniana*. Jour. Parasitol. 19 (3), 244. 1933.


8. Recent advances in our knowledge of poultry parasitism. Vet. Med. 27 (1), 30-34. 1932.


INDEX TO PARASITES

The figures in black stand for pages in the main text (pp. 5-36). Those in roman refer to the outline of primary and intermediate hosts (pp. 38-43). Those in italics indicate where illustrations of intermediate hosts will be found (pp. 44-49).

### CHICKENS

**FLUKES**
- Collyriclum faha, 9, 38
- Prosthogonimus macrorchis, 9, 38, 46
- Prosthogonimus rudolphii, 9, 38

**TAPEWORMS**
- *Amoebotaenia* sphenoides, 41, 49
- *Choanotaenia infundibulum*, 40, 45
- *Dacanea proglottina*, 14, 39, 48
- *Hymenolepis cantaniana*, 40, 44-45
- *Hymenolepis carioca*, 15, 40, 44-45
- *Metroliasthes lucida*, 40, 47
- *Raillietina cesticillus*, 12-13, 38, 44-45
- *Raillietina echinobothrida*, 13-14, 39
- *Raillietina tetragona*, 13-14, 39, 45
- *Raillietina magnumudida*, 40, 45

**ROUNDWORMS**
- *Ascaridia lineata*, 18-19, 41
- *Capillaria* spp., 22-23, 41
- *Capillaria annulata*, 22, 41
- *Acuaria hamulosa*, 27, 42, 47
- *Acuaria spiralis*, 43, 49
- *Gongylonema ingluvicola*, 43, 44
- *Harterta gallinarum*, 42
- *Heterakis gallinae*, 23-24, 41
- *Oxyspirura mansoni*, 28, 42
- *Syngamus trachea*, 25, 42, 48-49
- *Tropisurus americanus*, 29, 42, 47
- *Tropisurus fissipinus*, 30, 42, 49

### DUCKS

**FLUKES**
- *Prosthogonimus macrorchis*, 9, 38, 46
- *Prosthogonimus rudolphii*, 9, 38

**TAPEWORMS**
- *Hymenolepis* sp., 40

**ROUNDWORMS**
- *Ascaridia lineata*, 18-19, 41
- *Capillaria* spp., 22-23, 41
- *Echinuria uncinata*, 43, 49
- *Heterakis gallinae*, 23-24, 41
- *Oxyspirura mansoni*, 28, 42
- *Syngamus trachea*, 25, 42, 48-49
- *Tropisurus americanus*, 29, 42, 47
- *Tropisurus fissipinus*, 30, 42, 49

### TURKEYS

**FLUKES**
- *Collyriclum faha*, 9, 38

**TAPEWORMS**
- *Prosthogonimus macrorchis*, 9, 38, 46

**ROUNDWORMS**
- *Hymenolepis cantaniana*, 40, 44-45
- *Hymenolepis carioca*, 15, 40, 44-45
- *Metroliasthes lucida*, 40, 47
- *Raillietina cesticillus*, 12-13, 38, 44-45
- *Raillietina echinobothrida*, 13-14, 39
- *Raillietina tetragona*, 13-14, 39, 45

### WILD BIRDS (Pheasants, Quails, Pigeons, Sparrows, Crows)

**FLUKES**
- *Collyriclum faha*, 9, 38
- *Prosthogonimus macrorchis*, 9, 38, 46

**TAPEWORMS**
- *Hymenolepis cantaniana*, 40, 44-45
- *Hymenolepis carioca*, 15, 40, 44-45
- *Raillietina cesticillus*, 12-13, 38, 44-45
- *Raillietina echinobothrida*, 13-14, 39
- *Raillietina tetragona*, 13-14, 39, 45

### GUINEA FOWLS

**TAPEWORMS**
- *Raillietina cesticillus*, 12-13, 38, 44-45
- *Raillietina magnumudida*, 40, 45
- *Raillietina tetragona*, 13-14, 39, 45
Loss of Vitality  
Reduced Egg and Meat Yields  
Lowered Disease Resistance

—are the prices a poultry raiser pays for harboring parasitic worms in his flock. Correct diagnosis of the type or types of parasite with which a flock is infested is the first step in eradication or control.

This circular describes and illustrates the different internal parasites known to infest Illinois flocks, shows many of the intermediate hosts that are involved, and outlines—

Simple—Inexpensive—Practical  
Methods of Control