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THE
PARASITIC DISEASES
OF
POULTRY.

BY

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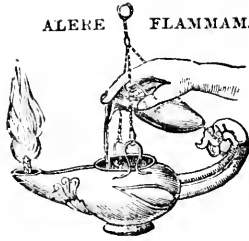
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* In a work on New Mallophaga published this year, by V. L. Kellogg, the Mallophaga are treated as a distinct order of Insects; and this order is subdivided into two sub-orders, (i.) *Ischnocera* and (ii.) *Amblycera*—the characters being taken from the antennæ and the labial palps.

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PREFACE.



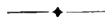
THE fact that Poultry-breeding is increasing to such an extent in England, and the numerous enquiries the Author receives regarding the many parasitic diseases to which Poultry are subject, has influenced him in issuing this small Manual relating to the parasitic infestation of Fowls and the various methods of coping with such diseases. The worst parasitic diseases in Fowls are due to animal parasites, such, for instance, as the 'Gapes' and Diphtheritic Roup; a few minor complaints are, however, due to Vegetable Parasites—minute fungi. In many cases the knowledge of the life-history of these enemies helps us to be able to battle with them more successfully. One of the objects of this Manual is to place before Poultry-keepers all the changes through which these pests go, with reference particularly to those points in their life-history that are of some economic importance. My best thanks are due to the many

Poultry-keepers who have sent me diseased birds to investigate and experiment with. For these and all other Poultry-breeders and Fanciers this book is written, with the hope that the too persistent loss from parasitic infestation may be considerably lessened.

Wye Court, Wye, Kent.

October 1896.

INTRODUCTION.



PARASITES AND PARASITISM.

THAT many, if not most, animals have upon and within them other and smaller animals and fungi—parasites or ‘guests,’ as they are generally called—is now a well-established fact. Regarding these ‘guests,’ always unbidden, and their effects upon their ‘hosts,’ there is considerable universal ignorance that Science is doing much to obliterate. The scientist, also, is sometimes in the dark concerning these parasitic forms; but rapid strides have been made in Parasitology during recent years. Many complicated life-histories of parasitic forms have now been unravelled, yet a vast field of research and careful experiment is still open. At one time parasites were thought to be part and parcel of the host upon which they lived. This absurd notion has long since been dispelled; yet it is still most difficult to make those who are not of a scientific

or enquiring turn of mind believe in many of the complicated life-histories of the unbidden guests that attack our farm-animals and ourselves. There are many who look upon the marvellous and complicated changes of some of the parasitic worms as mere 'fairy tales;' but doubtless the hand of time will obliterate this bigotry.

In Poultry the parasites have not such a complicated metamorphosis as we see in many that attack other farm-stock, unless it be amongst some of the innumerable Tapeworms that are found in the intestines of the Common Fowl; for most Cestode worms have two distinct hosts during their development—one in which the curious 'cystic' or 'bladder-worm' stage is found; another in which the adult sexual Tapeworm takes up its intestinal abode.

There are both Vegetable and Animal Parasites upon warm-blooded animals, although the former are few compared with the vast army of animal 'guests.' The vegetable enemies are of extremely low form—minute fungi, which nevertheless often cause very obnoxious parasitic infection, notably the human 'Ringworm,' which is not due to a worm at all, but to a microscopic fungus, the *Trichophyton*, which also affects animals and from which we can take the disease.

Amongst Poultry we have at least one serious 'vegetable' malady—the so-called 'Favus,' disfiguring the comb, wattles, and head generally of the bird. The minute 'spores' or seeds of these vegetable parasites are carried about in the air, so that they have a chance in the 'struggle for life' of increasing their race by other means than direct contagion.

It must be remembered, however, that these parasitic diseases are highly infectious. Many of the parasitic fungi have most interesting and almost marvellous life-histories; but as this class of disease is seldom manifest in the Fowl, they will only be briefly referred to in this small Manual. If vegetable parasites are wonderful, we must expect to find similar extraordinary cases of this degraded form of life in animals. In the animal world nearly every group of invertebrates has its degenerate members, some so far debased by their methods of living as to become almost unrecognizable in regard to their true relationship. With parasitism we find concomitant the loss of many structural elements owing to disuse: for instance, some of the small Crustacea that live entirely in fish, and which have no need of legs or even organs of sense, so needful in the struggle for life, have entirely lost these organs and appendages. On the other hand, there are many Entozoa that still retain their typical form. The more

important groups of animals amongst which parasitism is found are :—the Protozoa, or the ‘single-celled’ animals ; the Vermes, or the ‘worms’ ; the Arthropoda, or jointed-limbed animals (Insects, Mites, &c.).

Some members of all these three divisions are found in or on Poultry. The simplest, the Protozoan guests, are at present but little understood. Their small size renders their study extremely difficult ; hence the life-histories of many are still incomplete. Nevertheless we now know that they are responsible for that pestilential malady, *malaria*—minute parasitic amœboid forms in the blood being answerable for its deadly effects. As in man, so in animals and birds—Protozoa undoubtedly cause the liver-rot in rabbits (*Coccidiosis*), and the majority of cases of Diphtheritic Roup in poultry examined by the author have been caused by similar lowly forms.

The three chief groups of parasitic worms are known as the Flukes or Trematoda, the Tapeworms or Cestoda, and the Round-worms or the Nematoda. Poultry unfortunately suffer from all three of these. The Flukes and Tapeworms, although much more abundant in species (as will be seen in the list of Poultry Parasites), are not nearly so injurious to *Gallus domesticus* as the Nematode worms, for one

of these produces the dreaded 'Gapes,' and another is often too abundant in the intestines.

Amongst the Arthropoda the chief culprits are the Mites (*Acarina*) and the Lice (*Mallophaga*). The latter are true degraded insects—insects devoid of wings but, unfortunately for the Fowl, still possessed of a very powerful biting-mouth. The Mites, on the other hand, are often provided with a sucking- and piercing-mouth, which they plunge into their unfortunate victim and so feast off its blood. These latter can be told from true insects by the presence of four pairs of legs; the Lice, on the other hand, will be seen to possess six legs only—true insects.

Parasitism may be either internal or external, permanent or partial. Internal parasites live in all parts of the vertebrate frame: many, such as the Tapeworms, live in the alimentary canal; others, as the Gape-worm, in the air-passages; even the eye and kidney may be invaded by some unwonted visitant. The Protozoa and Vermes are the chief internal guests, although a few Mites penetrate some distance *into* the skin and air-passages of birds. The external parasites are mainly Insects and Mites, living upon the skin and amongst the epidermal productions, hair and feathers. Sometimes these pests live permanently on their host: the Lice of poultry, for instance, seldom leave the birds unless the latter

die. Partial parasites are those that only go to their host to feed—as soon as they have taken sufficient nourishment leaving their ‘object of robbery’ to sleep off the result of their meal in some quiet and secluded spot. The Poultry Flea and the prejudicial Red Hen-Mite have this irritating way of living.

One point economically of no little importance in parasites is that they may require two ‘hosts’ in which to develop, and occasionally one of those hosts happens to be man. *Tænia solium*, the dreaded human Tapeworm, is one of these ; it comes from the diseased pork known as ‘measly pork,’ the flesh of a pig that has eaten the cast-out proglottides or segments (full of eggs) of the human Tapeworm, the eggs from which are changed into the peculiar and repulsive ‘bladder-worms’ or cysts in the pig’s muscle, which on being eaten by man again become Tapeworms. Similarly, *Trichinosis* is taken by human beings by eating the flesh of pigs suffering from this disease.

Such facts as these make us chary of what we eat. All the more satisfactory is it, then, for us to know that, out of all the innumerable Poultry Parasites, none (so far as we know) are hurtful to us.

Not only do parasites sometimes destroy their host, but they stunt the growth if they commence their attack on young subjects. It is extraordinary how a

few neck and body lice will stunt the growth of chicks and turkey-poults ; yet few poultry-breeders try to check this often serious loss.

The further one investigates these parasitic infestations, the more one is impressed with the absolute necessity of cleanliness and freedom. The diseases described in this book have always been observed to be far more disastrous in dirty and neglected poultry-runs and houses, where the host is kept in unhealthy and unnatural surroundings, and thus rendered a more fitting habitation for its various 'guests,' whilst the parasites themselves are placed in most favourable conditions.

There is yet much as to which we are in the dark concerning Poultry Parasites and their treatment ; and it is to be hoped that poultry-keepers themselves will be on the alert to note and record new facts they may observe in this department, thereby helping perhaps hundreds of others who are liable to have their birds afflicted with the various parasitic diseases here recorded.

THE
PARASITIC DISEASES
OF
POULTRY.

PART I.

ANIMAL PARASITES.

THE Animal Parasites of Poultry will be treated of under the following heads :—

- (1) Protozoan Parasites.
- (2) Insect Parasites (Lice, Fleas, &c.).
- (3) Mite Parasites (Acarina).
- (4) Worm Parasites (Cestodes, Trematodes, and Nematodes).

I. PROTOZOAN PARASITES.

A. DIPHTHERITIC ROUP.

AMONGST the least understood parasitic diseases of Poultry, Diphtheritic Roup stands paramount. That it is due to certain minute and lowly animal forms there is much evidence to show, but nevertheless we know comparatively little regarding the Pathology and Etiology of this often disastrous epidemic in the Poultry World. Like very many things that have not been studied scientifically, Diphtheritic Roup has been commingled with other complaints of a perfectly different facies. Even 'science' is at variance upon this subject, for the nature of this complaint is a subject of very diverse opinions. It is possible, and I feel sure this is the case, that there are three kinds of affections grouped under the name Diphtheria. Two of these are certainly due to minute Protozoan parasites; the third, which I have not so far been able to observe, may be due, as stated, to some minute microbe. Colin and Roux have demonstrated this latter point, and they show that the microbe of Chicken Diphtheria is not the same as produces the similar named disease in man.

Appearance and Symptoms of the Disease.

The disease manifests itself as white and creamy patches in the mouth, pharynx, and even in the crop. The upper surfaces of the growths are slimy

and the mouth also becomes filled with viscid slime, and in advanced cases passes out a foetid odour. The growths spread downwards, enter the œsophagus and trachea, and so cause the death of the individual. The mouth and nose also become blocked by these purulent masses. This disease, which is highly contagious, as a rule coming in an epidemic form, can at once be told by the dejected look of the patient, the frequent glairy mucus exuding from the mouth and nostrils (similar to the exudation in ordinary Roup), and finally by the appearance of the internal excrescences.

Two Forms of Growth.

I have noticed two distinct forms of growth in the bird's mouth, which I also found contained different microscopic organisms. The most virulent, yet most easy to treat, form of growth are the large creamy loose foliate patches, which are often spongy and elongate; these grow rapidly and soon fill up the mouth, and may often be seen exuding from it. The second kind of growth is firmly attached, it occurs in small dots and spindle-shaped patches upon the underside of the tongue and sides of the beak; these latter are firmly embedded in the skin and increase much less rapidly.

Discovery of Parasites in the Growths.

Rivolta and Delprato were the first, I believe, to discover the parasites in these purulent masses, and

they classed these parasites with the *Coccidia*, a group of Protozoa, included in the division Sporozoa, that are parasitic in various parts of animals and birds.

In the smaller white spots, evidently those above referred to, the same investigators found numbers of Flagellata; these 'Infusoria,' or tailed Protozoa, have been named *Monocercomonas gallinæ* by Rivolta.

Pfeiffer has also made observations regarding these flagellate forms, but he regards them as *Tricomas*, minute flagellate forms with two whip-like flagella. My own investigations clearly support the discoveries of the above scientists, but the part played by the *Tricomas* seen by Pfeiffer I could not in any way follow. Fowls would easily take the disease from the *Coccidia* when injected into a scratch in the mucous membrane of the pharynx, but in no case could I 'plant' the disease by means of the flagellate forms.

The Forms of Parasites.

Rivolta states that these *Coccidia* develop in the epithelial cells. In this stage the Protozoan is in a thin shell, which contains a number of spores, lemon-shaped in form, and known as 'pseudo-navicellæ.' These spores in due course turn into true amœboid forms, the so-called embryos of *Coccidia*; and, according to the above authority, these amœbulæ can migrate between the epithelial cells. On reaching the topmost layer of epithelium they take up their abode in the youngest cells, where they become

shining, globular bodies, forming small granular excrescences. Fresh spores are here continually being developed, and thus spreading the growth. In these growths I have *nearly* always been able to discover numbers of pseudo-navicellæ (fig. 1, *b*), which are undoubtedly the spores of one of the Sporozoa, and which I found likewise gave rise to amœbulæ such as Rivolta described (fig. 1, *a*). On inoculating five Fowls

Fig. 1.



Pseudo-navicellæ and Amœbulæ.

with these germs, the usual diphtheritic symptoms made their appearance in about ten days. These spore-cases, full of pseudo-navicellæ and scattered spores, were generally found in the deepest parts of the growths together with numbers of amœbulæ. In several birds I examined, however, which were in an advanced cachectic condition, and which had these diphtheritic masses of immense size and comparatively loose, one might almost describe them as 'ripe,' no traces whatever could be found in the purulent mass of granular matter. Probably the disease had worked itself out.

In several cases both Rivolta and Pfeiffer have observed flagellata in these growths. The form observed by Rivolta in pullets and young Pigeons has one flagellum as long as the cell at the obtuse end of the body, the other or acute end of the body being provided with three flagella united at the base ; these round or discoidal bodies, pale in colour, he named *Monocercomonas gallinæ*. The affection caused by the millions of these minute organisms is, he says, distinguished from diphtheria by the exudate being only slightly attached to the mucous membrane. I found these loose growths contained spores of Coccidia and only flagellulæ in the uppermost layers occasionally. Many of the flagellulæ apparently had only one flagellum, and I believe were nothing more than a flagellate form of Coccidia. There were also numbers of Tricomas in two instances in the slime on the top of the exudations.

Pfeiffer states that these Tricomas lose their mobility in the tissues, and assume an amœboid condition, the encysted form and even that of round cells.

The above authority looks upon the presence of bacilli in this form of diphtheria as secondary, and that they only appear when these parasites have broken up the epithelium ; and this my observations entirely endorse.

Cornet and Babes found that the flagellata die after being multiplied in culture-broth for a few days, and they believe that these flagellata only play a

secondary part. Löffler has, I believe, described bacilli in this avian affection, and states that they are always present in the false membranes of diphtheria. Nevertheless direct inoculations of some of these simple protozoan forms has given the subject the disease; and as even the opponents of this theory always acknowledge their presence, we must conclude that they are sometimes, if not in every case, the cause of this often serious malady in poultry. The subject requires much further investigation and experiment.

One thing we know for certain; and that is, that the disease is most contagious, and often spreads rapidly through a poultry-run. Unless treated in time it generally ends fatally.

Prevention and Treatment.

One of the most important steps to take in regard to this disease is to ensure the complete isolation of the affected bird, as the disease is highly contagious. As a rule it appears in an epizootic form amongst poultry. This can often be prevented, however, by the immediate isolation of the patients and the application of salicylic acid to the fowls' drinking-water, which should be very limited, and watering the ground of the poultry-yard or pen with a 2 p. c. solution of sulphuric acid. About one pint of 10 p. c. salicylic acid (dissolved in alcohol) to an equal quantity of water should be given the fowls for drinking for some days, as the acid destroys any

of the wandering germs that may possibly take up their abode in the fowl's mouth.

Those that are suffering from this complaint should be at once attended to. The mouth should, as far as possible, be freed from all the growths. One form can easily be removed with two needles from the mucous membrane. The membrane under the growth will be found to be white and unhealthy, many of the parasites may remain on this, thus touching it with a strong solution (10 p. c.) of boracic or, better still, salicylic acid should invariably be practised. The whole mouth should also be well cleaned out, the birds given only a limited quantity of water, with the salicylic acid as mentioned on page 7. I have found most obstinate and advanced cases give way under this acid. In the case of those firmly embedded growths under the tongue and upon the sides of the mouth, more difficulty will be experienced in treatment. The way I have followed, generally with success, is to paint the white spots with iodine, or by the employment of lunar caustic burn them away, at the same time dressing the spots and mouth with either boracic or salicylic acid as before.

In its *early* stages the disease can be easily cured, but if once allowed to get into either the œsophagus or trachea the case of course is hopeless. So long as the mouth only is invaded, the disease is amenable to the above method of treatment.

For numerous cases of this disease for experimental purposes I have to thank Mr. Cobb, the late manager of the Manor Poultry Farm.

B. EPITHELIOMA CONTAGIOSUM.

A similar complaint to the preceding is found attacking the comb and wattles of birds. This cutaneous affection is known under a variety of names—more generally, however, as Epithelioma Contagiosum and Cutaneous Psorospermosis.

Appearance of Disease.

The disease, which is generally limited to the head, manifests itself as yellowish-brown nodules varying in size from a minute speck to a small bean. In form the nodules are generally roundish, and become at first depressed in the centre. On pressing them a purulent yellow exudate appears. I have only seen this disease on the head, but it has also been recorded on the neck, rump, chest, and abdomen. It affects Pigeons to a greater extent than Poultry.

Probable Cause of Disease.

After a time the nodules form crusts of a brownish colour, and under these in the lowest parts I have found numbers of Coccidia, which seemed to be similar to those in diphtheritic growths.

Rivolta regards these parasites as a distinct form which he named *Amœba croupogena*. So far as is

known at present, this disease is a true Coccidiosis of the skin. At the commencement these Sporozoa are small, round, nucleated protoplasmic masses. These masses by degrees increase in size, and then become surrounded by a thin shell. These encysted bodies appear to burst the epithelial cell into which they have entered. Then each encysted mass becomes broken up into spores internally. Each spore again subdivides into two or more bodies known as falciform spores, which when liberated become amœboid forms ; these then invade other cells, generally taking up their position in the Malpighian stratum of the skin. In this latter position they commence again a similar life-history, and so the disease is spread.

Fowls inoculated with this germ develop the disease in about eight to ten days. In Poultry the growths are seldom found except on the comb, wattles, and near the mouth.

Effects of the Disease.

The disease may or may not prove fatal if left alone. The fowls become gradually emaciated and the feathers erect when severely attacked. Often this and diphtheritic roup appear together, and then, unless stringent measures are taken, death is sure to ensue.

Prevention and Remedies.

The disease is contagious, and thus any affected bird should be at once removed and isolated. The best method of treatment is to paint the growths

with oil of turpentine. Cauterization is also adopted with success. Before treatment the head should be bathed in warm water and soft soap, and any of the crusts should be carefully removed, care being taken to prevent bleeding. The runs in which the birds have been living should be cleansed with some of the numerous disinfectants.

C. FURTHER PROTOZOAN PARASITES.

Other Protozoan parasites found in the Fowl are as follows :—

Trichomonas Eberthi : this flagellate is found in the glands of Lieberkühn of the fowl's intestine, but not sufficiently to cause any serious disease.

Coccidium tenellum (= *Rivoltae*) is also found in the intestines in some numbers.

Gregarina avium intestinalis.—This was observed by Rivolta in the submucous connective-tissue of the intestines, in the form of oval, globular cysts, filled with pseudo-navicellæ (spores). This protozoan appears sometimes sufficiently abundant to produce severe epizootics, causing violent diarrhœa and often death. This possibly is the same as the

Eimeria dubia, described by Railliet in 1892.

A *Sarcocystis* has also been found in the muscles. For others see Appendix.

II. INSECT PARASITES.

The chief insect enemies of the Gallinacæ are found amongst the orders Diptera and Neuroptera—the former being armed with a sharp piercing-mouth, the latter with biting-mouths. The Diptera are those insects which are typically characterized by possessing one pair of wings only, the second pair being reduced to minute club-shaped processes called halteres, balancers, or poisers. All the Diptera pass through a complete metamorphosis—that is, they have an active larval or maggot state, which on reaching maturity gives place to a quiescent period, known as the pupal state, the insects then taking no food whatever; in this condition the larva is transformed into the perfect insect or imago. There are some few Diptera, however, that are devoid of wings, notably the Fleas (*Pulicidæ*) and some of the Ticks (*Pupipara*). The former are the chief true dipterous enemies of the Fowl. A few others referred to are not of any great import.

The second group of insect pests are the Bird-Lice or *Mallophaga*. These Lice, of which there are eight species found on the Fowl in our country, are armed with a biting- and not a sucking- and piercing-mouth, such as we see in the *true* Ticks (*Pupipara*) and Acarina or Mites. Their true systematic position is not clearly defined; in all probability they are closely related to the Neuroptera. In this order they are placed by Dr. Sharp in his admirable account of the Insecta

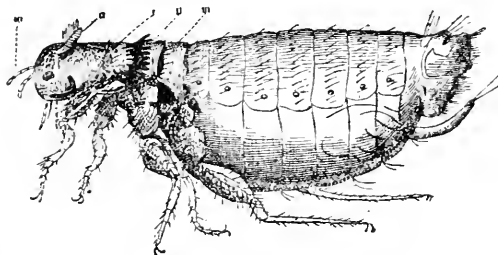
in the ‘Cambridge Natural History.’ They likewise are apterous insects, and undergo an incomplete metamorphosis—that is, there is no distinction between the larval, pupal, and imago states, except in size and colour; they are active during the whole of their existence, and live upon the epidermal productions of the skin and feathers.

A. FLEAS (*Pulicidæ*).

A single species of Flea known as *Pulex gallinæ* or *avium* (fig. 2) lives upon the Fowl. This same species seems to be common to most birds, for I have found it in various nests, as recorded in my ‘Account of British Diptera.’

This pulex, like all its relations, is provided with a sharp piercing-mouth, which they plunge into the

Fig. 2.



Hen-Flea (*Pulex avium*).

flesh. Their food consists of blood drawn from the host. Fortunately for the host, they are not permanently parasitic, but partial ‘guests,’ only going

to their host to feed. The irritation caused by the insertion of their proboscis is, as we know sometimes to our cost, very severe. Just as with us so with poultry, and when numbers are present, as they too often are, they not only prevent rest, which is as necessary for a fowl as a human being, but they in young birds often cause such severe pruritus that they stunt the growth, like lice. In the case of sitting hens they also are most harmful, helping on the irritation of the lice, which are so often their fellow lodgers.

The general abode of the Hen-Flea is in dirty nests, where they spend the day, only or generally attacking the birds at night. Anyone can soon catch these vagrants for examination by putting one's hand into a dirty fowl nest, when the little blackish creatures soon hop on to it.

Life-history of the Hen-Flea.

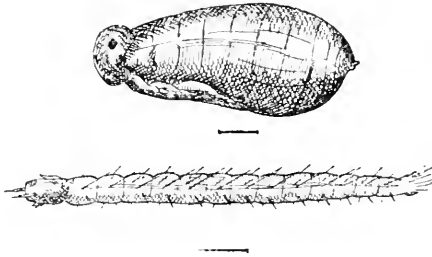
The female flea is somewhat larger than the male ; deep black above, testaceous below, the curious comb-like structure of the back of the first segment of the thorax (prothorax) having twenty-six or more teeth in it, thus distinguishing it from the fourteen species of other English fleas.

The female lays her eggs (nits) in the nests chiefly, but sometimes they are to be found in dung on the floor. Not unfrequently the ova are deposited in crevices in the perches, boards, and in fact wherever there is dirt. It is said that some fleas will live in

their maggot state amongst the productions of the skin of their host—amongst scurf and humours that may be present.

These minute white ‘nits’ in a week or ten days give rise to the larval fleas. On the bursting of the egg-shell there appear at first very minute pearly white maggots, which even in their very early life have the head somewhat darker than the rest of the body. Upon the head will be observed, with a microscope, a curious kind of horn. This horn is for the purpose of rupturing the egg-shell, so that the maggots can more readily escape. When full-grown these flea larvæ (fig. 3) reach one-sixth to one-fourth

Fig. 3.



Larva and Pupa of Hen-Flea.

of an inch in length. They remain pearly white during their whole existence, which may extend to even three weeks. Their length of life, however, seems to depend a great deal upon the temperature, for in warm weather or warm places the larvæ may become full-grown in ten days, or at least two weeks.

On reaching their so-called 'full-fed' state they get into some crevice or amongst dust and dung, and there spin themselves a pale silken cocoon, often covered in dirt.

In this cocoon the maggot changes into the pupal or nymph state (fig. 3), the period of quiescence, when the larva is 'transformed' into the distinct adult. This pupa is at first quite pale in colour, but by degrees its covering hardens and becomes brownish; the wings, feelers, legs, and eyes of the future adult flea are now to be seen marked out upon the pupal skin, closely folded and soldered together. From ten to twenty-one days is the length of time passed in this condition. At the close of pupal life the shell, as it were, of the pupa, splits, and from it there crawls the future active degenerate little dipteran, destined to form a cause of great annoyance to our poultry.

The Hen-Flea breeds all the year round, but is more productive in warm weather. It is very widely distributed in Great Britain as elsewhere.

Like most members of this extremely active family, it will not live upon any but its own particular 'host.' That 'Hen-Fleas' will settle upon us when we enter dirty hen-roosts of course is well known, but they will not live, even if transferred to our houses. Regarding their so-called bite, possibly some thin-skinned people may suffer from them, but, as a rule, they have little effect upon human beings.

Regarding the food of the larva there is much

discussion. In the case of the Human Flea (*Pulex irritans*) it is said that the female, or 'mother' flea, after taking a sumptuous feast of blood from her host, repairs to the larvæ and disgorges part of her meal for the benefit of her offsprings. We know that Earwigs look after and tend their young, and it may be that this is also the case amongst that nimble but obnoxious group of parasites the Fleas.

That the larvæ of the Hen-Flea feed upon the scaly productions of the quills of the feathers seems also possible. The exact food, however, is still unsatisfactorily settled; possibly they feed upon a variety of substances.

One of the most important things for us to remember in regard to not only the Hen-Flea, but to all fleas, is that they love dirt, bad air, and any unhealthy conditions. Wherever we find dark, dirty, and badly ventilated hen-roosts, there shall we find also innumerable creeping things.

Prevention and Destruction of Fleas.

By doing away with the above conditions, we shall to a large extent do away with this pest.

The frequent use of limewash, especially if a small quantity of paraffin or kerosene oil be added, will not only block up those crevices in which the young pulices pass part of their lives, but it will *destroy* the larvæ, and at least drive out the adults. It is a good plan to put a small quantity of size in the wash, which should be as liquid as possible, so as to make

it adhere more firmly to the walls. The sprinkling of finely powdered lime upon the floors of the houses and into the corners will tend much to help their eradication, whilst the perches should also receive their share of attention. As pointed out later on, both these and the nests should be movable, relays of them being kept, so that they can be completely purified at intervals. It is extremely difficult, of course, in old sheds and houses where poultry are often kept, to keep off these insects. To remedy this, however, it is quite possible, and most advisable, to dress the nests with some powder that will ward off these invaders and yet not affect the eggs. There is nothing I find better for this purpose than to use 'wood-wool' or wood shavings, instead of the much employed straw. There is something nauseating to the fleas about 'wood-wool' which tends to keep them away from the nests, and I have found that the flavour of the eggs is in no ways impaired. Failing the use of wood-wool, the well-known Keating's Insect Powder dusted about the nests once a week will keep off all marauders. Similar successful results in keeping off noxious insects from sitting birds have been obtained by the simple method of putting a small quantity of sawdust soaked in naphthalin in each nest.

B. LICE (*Mallophaga*).

The Lice which prey upon Birds are quite distinct from those affecting animals and man. They are

scientifically known as *Mallophaga*, and are true insects. Their exact place in classification is not conclusively settled. They show in many respects close relationship to the order Neuroptera, the group of insects that includes the Dragon-flies, Lace-wing-flies, and others. They are quite distinct from the Human Lice or *Pediculidæ*, and equally distinct from most of the Mammalian Lice (*Hæmatopinæ*). The true Bird-Lice have a mouth formed for biting and chewing their food; the Human and Mammalian Lice have the mouth formed into a piercing-organ, by which they *suck* out the blood of their host. The Mallophaga, sometimes known as the *Ricinidæ*, subsist upon the productions of the skin. They also devour the fragments of feathers, and even (sometimes to a most alarming extent) feed upon the barbs of the feathers, especially attacking the saddle-hackle—the feathers of the latter showing curious jagged and notched edges in lice infestation.

Closely related, however, to the Bird-Lice are some Mammalian Lice, or Ticks, known as *Trichodectes*. These so-called Ticks are quite distinct from the general run of Mammalian forms and are very abundant. They are provided, like the Bird-Lice, with a biting-mouth, but they can at once be distinguished from the latter by the structure of those remarkable sensory organs common to all insects, namely the antennæ or ‘feelers.’

On examining one of the commoner Bird-Lice, these antennæ will be found to be composed of either

four or five joints. Compare the Mammalian Lice with the biting-mouth, and you will only find three joints constituting the antennæ. The reason I am pointing out this structural character is because, owing to the similarity between these two groups, they are often confounded with one another, and you find such statements in Poultry Journals as that poultry lice can be transmitted to animals and *vice versâ*. A few minutes' examination with a microscope would soon dispel the idea that the lice, for instance, on horses are similar to those on fowls. So particular are Bird-Lice, that it is quite the exception to find one species upon two distinct kinds of birds. Fowl-lice will not even attack the duck, nor duck-lice the fowl. Nearly every bird has its own particular Mallophagan parasite or parasites. They may possibly pass to some strange host for a short time, but they will not live and breed. Moreover, we shall see later on that particular species attack restricted areas on the same host, and are seldom found in other positions.

Damage caused by Lice.

The damage caused by Lice is often very considerable, and in many cases it is entirely overlooked, or even if the cause is known little attention is paid to the matter, and wonder is still expressed if the poultry do not flourish. The serious loss occasioned by lice cannot be too fully considered by poultry-breeders and fanciers.

By constantly biting at the skin violent irritation

is set up. The rest of the fowls is disturbed, and a general weak and cachectic condition will be sure to prevail if the parasites are present in force and no steps are taken for their destruction.

Brood-hens are frequently much inconvenienced by lice, many failures in hatching being due to their constant irritation.

It is, however, chiefly in chicks that the mischief is caused. The lice, as it were, sap the life-blood out of the young growing birds. The result is that by this constant biting, causing violent pruritus and inflammation in the affected parts, the growth of the birds is checked, and stunted birds are the consequence.

Some experiments in this direction showed that chicks suffering from lice, at the end of the year, weighed one pound less than those which had been kept free from these pests, both having exactly the same diet.

It must be remembered that the sharp biting and violent irritation causes considerable pain to the bird, when these parasites are present in abundance.

We often find that lice are present in superabundance in fowls suffering from Diphtheritic Roup and Gapes. As a rule the lice are the precursor of these two maladies, especially the former. By their deleterious effects the constitution of the host becomes impaired, and thus, just as with human beings, rendered more liable to contract any such infectious complaint as Diphtheritic Roup is well known to be.

The different species seem partial to particular

parts of the host ; their favourite positions are the neck, rump, under the wings, and between the wing-feathers. Certain species seem to be restricted to given areas ; others wander about upon the host to some extent.

The presence of these lice in chicken is ascribed to a variety of causes. Food, if too uniform, is stated to be answerable for their presence. Insufficient nourishment again is said to help them to flourish in chicken-runs. Neither, I find, have any real bearing on this parasitic affection. On the other hand, dark, damp, badly ventilated, and above all dirty runs and houses are sure to encourage them, and make the fowls acceptable to their presence.

The irritation, pruritus, and cachectic conditions produced by these gallinaceous 'guests' is usually spoken of as *Phthiriasis*.

Varieties of Fowls affected.

It is sometimes stated that breed affects their presence. This, however, is contrary to all information sent me and to my own experience.

Certainly the more delicate varieties of fowls suffer to a greater extent than the hardier breeds. Cochin Chinas, for example, are very prone, both as chicks and adults, to Phthiriasis. White Brahmas are again much affected by lice.

Plymouth Rocks alone seem to be indifferent to these unbidden guests. So far I have not noticed any lice on Bantams ; but I have no doubt they affect

them like all other Gallinaceæ. (They are recorded by Neumann as attacking Bantams.)

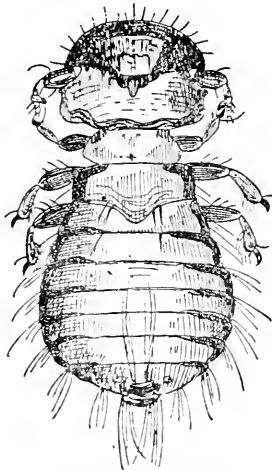
Species of Lice found on the Fowl.

There are eight distinct species of Mallophaga found on the Fowl in England. Seven of these have been known for a considerable time. The eighth species, which is quite new, was forwarded to me by Mr. Till, of Eynsford, Kent. Two of these belong to the genus *Goniodes*, two to the genus *Goniocotes*, two to the genus *Lipeurus*, and two to the genus *Menopon*.

The seven previously described species are characterized by the following points :—

- (1) *Goniodes dissimilis* (fig. 4).—Dull white to pale

Fig. 4.



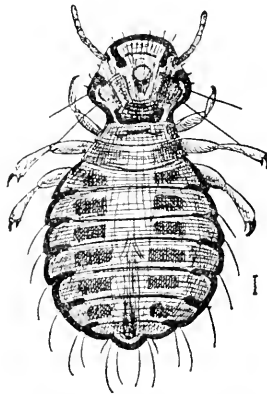
Goniodes dissimilis.

brown in colour, with dark chestnut-brown markings ;

end of abdomen slightly bifurcate. Head wider than long; in the female the first joint of the antennæ is most developed, there is also a long hair on the inner side. On the posterior border of the metathorax are five bristles; in the abdomen there are two median bristles and three at the sides of the anterior segments, four at the posterior; each segment has also a curved marginal dark mark. Length in ♀, 2·5 mm.; in ♂, 2 mm.*

This is an abundant species on most varieties of fowls, and is especially located under the wings and on the rump. According to Denny †, whose work appeared some time ago, this species is rare. It seems to be more abundant in the South than the North of England.

Fig. 5.

*Goniocotes hologaster.*

(2) *Goniocotes hologaster* (fig. 5).—This species is

* A millimetre (mm.) = $\frac{1}{25}$ th of an inch.

† Monographia Anoplurorum Britannicæ, 1842.

much smaller than the former and of commoner occurrence. Dirty yellow in colour, somewhat chestnut-brown toward the thorax. The head is as wide as long. Two large bristles on each side of the lower angles and a few short ones in front. The abdominal segments being marked with dark brown, quadrangular lateral bands. A single hair on each side of the segments, except the last two, in which there are more. Length in ♀, 1·3 mm.; in ♂, ·8 mm.

G. hologaster is very partial to the rump and back.

(3) *Goniocotes gigas*.—This is a large species, not very abundant. It can be told by its large round abdomen. Yellow in colour. The abdomen has pale brown patches, coloured with dark brown at the border. Length in ♀, 4 mm.; in ♂, 3 mm.

I have not observed this species *on* the fowl myself, and am not aware if it locates itself in any particular part.

(4) *Lipeurus variabilis* (fig. 6).—The members of this genus have long narrow bodies.—Narrow elongated abdomen; pale yellowish, with dark brown bands and fawn-coloured spots, there is a dark brown middle spot beneath the thorax. Head quite rounded in front, with a dark border and a number of marginal hairs. End of the abdomen bilobed, with a genital lance-shaped spot; last six abdominal segments with from one to three hairs on each side. Length in ♀, 2·2 mm.; in ♂, 1·9 mm.

This is a very abundant and widely distributed species in most breeds of fowl. It lives amongst the

Fig. 6.

*Lipeurus variabilis.*

barbs of the primary and secondary wing-feathers, amongst which they remain stationary, but can move with great rapidity if they choose.

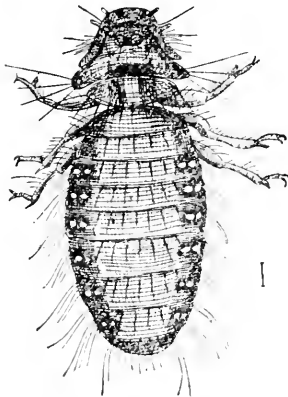
(5) *Lipeurus heterographus*.—Very similar to the former in colour, but smaller in size, and the head is parabolic, not rounded as in *variabilis*. The abdomen is also more oval; in the female there are six bristles springing from tubercles on each segment; there are also median brown spots on each segment, bordered with large hairs. Length in ♀, 2 mm.; in ♂, 1·8 mm.

This species is not nearly so abundant as the preceding. It lives in exactly the same manner.

(6) *Menopon pallidum* (fig. 7).—Dull yellow in colour, with darker side markings ; in each segment of the abdomen are two pairs of lateral pale dots. The head is angular in front, with four bristles and some hairs on the lower angles, a few hairs also on each side. The abdomen is oval in the male, slightly longer in the female, with a series of bristles on each segment.

This louse is extremely active and smooth to the touch. This is the species found running over the hands whilst plucking fowls. It is extremely abundant and lives in all parts of the body, constantly changing its position. On many occasions I have found these lice *in* the nests, and possibly this and the next species are spread in this way from bird to bird, as well as during copulation.

Fig. 7.

*Menopon pallidum.*

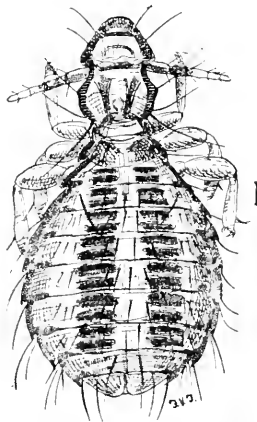
(7) *Menopon biseriatum*.—This is like the preceding

in colour, only it has a rounded head and two series of bristles on the segments. It is larger than *pallidum*, and the male is larger than the female. Length in ♀, 2·3 to 2·5 mm.; in ♂, 2·8 mm.

Found on the turkey, pigeon, and pheasant, as well as upon fowls.

(8) *Goniodes Eynsfordii*, n. sp. (fig. 8).—Tick-like in appearance. Ground-colour of *female* pale yellowish white or grey, the lateral bands dark shining chestnut-brown. A double pair of horizontal lateral stripes on each segment, chestnut-brown in colour,

Fig. 8.



Goniodes Eynsfordii.

much darker towards their outer edges, and forming a ready feature of distinction for the species. Four long bristles on front of head and two large pairs of posterior ones. The 5-jointed antennæ slightly hairy

at tip. Metathorax with four lateral bristles. Four anterior abdominal segments with a single lateral bristle, fifth and sixth with two lateral bristles, seventh with four. Anal segments bilobate, with four long and two short bristles. Each segment has four central and three pairs of lateral bristles, except the last, which has two large central ones. Legs thick, a single bristle on the tip of each tibia.

The male is narrower than the female, bright yellowish brown, borders of the segments very dark brown. Five pairs of fine bristles on the head and one large one on each side of the posterior angle. Each abdominal segment with a pair on each side. Abdomen dark in centre. Legs not so thick as in the female; three hairs on femora of second and third pairs. Length in ♀, 2·6 to 2·7 mm.; in ♂, 2·8 to 2·9 mm.

This species does not seem to leave the head and neck. It is especially abundant in chicks in the above-named positions. Specimens were first sent me by Mr. Till, of Eynsford, who finds they are most prejudicial to the health of the birds. They are found with their heads buried in amongst the feathers and their bodies in the air, just like a Tick. A full account of this species will be found in the Journal of the S.E. Agric. College, No. 5.

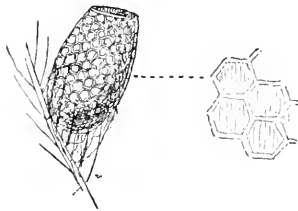
Life-history of Chicken-Lice.

Apparently Chicken-Lice breed all the year round, but more abundantly in the spring of the year than

at other times. Reproduction is fairly rapid under favourable conditions.

The eggs laid by the female have, I believe, only once been described; they are beautifully sculptured objects, oval in form, and, most that I have examined, truncated at the top. These 'nits' in *G. Eynsfordii* are covered with small hexagonal sculpturings (fig. 9). The ova are laid amongst the feathers of the birds, especially amongst the 'down' feathers; they are attached to the feathers by numerous fine threads around their base, as seen in the figure. In from six to ten days these hatch into small pale lice, which

Fig. 9.



Ovum of *Goniodes*.

at once commence to irritate the birds. There is little difference between the young and adult lice; they gradually become darker in colour. Some kept by the author moulted as many as twelve times, but this surely must be exceptional. There is no pupal stage in these insects; they undergo what we call an incomplete metamorphosis, remaining active all their life, no passive stage or pupa intervening as we saw

in the 'Hen-Flea.' There is little doubt but that reproduction takes place chiefly upon the host, although the writer has found on many occasions *Menopons* in copulâ in the nests. The two *Goniocotes* have only been observed in copulâ on the birds. Although the two *Menopons* are found often plentifully in the nests, they nevertheless spend most of their time upon the fowls. Mallophaga apparently live for a considerable time, for the author has kept *M. pallidum* alive for nine months on fresh feathers, they seemingly eating the quill-epidermis.

Mode of Distribution.

There are three ways in which Lice are spread from fowl to fowl. Firstly during copulation ; an infested cock will soon distribute the lice to all the hens. Secondly, there is no doubt that anyhow some of the eight species leave the birds and may be found in the nests occasionally, and thus crawl upon the hens sitting subsequently upon the same nest. Thirdly, as Dr. Sharp says :—"Possibly Mallophaga may be transferred from one bird to another by means of the parasitic two-winged flies that infest birds." This very probably does take place, but we must not overlook the fact that the parasitic two-winged flies spoken of, namely the *Ornithobia pallida* and the *Ornithomyia avicularia* (figs. 10 and 11), are not so very common on fowls. They have never been recorded to me as injurious to any serious extent, but

it is well known that they do occasionally enter the ear and nose of the fowl, duck, and gosling.

Dr. Sharp has observed this method of transference himself. In 1890 he exhibited, at the Entomological Society of London, a specimen of the *O. avicularia*, taken at Dartford, to which there were firmly adhering several specimens of a Mallophagous insect.

Prevention and Remedies.

Just as in the prevention of Fleas, so in Lice, cleanliness is one of the most powerful agents we can employ. Floors, ceilings, nests, and perches should be well whitewashed in the early spring, paraffin being added as mentioned before, with soft soap to make it adhere more firmly to any small lice that may have wandered off the birds. This wash should be sufficiently liquid so as to run into every crevice. A second cleaning should also be given again in the autumn.

There is nothing that keeps birds free from lice so well as *Dust-Baths*; these are natural remedies for the lice, and fowls should never be kept without them. In every run or house there should be placed a good-sized square box containing some powder in which the bird can dust itself. The writer has, after numerous experiments, found that ordinary road dust, in which a few handfuls of sulphur and lime are mixed, is as successful as anything. Sand mixed with a small quantity of creosote will also keep the birds

free from these noxious insects. The writer is also told that finely-powdered gypsum mixed with a small quantity of paraffin or carbolic is most successfully employed, quickly clearing off any lingering pests that the birds cannot reach.

Regarding the head and neck infestation of chicks, there is nothing like dressing them, once or twice early in the season, with *White-Precipitate*. The very smallest quantity rubbed upon the skin with a gloved hand will suffice to destroy all the lice, that would eventually stunt the chick's growth. It is well to give the caution that this is a strong irritant poison and needs great care in its use, especially upon very young chicks.

In the case of brood-hens it can be safely and most beneficially used: a small quantity of the ointment should be well rubbed into the feathers (at their base) around the anus, under the wings, and other places where lice congregate. It is surprising how many failures in hatching can be saved by this simple precaution, and by dusting the nesting-boxes with some of the numerous insecticides mentioned.

Amongst other methods experimented with, upon old birds suffering from 'lousiness,' the following may be worth recording:—Two hens badly infested with *Menopons* and *Lipeuri* were dipped in a bath of boiled elder flowers, twigs, and leaves, to the decoction being added a small quantity of soft soap. In both cases the lice were all destroyed and the plumage not damaged.

Fumigating the birds is sometimes resorted to, but it is troublesome and not always successful. An engine named Lagrange's Exterminator has been used for some time with more or less success. This is simply a wooden box, in which the fowl is placed in such a position that its head is out in the air and its legs firmly tied down. The box being made airtight, and the extruded head being tied around with a piece of thick cloth close to the opening in the box, no vapour inside can escape. In this box a small piece of brimstone can be burnt, the vapour soon killing all the body lice.

C. OTHER INSECT PARASITES.

There are two Diptera or true Flies found sometimes infesting the Fowl and other poultry. These pests are related, although distantly, to the Fleas, very closely to the Sheep-Tick, which, as I have pointed out, is also one of the true two-winged insects, only, like the Flea, it is minus its wings.

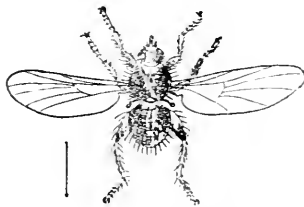
Diptera on Fowls.

These bird parasites are known as *Ornithobia pallida*, Mg., and *Ornithomyia avicularia*, L. (figs. 10 and 11). Both belong to the family *Hippoboscidae*, in which all the species pass their egg and larval state in the body of the mother, instead of leading a free larval life. These strange insects are born in fact as pupæ, or anyhow adult larvæ ready to pupate. Only a single egg is produced by each female, and

the young, either larva or pupa, when expelled from the parent's body is nearly equal to it in size.

O. pallida (fig. 10) has a small, oval, tough body, slightly hairy and bristly, tawny in colour, paler

Fig. 10.



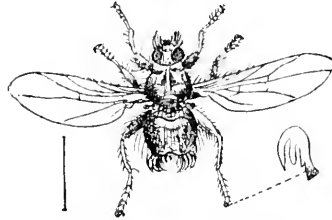
Ornithobia pallida.

beneath. Eyes large, oblong, and brown. Mouth (which is formed for suction) is not long; it consists of a pair of hairy hard valves, which enclose a slender stiff tube, the sucking-tube, which is formed by the union of two setiform pieces. There are very short antennæ, and stout wings, grey in colour with dark brown veins. The legs are robust and wide apart; claws long, curved, and black. About $\frac{1}{4}$ of an inch long.

O. avicularia (fig. 11) is greenish in colour, more or less varied with tawny. The thorax has a reddish-brown dorsal stripe. Wings ample, rather long, grey with black veins. Legs stout and bristly. Slightly larger than the former and more hairy.

Both these Diptera crawl about upon the fowls and fly from one to another. They generally infest the nostrils and ears, crawling into them and setting up

Fig. 11.

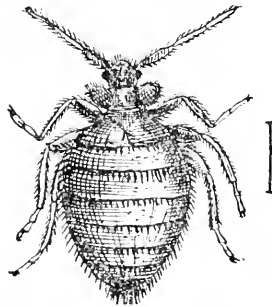
*Ornithomyia avicularia.*

violent irritation. These flies can easily be cleared from the cavities by sponging the openings with asafœtida (4 ozs. to a quart of water).

Fowl-Bug.

Not uncommon in very dirty poultry-houses is the Poultry-Bug or Dove-Bug, *Acanthia columbaria*, Jenyns (fig. 12). This is a large brownish bug,

Fig. 12.

Fowl-Bug (*Acanthia columbaria*).

about $\frac{1}{4}$ of an inch in length. It is closely allied to that nauseous creature the 'bed-bug,' and like the latter it is provided with a sharp and piercing proboscis. Its food is the blood of the Pigeon and Fowl—the latter being bothered by them chiefly at

night, when they cause severe irritation and much loss of blood. Railliet records that hens hatching are so tormented by these insects that they finally abandon their eggs, on which are then seen small specks of the Bugs' excrements (Bull. de la Soc. de Méd. Vétér. pratique, 1890, p. 99). I have only once seen this insect attack in England.

A new Fowl Pest.

Lastly a species of *Collembola*, one of those lowly insects that Sir John Lubbock tells us are like the primitive insects, and which perhaps represent some ancestral form from which all other insects have sprung, is said to affect fowls.

A single case of this pest has alone been brought to my notice. The insect was not sent, but a poor photographic plate taken of it was. From this it appears to be an *Isotoma*. This apteron was said to be a great torment to hens, and was usually found in old and fowl nests.

The Chigoe of the Fowl.

Two other Fleas are found on fowls abroad : one, *Sarcopsylla gallinacea* of Westwood, a flea related to the dreaded 'Jigger' of S. America, is found on fowls in Ceylon, especially at Colombo. Another, the Alakurt (*Vermipsylla alakurt* of Schimkievitsh), which is a remarkable flea found in the autumn in certain valleys and on particular mountains in Turkestan, also lives on the fowl in common with man and most other animals.

III. MITE PARASITES.

At least eighteen species of Mites are found parasitic on the Fowl. Four only of these can be said to be truly injurious, although the remaining fourteen now and then are sufficiently abundant to be prejudicial to the host's health. Mites are distinct from Insects. They are included in the group *Acarina*, and are more closely related to the Spiders than to the Insects.

These *Acarina* are characterized by a number of distinctive features, chief amongst which is the usual presence of *four pairs of legs*. They are generally small and thick, and have the head, thorax, and abdomen all united into one piece. The six, five, or even three-jointed legs terminate in hairs, claws, and in some in a curious sac-like vesicle, useful for the minute creature to hold on by to its host, for *nearly* all mites are parasitic.

The permanent parasitic mites with which we are interested in this article breathe not through stigmata, but their respiration is cutaneous; their skin alone is the respiratory apparatus. Other mites have true stigmata. The sexes are separate in all the mites. The males are always few in number and much smaller than the females; they also often lead quite a different life to the females. Mites undergo a kind of incomplete metamorphosis. The eggs or mits laid by the female hatch into little *six-legged*

larvæ. These hexapod larvæ undergo a change of skin several times ; at last they reach the four-legged stage, the *nymph* or *pupa*. Another moult brings about the development of the genital organs, the *acarus* then becoming the imago. This imago again moults, and if a female, becomes the true egg-producing or ovigerous female.

Amongst the great variety of Mites we find many ways of living ; the majority are parasitic, some permanent, some partial parasites. Many are external guests ; others, however, are internal. Their food consists of either epidermal products and natural excretions of the skin, or blood, whilst many exist under the skin, forming sometimes serious cutaneous affections, such as 'Scaly Leg' in Fowls and 'Scab' in Cattle.

The diseases produced by these various Mites are known under the name of *Acariases*.

There are two distinct modes of attack in Fowls as well as in other animals : firstly, those that suck the blood only of the host ; secondly, those that multiply rapidly, and excavate passages under the skin, giving rise to deep-seated cutaneous affections. These latter are known as *Scabies* or *Psoric* diseases.

There are, then, Psoric and non-Psoric Acariases.

We will treat of the former first.

A. PSORIC ACARIASES.

The Psoric diseases in birds are produced by a group of Mites known as the *Sarcoptidae*. These are

the smallest of all the Acarina, varying from $\cdot 1$ to 1 mm.; their appearance is best indicated by the figures. They have no eyes, and breathe through their skin. The only two *Sarcoptidae* found on domestic birds, anyhow on the Fowl, are both answerable for very serious complaints. These two Mites are known as *Sarcoptes mutans* (fig. 14) and *S. lævis* (fig. 15). The former of these two Mites produces the well-known disease of 'Scabby Leg' or 'Scaly Leg'; the latter is anyhow answerable for the so-called 'Feather-eating' in Fowls, the 'Depluming Scabies,' or 'Body Scabies' of Fowls and Pigeons.

SCALY LEG OF FOWLS.

This unsightly disease, due to the minute Sarcopt Mite (*S. mutans*), is very prevalent. Like most psoric diseases, it is not always amenable to rapid treatment; patience, however, even in advanced cases, will usually be rewarded by recovery.

Some authorities state that the disease may appear on the head as well as upon the legs. Reynal and Lanquetin (who are partly answerable for this statement), Mégnin, and others who have paid much attention to this affection only refer to the leg attack. Some hundred cases have been examined by the author, and all of these were upon the legs, no signs appearing in any other part of the body; moreover, every attempt to implant the Acari on the head failed.

Symptoms.

One of the chief symptoms is that the scales of the legs and feet become raised up and separated from one another. A white powdery substance forms beneath them, which, mixing with the serum, produces a white chalky exudate which hardens between the scales; gradually this forms greyish crusts over the feet and legs, and if not checked in its somewhat slow progress the disease will often end fatally (fig. 13).

Fig. 13.



'Scaly Leg' of Fowl.

On examining one of these rough crusts it will be found to be of a spongy texture internally, and as the spongy cavities pass towards the interior they become larger; in these recesses are lodged the ovi-

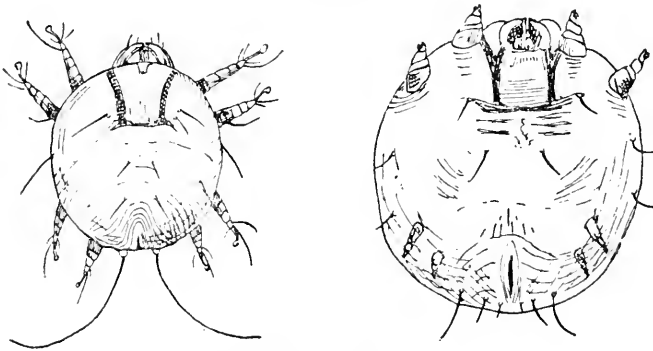
gerous female mites and also we shall find larvæ, female imagines, and a few males.

As the disease increases, the birds have a difficulty in standing, then lameness follows, and not unusually one or more of the toes fall off. As a rule it takes from 6 to 12 months to run its course. Gradually the fowl becomes affected in health, and either dies from this disease or, as is more usual, other complaints accompany it in its later stages, such as favus, diphtheria, and tuberculosis of the lungs and liver, and so speedily destroy the victim already weakened by the subcutaneous parasites.

The Mites.

It appears that these mites do not occur in the egg-state beneath the scales. The author has been

Fig. 14.



'Scaly Leg' Mite (*Sarcoptes mutans*).
Male and ovigerous female.

unable to find any trace of eggs at all upon the legs of numerous fowls examined.

The female ovigerous mite (fig. 14) is a minute round white body, with very short legs, .40 mm. to .45 mm. in length; the male is still smaller, being only .20 mm. long.

The male, larva, and nymph have on all their legs suckers, common to all *Sarcoptes*. The females have no suckers and are more globular than the other three forms. They are ovoviviparous.

Disease Contagious.

The 'scaly-leg' disease produced by these mites is spread by contagion, through the contact of unhealthy and healthy fowls. It cannot, however, be highly contagious, for it is not unusual to see a bird suffering severely from this Acariasis amongst a lot of perfectly healthy birds. However, it is very likely to spread in time to other birds by the young mites, which move about amongst the scales and even on the outside of the leg.

Influence of Breed.

It has been noticed that the exotic breeds of fowls suffer most severely. Reynal and Lanquetin have noticed its more frequent occurrence in Cochin-Chinas and the varieties than in the Dorking. Leghorns and Wyandottes I have seen with this complaint. Dorkings seem less susceptible to this malady than any other breed.

Other Birds affected.

Passeres and Climbers are also predisposed to *S. mutans*. The Sparrow particularly is subject to this parasite, and may possibly help to spread this mite from one run to another.

Prevention and Treatment.

The prevention of this malady is most important. Any diseased bird should be at once isolated, and the run and house in which it has been living disinfected. This may be carried out by a thorough white-washing of the walls and nests, cleaning perches, and the purifying of the floor by drenching with boiling water and carbolic acid.

Treatment of the patient consists of careful removal of the crusts. Before so doing, the leg should be soaked in warm water, care being taken not to cause bleeding. When as many of the crusts are removed as possible, the limb should be smeared over with creosote (1 part) and lard (20 parts). Balsam of Peru applied once a day for about a week also has good results; whilst some breeders recommend equal parts of flowers of sulphur and vaseline well rubbed into the leg. Very similar in effect is carbolic-acid ointment, formed by mixing one part of crystallized carbolic acid to every ten of lard.

Just as in 'epithelioma contagiosum,' oil of turpentine has been found a most effectual remedy, but its action is sometimes too irritating and must

be allayed with sweet-oil well rubbed into the leg some little time after.

In every case the diseased part should be well cleaned with hot water and soft soap some few days after treatment.

If taken in time recovery is very rapid, but if allowed to work well into the leg this Scabies is not readily remedied.

DEPLUMING SCABIES (FEATHER-EATING).

The annoying and so-called 'vicious' habit of some birds of plucking out their own and other birds' feathers is usually attributed to pure mischief on the part of the birds: such, however, is not always the case. Railliet discovered some years ago (1886) scabies of the fowl's body in a poultry-yard in Normandy. Since then many fresh areas have been found affected with this Acariasis. It has not, I fancy, been paid much attention to in England, and the general idea still is that the feather-pulling or, as it is called, eating is due to some vicious habit, whereas it is really due in most cases to a minute Sarcopt mite, known as *Sarcoptes laevis* (fig. 15). Idleness, thirst, &c., and other absurd theories have been put forward to account for this habit, without any examination of the bird.

Most of the cases examined by the author have been in pigeons, but those fowls reported suffered in a similar way and from a similar cause. According to Railliet, however, the mite on the pigeon is slightly

different from that on the fowl, the former being known as variety *columbæ*, the latter as variety *gallinæ*. The pigeon variety, I find, will not attack the fowl when put upon it, and *vice versâ*.

Symptoms of Disease.

The early signs of Depluming Scabies are first of all a quantity of epidermic scurf and the falling-off of the feathers in certain areas, the feathers as it were breaking sharply off close to the roots. The disease usually commences at the rump, from there spreading to all parts of the body. The head and neck often become severely affected. I have at present under treatment one of my Dorking cocks, in which the feathers on one side of the head and neck had completely gone, all in about ten days.

Often prior to any external sign of the presence of these mites, the birds have been noticed plucking the feathers. On pulling out a feather from this area, the base of the quill is found to be full of a white powdery epidermal product, and amongst this the *Sarcoptes lævis* live. Here they set up irritation, to alleviate which the fowl pulls out one of the feathers near the area of infection. This is the so-called 'auto- or self-feather eating,' and is due entirely to this mite. The birds undoubtedly render each other service in this matter by plucking one another's plumage, to rid the companion of the irritation. Such an observation has been personally made once upon my own fowls, and such undoubtedly is generally

the case. This was especially noticed in the cock bird.

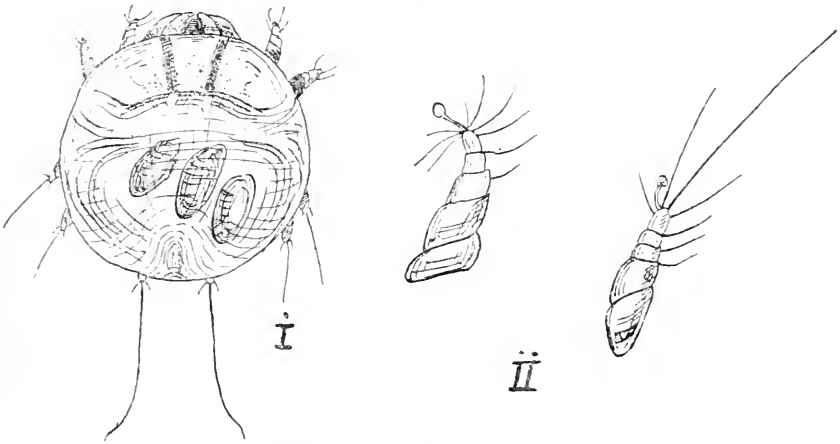
It is well known that animals will destroy one another's parasites, as anyone can verify who has been to the Monkey House at the 'Zoo'; this habit is undoubtedly found in fowls in connection with this depluming Sarcopt mite.

Fowls do, nevertheless, pull out one another's feathers from pure vice.

Life-history of the Mite.

The form on the Fowl is most abundant in spring and in summer. The mite (fig. 15) is much smaller

Fig. 15.



Sarcoptes levis var. *gallinæ*.

I. Ovigerous female. II. Legs of male.

than *mutans*, and the male has much longer bristles on the legs, so also has the ovigerous female.

These minute forms of life live at the base of the feathers amongst the white powder referred to, as many as ten to twelve being found at each feather. Larvæ are also found in a similar position, together with the males and young females; they are also found around the base of feathers on the skin.

Spread of the Disease.

From the above position they readily become spread from bird to bird by the cock in copulation. The region of the croup is that always first affected. This Acariasis spreads with great rapidity, a single cock soon infecting the whole run.

Effect upon the Birds.

The presence of these mites not only affects the plumage and causes the habit of feather-plucking, but it also, in the case of hens, checks egg-laying. In cocks, in which the malady is usually most severe, cachectic conditions may follow, often ending in emaciation and even death of the patient.

Prevention and Treatment.

As it has been pointed out that the disease is most contagious, isolation of the affected bird is the first point to receive attention. This is especially the case if the disease appears in a cock.

The mites being only slightly protected, readily

yield to treatment. The writer has found much success attended by the use of oil of cloves rubbed well into the invaded area. Creosote and vaseline as given for 'scaly leg' is also a useful remedy, and is better for use than the benzine and sweet oil that has also been tried; this latter causes too much irritation to the skin.

B. NON-PSORIC ACARIASES.

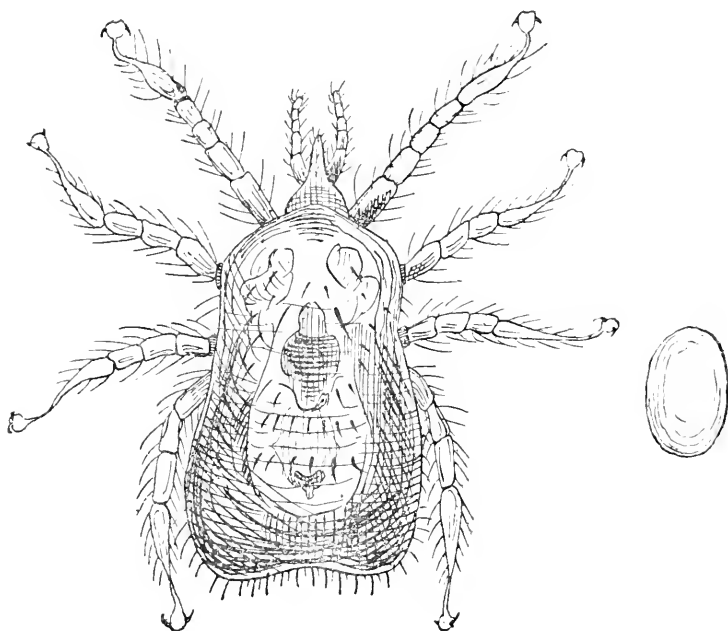
The majority of the non-psoric Acari found on the Fowl are comparatively harmless. One species only is really a serious nuisance to the poultry-keeper, namely the *Dermanyssus* of the Fowl, or the Hen-Mite. There are, as we shall see, others that are of interest, such as the Harvest Bug, which attacks our poultry as well as ourselves. Some *Sarcoptes* live between the barbules of the feathers, but are quite harmless; another group live in the air-passages and even hollow bones of birds (*Cytodites*), and have been known in several cases to cause enteritis and peritonitis when present in large numbers, and a few others living in connective tissue, of less importance, will be briefly recorded.

THE HEN-MITE OR DERMANYSSUS.

Under the name of *Dermanyssus gallinæ*, Redi has described a small mite that is most obnoxious to poultry, a small Gamasid mite that may be found

in nearly every hen-house, unless very clean. Some considerable time ago De Geer described a *Dermanyssus* under the name of *D. avium* (fig. 16), which

Fig. 16.



Hen-Mite (*Dermanyssus avium*) and Ovum
(greatly magnified).

I fancy to be synonymous with *gallinæ*. This fowl-mite, which is provided with a sharp, piercing, and sucking proboscis, lives in poultry-yards and in pigeon-houses.

Life-history.

This mite is a fair size, being .70 mm. in the egg-producing female and .60 mm. in the male; the posterior end of the body is largest; flattened, and the abdomen edged with bristles, the stoutish legs also being covered with the same. In colour this mite varies from pale yellowish to dark red. The alimentary canal can sometimes clearly be seen, especially if the mite has just been feeding, when it will be observed to be full of blood.

Both sexes are armed with the formidable piercing-mouth, the female being, as in all Arthropod or 'jointed-limbed animals,' the most bloodthirsty. They are very prolific and can remain for months without any food. The ova hatch rapidly into little white six-legged larvæ, which grow by repeatedly moulting their skins. These young forms are quite white, almost silvery in colour, gradually they become darker in hue.

The exuvie or cast-skins form a kind of white powder on the perches and in the nests, &c.

Nocturnal Habits.

Like many of these partial parasites, the Hen-Mite is strictly nocturnal in habit; for this reason they are often unobserved. During the daytime the *Dermanyssus* hides away in crevices in the walls, ceilings, nests, and perches; as soon as it becomes dark, they leave their retreats and pass to the

roosting birds, where they at once commence their bloodthirsty habits. They have an intense dislike to light and air; damp, dark, and badly ventilated roosts are where they flourish best. Straw-nests are perfect harbours of refuge for this *Acarus*; colonies of them may be found, including the eggs, exuviae, young mites, and adults. Many of the adults may be found coupled together.

Transmission to Man and other Animals.

The chief breeding-time seems to be in spring and early summer, when the rate of reproduction is tremendous. *Dermanyssus gallinae* not only attacks birds, but also man and numerous other animals. This attack, however, is only *pro tem*.

Regarding man, there are numerous cases of infestation, chiefly amongst those who are about poultry-yards and upon persons engaged in plucking birds. The mite does not breed on human beings, not finding sufficiently favourable conditions. It, for the time being, however, causes severe irritation. This can easily be alleviated with any soothing application.

The horse is most liable to this mite of all animals. So long ago as 1846 the transference of this mite to the horse was known. Nearly all cases where this malady has appeared in horses have been where fowls have been kept in the stables.

The mites only attack horses at night, as in fowls and pigeons. The first appearance of their presence is a number of small erupted vesicles, which may be

isolated or all united together. Later these patches, about 10–20 mm. in diameter, become bare. After a few days they may increase and unite, forming large depilated areas. If left alone and any poultry taken from or stopped going to the stable, the disease will die out in a few days. On the other hand, if poultry are allowed to live and sleep with the horses, it will gradually spread and may seriously affect the horse by the irritation the mites produce.

It is most important, then, for this reason that fowls should not be kept in stables, or in fact with any other animals.

Cows, dogs, goats, rabbits, and cats are also liable to be pestered with this *Acarus*.

Attack on Nasal Cavities of Fowl, &c.

Three or four cases of this *Dermanyssus* entering the nasal cavities and the auditory meatus have come to my notice. The mites entering these cavities in considerable numbers, set up violent irritation and consequent inflammation. Zürn, Weber, and Lax have also recorded this somewhat unusual attack.

Symptoms of Mite Presence.

If birds are seen not to be thriving, examination should be made at night to see if mites are upon them. The presence of the mites sucking the blood of the host, causes the latter to become emaciated in condition. Marasmus may follow, and death the final result. There are seldom any signs of their attack seen on the bird's skin ; sometimes I have noticed that

small red papules exist where many have been irritating. A white, silvery powder will also be noticed upon the perches and in various other places (the exuviae of the mites), if the mites are present in great numbers.

They have also been found in the ear of a cow—the cow-shed only being separated from the hen-roost by a plank partition (*Schümacher*).

Prevention and Treatment.

In the exceptional cases just referred to, both in fowls and animals, there is no solution so successful as the following:—Olive oil (100 grammes), ether (30 grammes), naphthol (10 grammes). This mixture of Nocard's I have always found most potent in all parasitic auricular affections.

Regarding the ordinary attack of this mite on Poultry, cleanliness again is one of the most important preventative measures. The constant use of lime-wash, and the cleaning every now and then of the perches and nests with boiling water and some disinfectant, will help to keep down this too abundant nocturnal visitor. The use of paraffin or creosote for the perches in any wash used has been found most decisive in its effects.

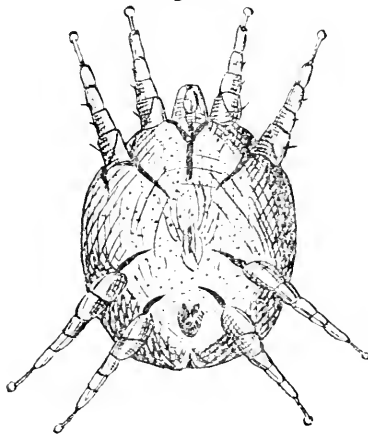
On two occasions Schneider's suggestion of fumi-gating the roosts with bisulphide of carbon, put in small phials in corners where they cannot be upset and then blocking up all cutlets, has been tried. Although no mites attacked the birds afterwards for some days, they appeared again shortly, the ova not

being affected; two or three distinct fumigations would be necessary to clear them out. Although successful in every respect, this method can scarcely be recommended. Not only will this destroy the mites but fleas also.

“ Moss-peat litter frequently harbours them by millions, and often unsuspected, on account of their similarity to the colour of the peat ” (*Till*).

Treatment is practically impossible in the ordinary attack, as the mites only appear at night. Paying attention to the houses in the ways mentioned during the daytime will, however, keep off this often unsuspected noxious parasite.

Fig. 17.

*Cytodites nudus.*

PULMONARY MITES.

The next most important mite affecting Poultry is known as *Cytodites nudus* (fig. 17), which inhabits

the air-sacs, reaching the finest divisions of the bronchi and even the cavities in the pneumatic bones; more rarely they are found in the lung-tissue. This mite, which is of considerable size, readily seen with the naked eye, is particularly found in Fowls and Pheasants.

This *Acarus* is white and globular in form, the legs being composed of five pieces. The male is .45 mm. long. The female .56 mm. long, and may produce either ova or larvæ.

Their Effect upon the Fowl.

The mites, as a rule, have little effect upon their host; it is only when they appear in large numbers that they produce any malady. Sometimes they crowd in the bronchi and cause obstruction, and eventually death by asphyxia. Zundel and other observers accuse them of causing enteritis and peritonitis.

A single instance of this mite affecting the liver has come to my notice. The fowl died, and in the liver were found numerous yellow, round nodules which contained numbers of this *Cytodites*. Holzen-dorff has also observed them in the kidney, liver, and lungs, in similar yellow nodules.

In such an attack all we can do, should it take an epizootic form, is to disinfect the houses and destroy by burning all parts of the diseased birds. Such attacks, however, are very few and far between.

SYMPLECTOPTES MITES.

Analogous to the above is a more elongated *Acarus* known as *Symplectoptes cysticola*, about .22 mm. long

in male and slightly larger in the female (fig. 18). These minute mites are special to the Gallinaceæ.

Fig. 18.



Symplectoptes cysticola.

They live in the connective tissue of fowls &c., but they apparently never affect the health of the host. They may give rise to the formation of tubercles, produced by the irritation they set up.

Heller, of Kiel, has found 70 per cent. of the fowls affected by this tubercle, which appears in the peritoneum of the abdomen and viscera generally. They are particularly prevalent in old and diseased birds.

FEATHER MITES.

Another group of Acari known as *Analgesinæ*, or *Sarcoptidæ plumicoles*, inhabit the feathers of birds: each bird nearly has its own distinct species of this minute group of mites; some birds have more than

one species living upon them, and even more than one genus. The abode of these minute mites is between the barbules of the feathers. They are also found in the quills of the feathers. The chief authority on these 'plumicoles' is Trouessart, who has shown that on the feathers drying the mites migrate to the roots, especially during 'moulting' time and in winter.

The following species are recorded from the Fowl:—*Pterolichus obtusus*, Robin; *Dermoglyphus minor*, Nörner, and *D. elongatus*, Mégnin; *Megninia cubitalis* and *M. asternalis* of Mégnin.

All these, although seemingly abundant, are quite inoffensive.

CUTANEOUS MITES.

Another division of mites closely allied to the former, the *Epidermoptinæ* of Rivolta, live in numbers upon the skin of fowls, often causing cutaneous troubles allied to Scabies. Two species seem to be known, *Epidermoptes bifurcatus* and *E. bilobatus*.

These two colourless Acari live on the skin at the base of the down of fowls, and when they increase to excess they produce intense pruritus.

The skin, where the *Epidermoptes* are present, becomes covered with pale yellow scaly-like masses and with dirty yellowish crusts (*Friedberger*).

In most cases they are nevertheless inoffensive. I have not been able to detect these cutaneous mites so far in England.

PRESENCE OF THE HARVEST BUG IN FOWLS.

Of more importance is the Harvest Bug (*Leptus autumnalis*), which affects Poultry in a similar way to human beings. This larval form of *Trombidium holosericeum* attacks late-hatched chicks, and according to Railliet is somewhat common, both on fowls and chickens.

The parasites fix themselves to the skin close to the feather bases, and produce such intense irritation that they give rise to epileptiform affections which speedily end in death—sometimes, according to Railliet and other authorities, causing great mortality.

Whether this attack occurs in England I am not aware. In any case it cannot be advisable to put, as is now often recommended, poultry on the barley stubbles where this pest, as we often know to our cost, abounds.

Should they be present, it is said that flowers of sulphur dusted amongst the feathers leads to good results.

OTHER MITES RECORDED UPON THE FOWL.

The following have also been recorded on Poultry:—

Mauritius Argas (*Argas mauritianus*, Guér.), a great torment and source of loss to poultry in the Island of Mauritius.

Picobia bipectinatus, Heller, in quills of poultry and pigeons' feathers at Kiel.

Leiognathus bursa, Berlese, and *Tydeus molestus*, Moniez, are also mentioned in Hassall's 'Check-list of the Animal Parasites of Chicken' (U.S.A. Dept. of Agric.).

IV. WORM PARASITES.

No less than thirty-six distinct species of Worms live as parasites in the various varieties of Fowls. The Worms form one of the greatest parasitic groups of animals. Some of these parasites are distinctly injurious to their 'host,' whilst many others seem to cause no inconvenience unless they are superabundant, then symptoms of their presence may make themselves obvious. Some of the vermiceous pests of the Fowl appear epizootically, but the majority only occur in isolated individuals. Worms are answerable for at least one well-known disease in our domestic birds, especially the fowl and the pheasant. The latter more especially when artificially reared continuously on the same ground. This malady is 'Gapes,' and is perhaps as serious a parasitic disease as any from which poultry suffer.

The Worms (*Vermes*) are one of the lower invertebrate groups of animals that are characterized by their bilateral symmetry, the absence of articulated limbs, the presence of curious paired excretory vessels, and the general segmented form of the body.

There is such a vast number of diverse forms that it is almost impossible to give all their varied characters. They may develop direct from the egg, or they may go through a complicated metamorphosis. Worms are found in every conceivable locality.

Some are marine, some freshwater, others live in decaying matter, many are terrestrial. Those, however, with which we have to deal are parasitic in their habits. There are three great sections of Vermes:—

(i.) The ringed or segmented Worms = the *Annelida*, such as the Earthworm and Leech, which are seldom parasites, those that have this habit being external parasites such as the Horse-leech. No Annelids are found to prey upon Poultry, so they can at once be dismissed.

(ii.) The *Platyhelminths* or ‘Flat Worms,’ most of which are parasitic in habits. These are all hermaphrodites—that is, they have male and female organs in the same individual.

(iii.) The *Nemathelminths* or ‘Round Worms,’ or Thread-worms, again mostly parasitic. But round in shape, and tapering to a point at each extremity.

These two latter groups are generally known as *Entozoa*, on account of their parasitism being internal. All the *Entozoa* have but feeble respiratory powers, respiration being carried on through the skin. They are found in all manner of organs and in all kinds of animals, man being subject to a great number, although serious consequences in our country from their presence are very exceptional.

The Flat Worms are again divided into three groups, two only of which are of importance to us here.

These are the *Cestodes* or Tapeworms (fig. 19), and the *Trematodes* or Flukes. The former being ribbon-like, the latter leaf-like in form.

Tapeworms are nearly always segmented; the adult form lives in the intestines, the earlier stages in various organs of the body—two distinct hosts for these stages being necessary.

The Flukes are always unsegmented.

Of the *Nemathelminths* only one group is parasitic upon Poultry, namely, the *Nematodes* or Threadworms, which are elongated and thread-like in form and attenuated at each extremity.

The diseases and pathological peculiarities invoked by the presence of certain of these groups will be discussed in the following article. A complete list of all that have been recorded within *Gallus domesticus* will be found in the Appendix.

A. CESTODA OR TAPEWORMS.

Cestode worms are often most troublesome in animals, and occasionally they become pathologically important in domestic birds. Twelve species have been recorded as guests of the Fowl. By virtue of their numbers they often produce what is known as *Teniosis*, which may end fatally.

Most of the Cestode worms have a very complicated life-history. They nearly all require two hosts in which to develop during their cycle of life. The Tapeworms are a group of the flat worms, or, as they

are scientifically called, Platyhelminths. They are ribbon-like in appearance, and vary from minute bodies barely one-sixth of an inch to many feet in length.

The typical tapeworm (fig. 19) is composed of a

Fig. 19.

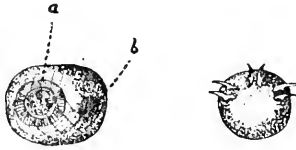


Typical Cestode Worm.

head or scolex, and a number of oblong segments called proglottides. The scolex or head is armed with suckers and hooks, and may be prolonged in front into a kind of rostrum. Behind the scolex comes a restricted area, the 'neck,' the region which is destined to produce, by a process of budding, the innumerable proglottides or segments. Each of these segments is, to all intents and purposes, an individual animal. The segments grow larger towards the end

of the worm ; they become, as it were, ripe. Each proglottis has male and female organs of its own and can fertilize itself. The last mature segments are full of ova (fig. 20). Although each segment is

Fig. 20.



Ovum and embryo of a Tapeworm.

apparently sexually distinct, yet nevertheless all the proglottides are united by a system of water or excretory tubes, and are supplied possibly by the same nerves.

The Tapeworm has no mouth and no alimentary canal. Its food is gained by absorption through the skin, a kind of *osmosis*.

The Tapeworm is the sexually mature form of Cestode, and always lives as a parasite in some part of the intestines, to the mucous membrane of which it anchors itself on by the hooks and suckers above referred to. The ripe proglottides full of eggs are passed out in the fæces, and in many cases get into water. This completes the first stage of Tapeworm existence.

The second stage is passed in quite a different 'host,' and in various organs, generally causing

serious disturbances. This second period of Cestode-life is known as the 'Cystic' or 'Bladder-worm' stage. The cyst is produced in the following way: the ova released from the ripe proglottides are disseminated over the grass and into water. The 'cystic' host eats these ova with its food, and the embryo Cestode (fig. 20) is released by the action of the gastric juice, which dissolves the egg-shell. This embryo is a minute body provided with six little hooklets. It bores its way through the walls of the intestine into the blood-system and is carried along by the blood; eventually it reaches its destination, which may be either the liver, brain, peritoneum, kidney, lungs, and other internal organs. Once on its

Fig. 21.

Bladder-worm. *Cysticercus* type.

'feeding-ground,' the embryo becomes converted into a small bladder-like body, which may grow to a considerable size—the cyst or hydatid (fig. 21). The bladder is full of liquid, and in it, according to the group of tapeworms, will be found from one to many small opaque points. These latter are scolices—heads of future tapeworms. This cystic form may remain for

some considerable time. Should some carnivorous animal eat these cysts, supposing it to be a fitting 'host,' the walls of the cyst are broken down, and the scolex or scolices set free. When once free from the cyst, they anchor themselves on to the intestinal mucous membrane, and by budding from the neck produce the ribbon-like sexual tapeworm from which we started.

Thus we have two distinct types of life in the cycle of a tapeworm's existence—one the sexual tapeworm, living in the intestines of animals only, and, secondly, the cyst that produces one or more tapeworm heads by budding, that is asexually, and living in the various organs and connective tissue of another host.

By the knowledge of the life-history of these Platyhelminths we are enabled to check their increase. Take, for example, the well-known disease of 'measles' in pork, the cystic stage of *Tænia solium*, the Human tapeworm; and, again, the cyst *Cænurus cerebralis*, causing 'Staggers' or 'Sturdy' in Sheep, and its tapeworm form *Tænia cænurus* that lives in the Dog. By not eating 'measly pork' and by not allowing dogs or other canines to get the brain with the cyst of *C. cerebralis*, we can stop the presence of the obnoxious human pest, and stop the furtherance of the 'Gid' in our flocks. Unfortunately the complete life-histories of many Cestodes are unknown, and this, we are sorry to record, is especially the case in those that attack our Poultry. Twelve species

seem to be known in the Fowl; their identity, however, is a matter of great difficulty, and much confusion regarding the species has consequently arisen. Of these twelve only two, and some doubt exists here, are cysts; all the remainder are sexual tapeworms, which produce in their numbers the disease known as 'Tæniosis.'

Various Species infesting the Fowl.

Regarding the best-known Cestodes in Fowls, we will take for description three whose life-histories are known:—

(1) *Davainea proglottina*, Blanchard.—This worm is sometimes very abundant in the Fowl's intestines, generally in the duodenum. About 8 mm. long. It never consists of more than four segments. The scolex or head is only .10 mm. long. The segments break off and live a free life in the intestine for some time, growing to about 1.8 mm. long. They can expand and contract, and are very lively. The ova are large compared to most 'tapeworms.'

The life-history of *proglottina* has been traced out by Grassi and Rovelli. It seems the ova are taken up by various species of Slugs (*Limax*), and there in the different organs they become transformed into cysts of the *Cysticercus* type (fig. 21).

The slugs are, as we know, eaten by fowls with avidity. The cysts are thus released, and develop into *D. proglottina*, with its four segments, in about eight days.

(2) *Drepanidoteenia infundibuliformis*, Railliet, is a much larger species, sometimes reaching 240 mm. in length. Hundreds of these worms are often present in Fowls' intestines, the *Cysticercus*-stage being passed in the Earthworm.

(3) *D. tetragona*, Blanchard, which also is found in numbers with its head buried in the intestinal villi, is supposed to have the snail-genus *Helix* as its intermediate host.

The other life-histories are not known, and the details of the species are not worth enumerating here.

Symptoms of Tæniosis.

Young fowls that harbour tapeworms lose their appetite, become emaciated, and gradually become listless. Diarrhœa often sets in. The most important symptom, however, is the presence of the segments (proglottides) in the dung.

Treatment.

Should Tæniosis, as now and then happens, become epizootic amongst the birds, steps should be taken to let the run be free from fowls for some time; the ground being purified with sulphuric acid, as mentioned in the article on Diphtheria.

Each infested bird should be caged, so that its droppings can be watched to see if the scolices of the worms come out. All infested droppings should be carefully burnt.

One of the best tænicides is the extract of male fern, about twenty drops of the liquid extract to a large spoonful of sweet-oil. Nearly as good is pomegranate-root bark ground to powder, a teaspoonful with the food for every fifty birds. During this curative treatment the birds should have little food and water. What food is given should be of a soft nature. It is best to starve the birds for at least five or six hours previous to dosing them.

The complete list of Cestodes will be found in the tabulated list of Poultry Parasites at the end of this work.

One must take '*cum grano salis*' most of the statements found in books on Poultry *re* these parasites. For instance, in one I find it stated that the fowl tapeworm "appears to be identical with the tapeworm found in cats (*T. crassicollis*), and it is therefore highly probable that it is derived from the same source—that is, the *fluke! of the liver of the mouse. . . .*" Such statements are more than misleading, but so utterly absurd and incorrect as to be almost amusing.

B. TREMATODES. FLUKES.

The Trematode worms or Flukes found in the Fowl are six in number. One is found in the egg (*Distoma ovatum*), the others in the œsophagus and intestines.

The Fluke found in the œsophagus of the Fowl is

known as *Cephalogonimus pellucidus*, a transparent reddish fluke about 9 mm. long. These were found by Von Linstow and Railliet. In the intestines Neumann enumerates seven species, namely, *Notocotyle triserialis*, *Distoma oxycephalum*, Rud., *D. dilatatum*, Miram, *D. lineare*, Zeder, *D. ovatum*, *D. armatum*, Molin, and *Mesogonimus commutatus*, Sons. These, however, are not all distinct: *dilatatum* is undoubtedly the same as *oxycephalum*; *armatum* is also probably the same.

None of these Trematode worms are of any pathological importance, although, as is well known, they often cause serious maladies in other animals. All the Flukes that have two hosts undergo a complicated metamorphosis, the early stages always taking place in some water-mollusc. Those found in *Gallus domesticus* have not had their life-histories worked out.

Parasites in the Egg.

Occasionally parasitic worms are found in the oviduct of Fowls, and, as we shall see later, a few vegetable parasites also make their appearance. These 'guests' found in the oviduct are quite accidental, and not unusually they manage to enter the ovum. They are purely of interest only and are of no pathological importance.

A Fluke (*Distoma oratum*), a Nematode (*Heterakis inflexa*), and fragments of Tapeworms (Cestoda) have been recorded in Fowls' eggs.

The ova of a Fluke have also been found in the albumen of an egg by Bonnet (Jahrb. d. k. central. Thierarznei-Schule in München, 1881). This Fluke is also found in the bursa of Fabricius.

C. NEMATODE WORMS.

The round worms or Nematodes, the Thread-worms of popular language, are by far the most injurious worms to the Fowl ; for in this family we find present the much dreaded Red Forked Worm or the Gape-worm (fig. 22), often so pestilential amongst Poultry and Pheasants. Others, the 'White Worms' of the intestines, also produce epizootic maladies in chicks.

No less than eighteen species are recorded as parasitic in the Fowl. Most of these live in the intestines ; some, however, in the proventriculus, gizzard, œsophagus, and the eye ; and the Gape-worm in the respiratory passages.

Characters of Nematodes.

The Nematodes are round worms and, unlike the Cestodes, are provided with a mouth, alimentary canal, and anus. They are usually elongated, slender, and thread-like in form.

The sexes are separate, the female generally being larger than the male. The latter also has, as a rule, a curved anal extremity and two curved spicula

attached. Nearly all Nematode worms lay eggs; a few, however, such as the *Trichina spiralis* of pigs, produce living young. The free development is a metamorphosis which is often complicated by the necessity of two hosts, or, anyhow, two different parts of the same host. The larvæ live generally in parenchymatous organs; they may be free or in the form of a cyst enveloped in a capsule. The adults nearly always live in the alimentary canal. An intermediate host is, however, not always essential; for instance, I have clearly shown in Gapes that the ova of the Gape-worm given to Fowls produces Gapes at once. As a rule, in these simplest cases, the embryos in the egg-membrane are transported passively in the food or water into the host. This is what I have tried clearly to point out is the case in *Syngamus trachealis* (fig. 22). Again, in small Nematodes (*Spiroptera*), some of which are found in Poultry, two quite distinct hosts are necessary: for instance, the mouse *Spiroptera* (*S. obtusa*) is found in the encysted stage in the Meal-worm; whilst as another type we may take the *Trichina spiralis* of the pig and man, which is sexually mature in the intestines, and passes its larval state encysted in the muscle of the same individual. Many remarkable cases of these complicated life-histories could be given, but space forbids; one other instance must suffice, namely, the group of Eel-worms, or *Anguillulidæ*, which are parasites not in animals but plants. Thus it will be seen that the life-histories of Nematodes are very varied.

The food of these parasitic worms is chiefly the organic juices of the body. Some, the so-called Hæmatozoa, live on the blood; the majority, however, on alimentary fluids.

Tenacity of Life.

One point is of great importance regarding these round worms, and this is that in the egg (and encysted stage) they can remain for a great length of time undeveloped, awaiting favourable opportunities for the propagation of the species.

Number of Species infesting Fowls.

At least eighteen species have been recorded from the Fowl in various parts of the world. Of these, seven only seem to have been met with in England and thirteen in Europe. The only important genera, pathologically, are *Syngamus* and *Heterakis*, the former being parasites of the respiratory system, the latter of the alimentary system; others producing morbid effects will be briefly referred to in this article. Gapes being by far the most important vermiceous infestation, we will deal fully with that first.

THE GAPE-WORM.

= RED WORM OF FORKED WORM.

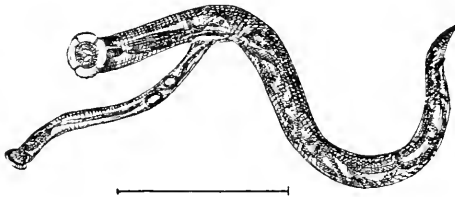
(*Syngamus trachealis*, Siebold.)

The peculiar symptoms of this parasitic disease render its detection an easy matter. It is often an

extremely fatal malady, and yet great ignorance still exists regarding it and the life-history of the worm that is accountable for it.

This Nematode worm producing Gapes has been described under the following names, as well as that given in the heading, viz., *Sclerostoma syngamus*, Diesing, and *Syngamus bifurcatus*. This worm (fig. 22), that lives in the air-passages of the gallinaceous birds, produces tracheo-bronchitic symptoms. The genus *Syngamus*, to which the Gape-worm belongs, has also members living in the air-passages of mammals.

Fig. 22.



The Gape-worm.

The Gape-worm is often very abundant also in Pheasantries and causes great havoc. It is known to gamekeepers as the Red or Forked Worm.

The disease was first, I believe, reported by Dr. Wiesenthal in the 'Medical and Physical Journal' for 1799 (May), who observed it at Baltimore, U.S.A., both in Fowls and in Turkeys. The first English record I can find is by Montagu, in the 'Transactions of the Wernerian Natural History Society'

for 1806. It is here noticed as appearing in an epizootic form in Fowls. Young birds are most generally attacked, but I have many notes of its occurrence in old ones. Many instances of the latter seem to be in Dorkings.

Dr. Wiesenthal, in the journal quoted above, states that the disease takes place in the greatest degree amongst the young turkeys and chicks bred upon *old-established farms*. "Chicks and poults," he says, "in a few days after they are hatched are found frequently to open their mouths wide, &c., and to become affected." This statement has been corroborated time after time since it was made. In 1895 the writer conducted experiments with Fowls on contaminated soil, and found both young and old birds quickly obtain the disease from the ova on the ground. This is a point we may well remember from a practical point of view. Chickens, if for this reason only, should have frequent change of environment. Although many who keep poultry overlook this point, it is one paid great attention to by good gamekeepers, who know full well that constantly breeding pheasants on the same ground leads to disease, and especially to 'Gapes.'

Life-history of the Worm.

On opening the trachea and bronchi of a bird showing symptoms of Gapes, from three to as many as twenty small red worms will be found. Their

forked shape will at once be noticed ; some single straight individuals will most likely also be seen. The forked worms are the copulating males and females, the smaller one, forming the fork, being the male. In most instances the worms are surrounded by a frothy saliva, from which they can readily be freed.

The adult worm is red in colour, cylindrical in form. The head is broad and truncated. The mouth is a large, circular, cup-like depression supported by a circular capsule ; at the base of this capsule are six horny pointed processes around the opening of the œsophagus. The male is from 2 to 6 mm. long, the female varies from 10 to 20. In the male the caudal pouch is truncated and supported by twelve ribs ; this pouch is attached around the vulva of the female. The male is attached so closely that it cannot be separated from the female without tearing. The female's body is much swollen at various places when full of eggs.

The eggs are very minute bodies, only $\frac{1}{250}$ th of an inch in length, ellipsoidal in shape, and have a distinct operculum. The eggs are not laid, the vulva of the female being closed by the male. In some large females embryos are found, but in the majority I have seen only undeveloped eggs in the uterus. Both ova and embryos escape by the rupturing of the female's body. This takes place, as a rule, after the worm has been expectorated by the fowl, and some two or three days after the worm's death. Both ova and embryos take up their abode in damp ground and in

pool edges, in and around the drinking-vessels of the fowls being also a favourite locality.

The eggs hatch in from seven to forty days, according as to whether the surroundings are favourable or not.

These ova and embryos get taken up by the fowls either off the ground or in the water. They then develop direct into the worm in the tracheal region of the fowl. The small embryo-worm grows rapidly, and soon becomes mature and the female united permanently to the male. They are often spread by one bird devouring the worms coughed up by another. Distribution from one area to another is carried on by such wild birds as the Starling and Magpie, which are both very largely infested with *Syngamus trachealis*. Other hosts are the Sparrow, Partridge, Green Woodpecker, Martin, Linnet, Hooded Crow, and the Rook.

Ehlers was the first to show that the ova develop direct into the worm, no intermediate host being necessary as hinted at by that great authority Dr. Cobbold. Ehlers fed birds on *Syngamus*-ova, and in ten days he found coupled worms in them, and seventeen females were present full of eggs. Mégnin again, in 1872, gave a parrot Gapes by feeding it with ova from a pheasant. Numbers of times I have convinced myself of the truth of these statements by feeding quite healthy pullets with the worms and ova, and thus producing the disease in individuals quite free from it previously.

It was never a case of the *identical worms* given the

fowls causing the disease ; the parent worms were ruptured either in being picked up, or soon after, the embryos thus set free at once entering the tracheal tube.

How this entrance takes place is not known : whether by the self-conscious movements of the embryo or by chance yet remains to be proved.

Walker has observed the embryos of this parasite in Earthworms, and thus he says the fowls get the disease. There is no reason to doubt that this does often happen ; the embryos and eggs may, and *probably* would, be taken in with the soil the Earthworms devour. But this is no proof that the Earthworm is an intermediate host of the *Syngamus*.

Amount of Loss in Fowls, &c.

Crisp says that half a million pullets are destroyed annually in England. Wiesenthal estimated the loss of Gallinæ in the invaded areas he examined at four-fifths. If not so great as this now in England, the loss is still serious in some districts.

Theories regarding the Development of the Gape-worm.

Regarding the development of *Syngamus trachealis* there seem to be three theories, each entailing an intermediate host. The necessity of this intermediary is now practically disproved. The three hosts sug-

gested have been :—(1) The Bird-Lice (*Mallophaga*), (2) various Mollusca, and (3) Earthworms.

(1) *The supposed connection between Lice and Gapes.*—This theory, for we must call it such, is based upon three points, namely :—(1) Dr. Cobbold's suggestion (p. 77). (2) The observations of a Mr. Halsted, who noticed that if he cleaned off *certain* insects (what they were we are not told!) which were observed attached to the head of some of his chickens, that those broods never had Gapes, but those upon which the insects remained suffered from the disease. These '*certain insects*' were probably lice; he therefore at once assumed that there was a connection between Gapes and the insects he observed. But Mr. Halsted says of this insect that "it is not a louse." The figure in Mr. Wright's excellent book on Poultry is, however, one of the Mallophaga, but what species it is not possible to tell. (3) Thirdly, inferences have been drawn from other parasitic worms, such as the *Tænia* found in the dog, which is derived from the cystic stage found in the dog's louse (*Trichodectes latus*). Undoubtedly, we often find lice when Gape-worms are present, because, unfortunately, very many fowls suffer from this insect infestation recorded in one of the previous articles. On the other hand, I have numerous records of Fowls in isolated runs which were quite free from lice and yet suffering from Gapes. Again, we must remember that the Nematode worms are not Cestode worms. Many of

the former develop direct, whilst the latter (except *Bothriocephalus*) can only develop by means of a second host. Lastly, we know that no intermediate host is necessary, as it has been shown that development can take place by direct transmission of ova.

(2) *Cobbold's supposed intermediate Host an Insect or Mollusc.*—Cobbold, after alluding to the permanent union of the two sexes, says :—“ Clearly the eggs can only escape by an eventual breaking-up of the body of the parent ; , by whatever mode the young escape the shell, it is clear that they are already sufficiently developed to undertake an active migration. A change of hosts is probably necessary, but in the first instance they either enter the substance of fungi or other vegetable matters, or they bury themselves in the soil a short distance from the surface.” Later Dr. Cobbold, in a communication to the Linnean Society, suggests that the intermediate habitation might be the larvæ of certain insects or land-mollusca.

That they may enter the soil we know ; but unfortunately no evidence has been brought forward of sufficient importance in favour of either larval insects or mollusca being the connecting-links in their life-history.

(3) Thirdly, *Dr. Walker's Theory* must be referred to. It is that the eggs falling upon the ground, and also the embryonic *Syngami*, enter the Earthworm, and there they live and undergo certain changes

during development. On the earthworm being eaten by the fowl, the embryonic Gape-worms are released in the digestive organs, and then find their way back to the air-passages, take up their permanent abode there, and reach maturity.

Unfortunately for this theory, we find that Gapes appears in young chicks long before they could have eaten earthworms. Again, Gapes appears in fowls on land where earthworms do not exist. The Green Woodpecker, the Martin, and Swift suffer from this parasitic disease, yet they do not eat earthworms.

It is quite possible, nevertheless, that fowls may take in embryos from eating, as they ravenously do, the earthworms. These useful annelids would doubtless take in the ova in the soil that passes in such quantities through their bodies. This is quite different to assuming that the earthworm is an intermediate host : it is simply a chance occurrence.

There is very little doubt but that Gapes is spread by direct infection derived from the ova and embryos brought up in the expectorations of the fowls. These are taken from the soil and from polluted drinking-water—wild birds playing an important part in the distribution of this pest. I have transmitted this disease direct from one bird to another with ease ; whilst water polluted with the ova taken from mature worms gave the complaint to seven out of nine fowls drinking it.

Symptoms of the Disease.

The symptoms of Gapes are very pronounced. One of the chief features is the 'yawning' or 'gaping,' with widely opened beak and constant straining forwards of the neck. In many birds, especially young ones, a wheezing cough is noticeable. When many worms are present, a frothy saliva is often noticed in the mouth. The birds become dull, and have a diminished appetite. The feathers become erect, weakness increases, and death may result unless remedies are adopted.

Treatment and Prevention of Gapes.

One of the first steps to take is to isolate any affected bird, so that others cannot eat the coughed-up *Syngami*, as is too often done.

The runs and houses after an outbreak should always be disinfected. This is best performed by watering the ground with a one-per-cent. solution of sulphuric acid.

By the addition of 3 drams of salicylate of soda to every quart of drinking-water, the ova and embryos are destroyed. In cases where the disease is very prevalent, this may well be employed.

The frequent removal of the birds from place to place, dry, clean, and light houses and runs, will greatly tend to lessen the chances of this parasite.

As the ova of many, if not all, parasitic worms can remain some time without undergoing development

unless eaten by their host, steps must be taken to free the land from them if infected birds have been present. Gas-lime is as good a purifier as any for use on a large scale. It destroys all such germs, just as sulphuric acid does, but is cheaper if it be used on a large scale. Of course this necessitates a longer absence of the birds from the invaded ground, as the gas-lime takes some little time to work out.

Another point to remember in regard to the prevention of Gapes, is to destroy by fire the heads and necks of all birds that have died and suffered from this disease. By so doing, the worms and their complement of ova are effectually disposed of.

In regard to *remedies*, the first point to call for attention is the removal of the worms from the throat. These pests have been removed mechanically for years. The usual plan is to pull off all the bar-bules of a feather except those at the tip. Then dip the feather in some substance obnoxious to the worms, and put it down the fowl's throat into the trachea and twist it round several times. On withdrawing the feather, some of the worms will be found attached to it. One part of oil of turpentine to two of olive-oil has been found most successful. Oil of rue and olive-oil in same proportions as above have been employed with similar results. I have found oil of cloves most useful, and less irritating than oil of turpentine and paraffin, so often recommended. An old plan of freeing the trachea of worms was by inserting a looped horsehair into the fowl's trachea.

This is most painful to the birds, and not at all successful.

Garlic is said to get rid of the worms by means of its powerful odour. This can be used either chopped up in the food or given in pills. I have never tried this remedy, but both Montagu and Mégnin have found it very successful.

Rue infused in the birds' drinking-water is another old remedy, by no means to be despised. I have known several cases of Gapes successfully overcome by the use of this herb.

Tobacco-smoke has been employed with advantage. The way to use it is to put the bird in a closed box, and fill the box with tobacco-smoke until the bird falls over, when it should be immediately taken out and put in the fresh air.

Tracheal injections have been tried in recent years. This method of curing Gapes is one of the most successful, but it requires care and attention. I have found a *few drops* of 8 p. c. solution of salicylate of soda, injected into the trachea with a fine pipette, invariably successful. I obtained similar results with *Eucalyptus*-oil.

A mixture of one ounce of powdered chalk and half an ounce of finely-ground camphor, sprayed into a closed box so that the birds must inhale it, is by far the safest and most successful remedy I have tried, although not so certain in its results as by tracheal injections. It has, however, many advantages over the former, as so much care is not needed. This

camphor and chalk has a similar effect to that excellent compound sold under the name of 'Camlin Powder,' which has met with general approval.

This disease is one, fortunately, that lends itself to treatment; but it is well to take all steps to prevent its spreading and appearance, which we are capable of doing without any very serious expense.

THE WHITE WORMS (*HETERAKIS*) OF THE ALIMENTARY CANAL.

Amongst the numerous worms mentioned as occurring in the alimentary canal of the Fowl, these are by far the most important. There has often appeared a kind of epizootic attack of so-called White Worms in the Fowls' intestines. These White Worms have more than once come under my notice. They belong to the Nematode genus *Heterakis*. Four species of this family will be found recorded in the Appendix as living in the Fowl. Two only are ever very abundant, namely, *H. inflexa* and *H. papillosa*. They are dirty yellow to white in colour. *H. inflexa* is only 8 cm. long in the male, and from 7 to 12 cm. in the female. *H. papillosa* is very similar.

As far back as 1789 we find records of the damage caused by these worms in domestic birds. Blavette and Rossignol made observations on this subject in 1840. They found that the death of fowls they examined was due to the accumulation of these White Worms in the intestines. As many as thirty were found in each fowl that died. In the *post-mortem*

examination of fowls I have found these worms chiefly located in the duodenum. A common habit seems to be for the worms to roll themselves together into a ball. I have counted as many as fifteen tightly knotted together. The worms form a plug, causing obstruction and thus death.

They develop direct from the eggs, which are eaten by the fowls.

As a rule, these worms are very slow working evil results, but if allowed free play in their host they may often cause sickness and even death.

Symptoms of White Intestinal Worms.

As a rule, infested birds become ravenous, yet at the same time they seem to lose condition. The feathers become erect and lose their sheen. The comb becomes pale in colour, the birds yawn, and when the parasite is present in large numbers diarrhoea sets in. The worms may be seen in the droppings, and unless the patients are kept isolated they are eaten at once by the other fowls in the run.

Prevention and Treatment.

Isolation of infested subjects is just as essential as in 'Gapes.' When penned separately, the bird should be given soft food only. For some time before being dosed, no food should be given at all.

Santonin is the best vermifuge for *Heterakis* worms. It is best employed in the form of a pill—three grains of santonin to each pill; this can be

mixed in meal or dough. These pills should be given every other day for about a week. About an hour or so after each pill, a teaspoonful of sweet oil should be administered. Disinfection of the ground where the birds had been should be carried out as described before, as the *Heterakis* eggs may remain in the runs for some time—in fact, until they are eaten by other fowls.

THE EYE-WORM.

Even the sensory organs of poultry are not exempt from vermiceous parasites. In China we are told by Dr. Cobbold that there is a minute Filarian worm (*Filaria Mansoni*) that lives in the eyes of fowls. This is of no unusual occurrence. Similar instances have been recorded in horses. But of course these are only accidental cases of parasitism.

In conclusion may be mentioned a case of a serious choleraic affection in Cochin-China Fowls, quoted by Zürn. In these fowls, in which violent diarrhœa set in, causing debility and speedy death, there were observed in the walls of the intestines quantities of a minute Nematode worm known as *Anguillula stercoralis*, which were undoubtedly the cause of the complaint.

A fuller account of parasitic worms will be found in an article by the writer in the Journal of the S.E. Agricultural College (No. 4).

PART II.

VEGETABLE PARASITES.

THE vegetable parasites of birds, so far as our present knowledge goes, are few in number. These vegetable parasites are minute microscopical fungi, about which we know comparatively little. Three distinct families of parasites are known attacking poultry, namely :— (1) the *Dermatophytes*, which are cutaneous parasites, such as Ringworm and the poultry-disease known as Favus : (2) the *Perisporiaceæ*, or ‘Moulds,’ which affect the air-passages and cause a disease known as ‘Mycosis’ : (3) the *Saccharomycetes*, which attack the mouth, pharynx, and other parts of the alimentary canal ; these are the cause of the ‘Thrush’ in human beings, calves, and poultry.

In England there does not seem to be much loss by these minute vegetable enemies. When outbreaks do occur, they are generally attributed to other causes, owing to the incomplete knowledge of the parasitic ailments of the birds. It must be remembered that our knowledge is not very complete in this subject ; but sufficient is known to be able to identify the diseases caused by these vegetable germs.

The diseases of the skin produced by the vegetable parasites are known under the generic name of

Dermatomycoses. Most of these vegetable parasites are related to the Moulds. Of these there are at least three found in animals and birds: one the unsightly 'Ringworm,' produced by the fungus *Trichophyton tonsurans*—a disease common to man and animals alike, and transmitted from one to the other; another, common to birds, the so-called 'Favus,' due to *Achorion Schonleini* (fig. 23)—this Favus is also found in the human being, especially in young subjects; the third produces brown eruptions in the superficial layer of the epidermis in man, and is known as *Microsporon furfur*.

These are all contagious and unsightly complaints in man, but never fatal. In Fowls, however, the 'Favus' is often a serious malady.

V. DERMATOMYCOSES (FAVUS, ETC.).

These skin fungi are characterized by their circular manner of growth. They are allied to the 'Moulds' that we see on many decaying substances. It is doubtful, however, whether there is any connection between them. In fact, we have almost sufficient evidence to enable us to state that there is no connection, and that the Favus parasite gives rise only to Favus, and the Ringworm to Ringworm.

Each one of the Dermatophytes is made up of two elements—one a system of *tubes*, forming the so-called *mycelium*, the vegetative part of the fungus, the stem and leaf, as it were, of the plant; and, secondly,

the *spores*, seeds or reproductive parts of the fungus. These spores may be quite free or grouped together in masses. The spores are practically buds at the end of the Dermatophyte filament.

These minute vegetable forms live only in and upon epidermal products and the epidermis itself. They invade the cells of the outer skin, and even the hairs and feathers, destroying the two latter and causing the former to separate and decompose. In this way they produce intense itching, soreness, and redness.

They are spread no doubt by contagion, and seem to flourish best in young individuals. They are also known as 'Tineæ,' and may be easily cultivated artificially.

FAVUS.

Favus takes its name from the curious honey-comb-like structure of the deeper layers of the 'crusts' it produces on the skin. These curious cup-shaped yellow masses of crusts are produced by the fungus *Achorion Schonleini* (fig. 23) of Remak. It is a parasite common to man, the cat, dog, rabbit, and fowl. In the former three it causes the hair to fall, in the latter the feathers. Not only is it found in hairy and feathery parts, but it, for instance, affects the roots of the nails in man, giving rise to the disease called *Onychomycosis favosa*.

Favus of Fowls.

The Favus, or 'Tinea favosa,' of Fowls differs but slightly from that of other animals, and is clearly due to the above-named fungus, as can be plainly demonstrated by microscopical examination.

In fowls the Favus first manifests itself on the comb, wattles, and neck. Often I have noticed one side of the head being affected only. The first signs of the attack are small pale yellowish spots, cup-like, but sometimes irregular in form. These gradually grow and unite, eventually forming a confluent covering of a greyish-yellow substance, showing concentric markings. By degrees, usually in about four to five weeks, the feathers of the head, and possibly neck, become affected. The feathers are stiff, brittle, and eventually fall off, leaving sometimes their base still implanted in the scutula of the 'Favus.' The discoid masses of Favus have slight depressions in their centre from which the feathers have fallen. The depositions apparently form around the bases of the feathers. Birds so affected are said to give off a rather offensive mouldy odour; this, personally, I have failed to detect.

Effect of the Disease.

The general result of Favus is debility and wasting, if no steps are taken to destroy it. Very often death of the patient results. I have nevertheless known cases of spontaneous recovery without any remedies being applied.

Regarding the breeds affected by Favus, Züirn states that if all birds are affected, the larger breeds and those of Cochin-China descent are most liable to it. Bantams are also noticed by Neumann. Recently I have had Dorkings severely attacked. A Dorking cock with favic scutula on one side of the head was allowed to run with some hens (Dorking); only one, however, caught the infection, and this was an old hen in moult, none of the other birds, which were all young and healthy, were affected.

Poultry Favus transmitted to Man.

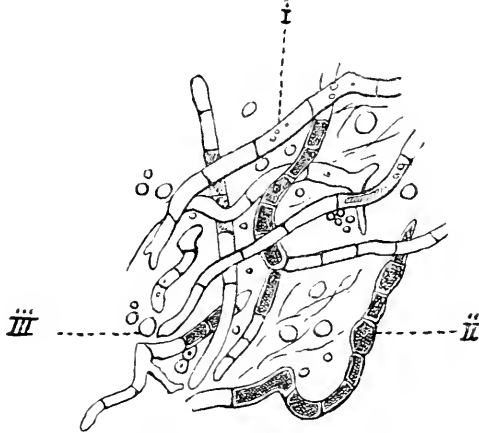
It is important to note that poultry Favus can be transmitted to man. This especially happens if there is a slightly abraded surface. Care, therefore, should be taken in handling diseased fowls, as it is anything but a nice human complaint, and not so readily amenable to treatment as in poultry.

Minute Appearance of the Fungus.

The fungus can easily be studied under the microscope by shaking the dusty matter that will be observed under one of the detached crusts taken from the fowl. This dust should be moistened with water and a small drop of acetic acid, when it will be seen that the favic cups are formed of thread-like mycelia and spores, together with epithelial scales detached from the skin of the 'host.' There will also be seen tubes containing spores, and between these and the mycelia minute granules in a viscid

substance. The mycelia are closely interwoven with one another (fig. 23).

Fig. 23.

*Achorion Schonleini.*

The *mycelium* is composed of simple cylindrical tubes (i) ; sometimes, however, they are dichotomously branched. These are full of protoplasm, and vary in breadth from 1 to 8 μ . Other filaments are partitioned and contain spores (ii) ; these are known as 'conidiophores' or spore-receptacles.

Thirdly, the spores (iii) are rounded or oval bodies generally in groups of three, four, or eight.

Both mycelium and spores may be seen as well in the feathers at their base.

Treatment.

This complaint readily yields to treatment in Poultry, especially if attacked whilst it is only on the

comb and wattles. Bathing the favic area should be done before any fungicide is employed, and if any crusts can be removed, they of course should. The diseased area then may be dressed with an ointment made of one part of red oxide of mercury to eight parts of lard well rubbed into the skin.

Benzine, sulphur, and soft soap also forms a good destroyer of this fungus—a few drops of the benzine and just a sprinkling of flowers of sulphur mixed up in an ordinary pill-box of soft soap or lard. With either of these the bird should be anointed every day. As a rule, in about a week all signs of the favic cups have disappeared. Isolation of any diseased bird should at once be carried out, and great care should be taken in dressing the patient not to transmit the affection.

VI. MYCOSIS OF AIR-PASSAGES.

As far back as 1815 Fungi were noticed in the air-passages of various birds by Meyer and Emert. These vegetable parasites seem common in many wild birds and in all our domesticated ones. Rosseau was the first, in 1841, to note this malady in Poultry.

Cause of Mycosis.

The mycosis of the air-passages, and even the airsacs, is caused by 'Moulds,' *Mucedinæ*, belonging to the genus *Aspergillus*, fungi that are endowed with great vegetative qualities.

The *Aspergilli* are formed of thin colourless filaments forming a matted layer or thallus, and a looser mass above, the so-called aerial mycelium. The lower filaments will be seen to be unequally divided by septa and to ramify about. From the aerial mycelium there appear upright branches ending in bunches of spores—the conidia. Other curious masses are noticed which contain eight larger spores, called *ascospores*, and which are set free by the rupturing of their case.

Symptoms.

The usual symptoms of Mycosis are heavy breathing, accompanied with curious guttural sounds, loss of appetite, feathers loose and erect, drooping wings, and general depressed condition. In a few weeks the malady causes emaciation, the bird becomes thoroughly cachectic, and dies.

Sometimes the 'mould' blocks up the bronchi entirely, and death becomes sudden by asphyxiation.

On examining a bird that has succumbed to this disease, one finds a number of dirty yellowish-green tubercles in the trachea, bronchi, lungs, and air-sacs, from 6 to 20 mm. in thickness, sometimes even larger. On their surface are found the mycelia and conidia of the mould. The tubercles formed in the lungs very much resemble those of phthisis.

It may be that the spores which originate this disease only take root, as it were, in already unhealthy

birds. Nevertheless it is unusual to find any other signs of disease in fowls suffering from Mycosis.

Mode of Infection.

The spores set free from other *Aspergilli* enter with the air the respiratory passages. Finding heat and moisture two conditions most favourable to fungoid development, they rapidly germinate on the moist warm mucous membrane. As the mycelium advances, inflammation is set up.

Forms of Aspergilli.

Four species of 'Moulds' seem to be parasitic namely, *A. glaucus*, Link, *A. niger*, Van Tieg. *A. fumigatus*, Fresenius, and *A. candidus*, Link.

Effect of Temperature.

The temperature of the body has much to do with the development of these mould-spores. *A. glaucus*, for instance, will not germinate at the animal temperature, and thus cannot do any harm except mechanically, the spores alone being able to obstruct the small air-passages, if in large numbers. *A. niger* will only grow at 95° F., and thus cannot flourish in Birds*. *A. fumigatus*, which seems to require a temperature of 98° to 104° F. to develop, has been shown by Schütz to be by far the most dangerous parasite of the fowl.

* The average temperature of a bird is 103° to 104° F.

By inoculating healthy pigeons with the spores of *fumigatus*, by injecting them into the axillary vein, Dieulafoy and Widal have shown that tuberculosis of the liver and lungs takes place, ending fatally in a few days. The tubercles very much resemble those of true tuberculosis due to the bacillus. When this Mycosis appears, it is usually in an epizootic form.

Prevention and Treatment.

Cleanliness of the fowl-houses is most essential, everything, such as straw, litter, &c., that may be about should be burnt, and the houses cleaned down with boiling water and corrosive sublimate, a pint of 10 p. c. solution to every gallon of boiling water. Treatment is usually futile; good, however, is said to be done by putting the birds in a closed chamber with tar-vapour, formed by putting a large spoonful of vegetable tar in a pint of water and then stirring with a red-hot iron. Only two birds affected with apparent Mycosis have come under my notice: burning sulphur in a similar way was tried, but the birds eventually succumbed, the liver being invaded as well as the trachea with mould.

This malady does not seem to be much known in England, but when cases do appear they are usually fatal.

VII. THRUSH IN POULTRY.

Two known cases of 'Thrush' in Poultry are the only records we have ; these were observed by Eberth and Martin, and are recorded respectively in 'Virchow's Archiv,' iii. p. 528, and in 'Jahresber. d. Thierarznei-Schule in München,' 1882-3, p. 125.

Many cases of so-called 'Thrush' in fowls have been mistaken instances, the true cause of the white creamy growths being the Sporozoa, &c., described in the article on Diphtheria (p. 4). True 'Thrush' is due to a fungus known as *Saccharomyces albicans*. These two instances recorded were found on examination to be due to the same fungus that is found in the 'Thrush' of children and calves. There were found in the fowl examined by Eberth several white deposits adhering to the mucous membrane of the œsophagus, similar in external appearance to those found in children. These two cases are interesting, but of little practical importance, as Thrush appears not only to be rare but not to attack healthy birds.

These are the only three groups of vegetable parasites known to me as affecting Fowls.

Bacilli.

Bacilli, although sometimes regarded as belonging to the vegetable kingdom, have such unique characters, both pathologically and physiologically, that they are best separated as a distinct group of disease-producing forms of life. Hence Fowl Cholera &c. are not dealt with in this Manual.

APPENDIX.

I.

LIST OF ANIMAL AND VEGETABLE PARASITES UPON *GALLUS DOMESTICUS*.

I. ANIMAL KINGDOM.

PROTOZOA. (UNICELLULAR ANIMALS.)

1. *Isospora avium*, Railliet Intestines.
= *Psorospermium avium*, Rivolta.
2. *Monocercomonas galline*, Rivolta } Mouth, Pharynx,
and Trachea.
3. *Trichomonas Eberthi*, Kent } Glands of Lieber-
kühn.
4. *Coccidium perforans*, Rivolta Intestines.
= *C. Rivoltae*, Harz.
C. tenellum, Railliet & Lucet.
5. *Eimeria dubia*, Railliet } Connective tissue
of Intestine.
= *Gregarina avium intestinalis*, Rivolta.
6. *Sarcocystis*, sp. ? (Coll. B. A. 1), Hassall. Muscles.

CESTODA. (TAPEWORMS.)

7. *Drepanidotænia infundibuliformis*, Goeze. Intestines.
= *Tænia infundibuliformis*, Goeze.
8. *Dicranotænia cuneata*, Linstow Intestine.
= *D. sphenoides*, Railliet.
Tænia cuneata, Linstow.
9. *Tænia exilis*, Dujardin Intestine.

10. *Davainea proglottina*, Blanchard Intestine
 = *Tænia proglottina*, Davaine.
11. *D. tetragona*, Molin Intestine.
 = *Tænia bothrioplitis*, Piana.
12. *D. echinobothrida*, Blanchard Intestine.
 = *T. echinobothrida*, Mégnin.
13. *D. cesticillus*, Molin Intestine.
 = *T. infundibuliformis*, Dujardin.
14. *Fimbriaria malleus*, Frölich Intestine.
 = *T. malleus*, Goeze.
T. fasciolus, Pallas.
F. mitra, Frölich.
15. *Cotugnia digonopora*, Diamare Intestine.
 = *T. digonopora*, Pasquale.
16. *Bothriocephalus longicornis*, Molin.
 = *Bothriotænia longicornis*, Railliet.
 = *Dibothrium longicolle*, Molin.
17. *Cysticerci* sp. ?, Railliet Peritoneal cavity.
18. Fragments of *Tænia*, Zürn Ovum.
19. *Piestocystis variabile*, Diesing Peritoneum.

TREMATODES. (FLUKES.)

20. *Cephalogonimus pellucidus*, Railliet. . . . Œsophagus.
 = *Distomum pellucidum*, Linstow.
21. *C. ovatum*, Stossich } Bursa of Fabricius
 = *Fasciola ovata*, Rudolphi. } and Ova.
Distoma ovatum, Rudolphi.
D. bursicola, Creplin.
22. *Crossodera linearis*, Cobbold Large Intestine.
 = *D. lineare*, Zeder.
F. linearis, Rudolphi.
D. linearis, Cobbold.

23. *Echinostomum echinatum*, Zeder Cæca & Rectum.
= *D. armatum*, Molin.
24. *E. oxycephalum*, Rudolphi ?
25. *E. dilatatum*, Miram Cæca & Rectum.
= *D. dilatatum*.
? = *E. echinatum*, Zeder ?
26. *Mesogonimus commutatus*, Sonsino Cæca.
= *D. dimorphum*, Wagner.
D. commutata, Diesing.
27. *Notocotyle verrucosum*, Monticelli Cæca.
= *Fasciola verrucosa*, Frölich.
Monostomum attenuatum, Rudolphi.
M. lineare, Rudolphi.
Notocotyle triserialis, Diesing.

NEMATODA = THREAD-WORMS.

ASCARIDÆ.

28. *Heterakis compressa*, Schneider Intestine.
26. *H. brasiliensis*, Magalhães Intestine.
30. *H. compar*, Stossich Intestine.
= *Ascaris compar*, Schrank.
A. lagopodes, Frölich.
Fusaria compar, Zeder.
31. *H. differens*, Sonsino Intestine.
32. *H. papillosa*, Railliet.
= *Ascaris papillosa*, Bloch.
H. vesicularis, Dujardin.
33. *H. inflexa*, Rudolphi Intestine.
= *H. perspicillum*, Schneider.
Ascaris gallopavonis, Gmelin.
A. gibbosa, Rudolphi.
A. funiculus, Deslongchamps.
Fusaria strumosa, Zeder.

FILARIDÆ.

34. *Dispharagus nasutus*, Dujardin Gizzard.
 = *Filaria nasuta*, Schneider.
Spiroptera nasuta, Rudolphi.
35. *D. hamulosa*, Stossich Gizzard.
 = *Cheilospirura hamulosa*, Diesing.
Spiroptera hamulosa, Diesing.
36. *D. spiralis*, Molin Œsophagus.
 = *F. papillosa*?
37. *D. laticeps*, Dujardin Œsophagus.
 = *F. laticeps*, Schneider.
S. laticeps, Rudolphi.
38. *Filaria Mansoni*, Cobbold Eye.

STRONGYLIDÆ.

39. *Syngamus trachealis*, Von Siebold { Trachea and
 = *Strongylus trachealis*, Creplin. } Bronchi.
Sclerostoma syngamus, Diesing.
Syngamus primitivus, Molin.
Fasciola trachea, Montagu.
40. *Psioloptera truncata*, Schneider Gizzard.

TRICHOCEPHALIDÆ.

41. *Trichosoma longicolle*, Rudolphi Intestine.
42. *T. annulatum*, Molin „
43. *T. collare*, Linstow „
44. *T. retusum*, Railliet „

ANGUILLULIDÆ.

45. *Anguillula stercoralis*, Bavay Intestine.

ACARINA. (MITES.)

46. *Argas mauritanus*, Guérin External.
47. *Dermanyssus gallinæ*, Redi External.
 = *D. avium*, De Geer.

48. *Cytodites nudus*, Vizioli Air-tubes.
 = *Cytoleichus sarcoptoides*, Mégnin.
Sarcoptes Gerlachi, Rivolta.
49. *Dermoglyphus minor*, Nörner External.
 = *Analgés minor*, Nörner.
50. *D. elongatus*, Mégnin External.
 = *Analgés elongatus*, Nörner.
51. *Epidermoptes bifurcatus*, Rivolta External.
52. *E. bilobatus*, Railliet & Lucet ,
 = *Symbiotes avium*, Caparini.
53. *Leptus autumnalis*, Latreille External.
54. *Laminosioptes cysticola*, Vizioli ,
 = *Symplectoptes cysticola*, Vizioli.
L. gallinarum, Mégnin.
55. *Lophoptes patavinus*, Mégnin External.
56. *Mégninia cubitalis*, Mégnin ,
57. *M. asternalis*, Mégnin ,
58. *Pterolichus obtusus*, Robin ,
59. *Sarcoptes lævis*, var. *gallinæ*, Railliet.. Skin.
60. *S. mutans*, Robin ,
 = *Knemidokoptes viviparus*, Fürstenberg.
61. *Syringophilus bipectinatus*, A. Heller .. External.
 = *Picobia bipectinatus*, O. Heller.
62. *Tydeus molestus*, Moniez External.

INSECTA. (LICE AND FLEAS, ETC.)

MALLOPHAGA.

63. *Gonicocotes gigus*, Taschenberg Rump & Wings.
 = *G. hologaster*, Denny.
G. abdominalis, Piaget.
64. *G. hologaster*, Nitzsch Rump & Wings.
 Var. *maculata*, Tasch.
65. *Goniodes dissimilis*, Nitzsch General.
66. *G. Eynsfordii*, n. sp. Head & Neck.
67. *G. Burnetti*, Packard ?

104 *Animal Parasites.* APPENDIX I. *Vegetable Parasites.* }
 68. *Lipeurus variabilis*, Nitzsch } Primary & secondary feathers.
 69. *L. heterographus*, Nitzsch }
 70. *Menopon biserialatum*, Piaget } General.
 71. *M. trigonocephalum*, Railliet }
 72. *M. pallidum*, Nitzsch } "

DIPTERA.

73. *Pulex avium*, Tasch. } General.
 = *P. gallinæ*, Bouché.
 74. *Sarcopsylla gallinacea*, Westwood }
 75. *Fermipsylla alakurt*, Schimk. }
 76. *Ornithobia pallida*, Mg. } Partial parasite.
 77. *Ornithomyia avicularia*, L. } "

HEMIPTERA.

78. *Acanthia columbaria*, Jenyns } Partial parasite.

COLLEMBOLA.

79. *Isotoma*, sp. } Nests & Skin.

II. VEGETABLE PARASITES.

1. *Achorion Schonleinii* } Skin.
 2. *Aspergillus glaucus*, Link. } Air-passages.
 = *Eurotium herbariorum*, Link.
E. aspergillus glaucus, De Bary.
 3. *A. candidus*, Link. } Air-passages.
 4. *A. fumigatus*, Fresenius }
 5. *A. nigrescens*, Link }
 = *A. niger*, Van Tieg.
 6. *Oidium albicans*, Robin } Throat.
 = *Saccharomyces albicans*, Reiss.
Syringospora Robini, Quinquaud.

7. <i>Penicillium glaucum</i>	Albumen of egg.
8. <i>Mucor stolonifer</i>	"
9. <i>Botrytis</i> , sp. ?	"
10. <i>Dactylium</i> , sp. ?	"
11. <i>Hætophora</i> , sp. ?	"
12. <i>Sporotrichium</i> , sp. ?	"
13. <i>Leptomitus</i> , sp. ?	"
14. <i>Macrosporium</i> , sp. ?	"
15. <i>Stysanus</i> , sp. ?	"

II.

BIBLIOGRAPHY.

DIPHThERITIC ROUP AND PSOROSPERMOSIS.

1. L'Ornitogatria. Pisa, 1881. RIVOLTA & DELPRATO.
2. Beiträge zur Kenntniss der Pathogenen Gregarinen. Zeitschr. f. Hygiene, v. Heft 3. 1889. PFEIFFER.
3. Les Bactéries. II. Paris, 1890. CORNIL & BABES.
4. Bull. de la Soc. Centr. de Méd. Vétérinaire, 1889. MÉGNIN & CADIOT.
5. Virchow's Archiv, 1873. BOLLINGER.
6. Epithelioma contagiosum des Geflügels. Gesellsch. d. Aerzte in Wien, 1883. CSOKOR.
7. Die Protozoen als Krankheitserreger. 1890. PFEIFFER.
8. Notes on Poultry Parasites. I. Diph. Roup and Epi. contagiosum. Jour. S.E. Agricultural College, 1895. THEOBALD.

FLEAS (PULICIDÆ) AND OTHER FLIES.

9. Die Flöhe. Halle, 1880. O. TASCHENBERG.
10. Art. "Puces." Nouv. Dict. Prat. de Méd., de Chirurg. et d'Hyg. Vétérinaires, xviii., 1890. RAILLIET.
11. Les Puces des Oiseaux. Bulletin de la Soc. Centrale de Méd. Vétérinaire, 1888. MÉGNIN.
12. Sur la Puce des Poules. Recueil de Méd. Vét., 1888. A. LUCET.
13. An Account of British Flies. Vol. I. 1892. (*Pulicidæ*). THEOBALD.
14. Syst. Besch. d. bek. europäischen zweiflügeligen Insekten. Vol. VI. (*Hippoboscidæ*.) 1830. MEIGEN.
15. Insecta Britannica. Diptera, Vol. II. 1851. WALKER.

MALLOPHAGA.

16. Monographia Anoplurorum Britanniae. 1842. DENNY.
17. Insecta Epizoa. Leipzig, 1874. GIEBEL & NITZSCH.
18. Jahresberichte naturw. Ver. Halle, 1851. Jahrg. iv.
pp. 113-135. GIEBEL.
19. Zeitsch. f. d. gesammt. Naturw., Hft. v., xi. (249),
xvii., xviii., xxiii., xxvii., xxviii., xxix., xxxvii.
GIEBEL.
20. Neue Federlinge. Zeitsch. f. d. ges. Nat. xlvii. pp. 247 &
528. GIEBEL.
21. New Forms. Annals & Mag. of Nat. Hist. vol. xvii.
1876. GIEBEL.
22. Classification and Structure of Bird Lice. Abstract by
G. Macloskie, Am. Nat. xx., and Journal of Micr. &
Nat. Science, p. 159, pl. xx. GROSSE.
23. Zeitschr. wiss. Zool. xlii. 1885, pp. 532 and 537. GROSSE.
24. Les Parasites et les Maladies Parasitaires. Paris, 1880.
MÉGNIN.
25. Arch. f. Naturg. xxxv. 1, 1869, p. 154, x., xi. (Ova).
MELNIKOW.
26. Notes on Mallophaga and Pediculidæ. Can. Ent. xvi.
p. 197. II. OSBORN.
27. Les Pédiculines; Essai monographique. Paris, 2 vols.
E. PIAGET.
28. Tijdschr. Ent. xxxi. & xxxiii. E. PIAGET.
29. Neue Mallophagen. Zeitsch. f. d. ges. Naturw. 1869,
xxxiv. p. 387. F. RUDOW.
30. Proceedings Ent. Soc. London, 1890, p. xxx. SHARP.
31. Journal of Agricultural Science, 2 vols. I. pp. 46, 62, 68.
SIMONDS.
32. Bull. d'Insectologie Agricole, 1878, p. 56. SCHNEIDER.
33. Science Gossip, 1871, pp. 131-185, 234-278.
34. Die Mallophagen. O. TASCHEBERG.
35. Insect Parasites of Poultry. Jour. S.E. Agri. Coll., pt. 2,
1895. THEOBALD.

36. Proc. U.S. Nat. Mus. xii. p. 189. UHLER.
 37. Ueber das Herz von *Menopon pallidum*. Sitzungs-
 k. Akad. Wiss. Wien, 1855, t. xvii. p. 173. Dr. D.
 WEDI.

HEMIPTERA.

38. Sur une Punaise qui attaque les Poules. Bull. de
 la Soc. de Méd. et Vét. Pratique, 1890, p. 99.
 RAILLIET.

ACARINA.

39. L'Ornitofatria. Pisa, 1881. RIVOLTA & DELPRATO.
 40. Die Krankheiten des Hausgefögels. Weimar, 1882.
 ZÜRN.
 41. Economic Entomology (Aptera). MURRAY.
 42. Hist. Natur. des Insectes. Aptères, III. p. 225. 1844.
 GERVAIS.
 43. The Veterinarian, 1851, pp. 222, 251, 254. WOODGER,
 HENDERSON.
 44. Traité de la Psore, 1862, p. 595. DELAFOND.
 45. Art. "Parasites." Nouv. Dict. de Méd., de Chir. et d'Hyg.
 Vétérinaires, xv. 1888, p. 454. RAILLIET.
 46. Oesterr. Vierteljahrsschr. f. Veterinärk. lvii. 1882, p. 87.
 CSOKOR.
 47. Les Sarcoptides Plumicoles. Jour. de Micrographie,
 1884-85. MÉGNIN.
 48. Sur les Acariens qui vivent dans le tuyau des plumes
 des Oiseaux. Comptes-rendus de l'Acad. d. Sciences,
 xcix. 1884, p. 1130. TROUESSART.
 49. Sur une Acariase des Poules. Revue Vétérinaires, 1887,
 p. 121. G. NEUMANN.
 50. Di una nuova forma di Rogna nei Polli. Bull. Vétéri-
 naire, 1880, p. 65. CAPARINI.
 51. Acariases Multiples sur des Poules. Bull. de la Soc.
 Centr. de Méd. Vétérinaire, 1891, p. 133. RAILLIET
 & LUCET.

52. Les Acariens Parasites du tissu cellulaire et des réservoirs aériens chez les Oiseaux. Journ. de Anat. et de Physiol. 1879, p. 123. MÉGNIN.
53. Eléments de Zoologie Médic. et Agricole. 1835. RAILLIET.
54. Étude Zoologique du Sarcopte lisse (*Sarcoptes lævis*). Bull. de la Soc. Zool. de France, xii., 1887. RAILLIET.
55. Comptes-rendus de l'Acad. des Sciences, p. 793, 1889. (*Sarcoptes mutans*.) ROBIN & LANQUETIN.
56. Sur la siège de la Gale Sarcoptique des Poules. Rev. Vét. 1885, p. 489. NEUMANN.
57. Nouvelle affec. psorique des Gallinacés. Bull. de la Soc. Cent. de Méd. Vét. 1887, pp. 45 & 193. RAILLIET.
58. Poultry Parasites, Notes on. Journal S.E. Agri. Coll., pt. 2, 1896. THEOBALD.

VERMES.

59. Einige neue Distomen. Arch. f. Naturgeschichte, xxxix. 1873, p. 95. VON LINSTOW.
60. Compte-rendu de la Soc. de Biologie, 1863, p. 218. (*Disparagus*.) LEGROS.
61. Embryologische Forschungen an Cestoden. Cent. f. Bakter. u. Parasitenkunde, v. 1889, p. 370. GRASSI & ROVELLI.
62. Recueil de Méd. Vét. Pratique, xvii. 1840, p. 332. BLAVETTE.
63. Entérite Vermineuse des Poules. Rec. de Méd. Vét. 1888, p. 312. LUCET.
64. Les Parasites et les Maladies Parasitaires. Paris, 1880. MÉGNIN.
65. Medical and Physical Journal, ii. p. 204, 1790. WIENTHAL.
66. Entozoa. London, 1864. COBBOLD.
67. Compte-rendu de la Soc. de Biologie, 1880, p. 394. CHATIN.

68. Journ. de Méd. Vét. Militaire, vii. p. 272. 1868. LIARD.
69. Vorläufige Mittheilungen über d. Entwick. von *S. trachealis*. Sitzber. phys.-med. Soc. Erlangen, p. 43. 1872. EHLERS.
70. Epizooties Vermineuse chez les Jeunes Faisans. Rec. de Méd. Vét. 1878, pp. 825, 927. MÉGNIN.
71. Second Ann. Rep. of Bureau of Animal Industry (U.S.A.). 1885. SALMON.
72. Jahresber. d. Westf. Prov.-Ver. f. Wissensch. u. Künstl. Münster, 1880, p. 11. RENNE.
73. *S. bronchialis*. Deutsche Zeitschr. f. thier. Med. u. vergl. Pathologie, x. 1884, p. 265. MÜHLIG.
74. Compte-rendu de la Soc. de Biologie, (5) v. 1873, p. 295, (6) i. 1874, p. 197. HAYEM.
75. Parasitic Poultry Worms—Gapes &c. Journ. S.E. Agri. Coll., pt. 4, 1896. THEOBALD.
76. Sur deux Cas d'inclusion de Parasites Nématoides dans les Œufs de Poule. Journ. de Micro. 1887, pp. 407, 512. CARUCCIO.

VEGETABLE PARASITES.

77. Virchow's Archiv, iii. p. 528 (*Thrush*). EBERTH.
78. Die Krankheiten des Hausgeflügels. Weimar, 1882, p. 130. ZÜRN.
79. 'Magazin' of Gurtl & Hertwig (25th year). Berlin, 1858, p. 236 (*Farus*). GERLACH.
80. Die pflanzlichen Parasiten (2nd edit.). Weimar, 1889. ZÜRN.
81. Revue Vét. 1885, p. 280. G. NEUMANN.
82. Compte-rendu de la Soc. de Biologie, 1886, pp. 173, 216. G. NEUMANN.
83. Hist. Nat. des Végétaux Parasites, p. 447. Paris, 1853. ROBIN.
84. Notes sur l'Histologie des Dermatophytes. Archiv de Physiologie, xii. p. 470. 1883. F. BALZER.

85. Arch. Gén. de Méd. 1881, ii. p. 391. F. BALZER.
86. On the Parasitic Affections of the Skin. New edit.
London, 1868. ANDERSON.
87. L'Ornitofatria, p. 247. RIVOLTA & DELPRATO.
88. Compte-rendu de la Soc. de Biologie, (5) v. 1873, p. 295
(*Mycoses*). HAYEM.
89. Il Medico Veterinario, 1884, p. 105. PERRONCITO.

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