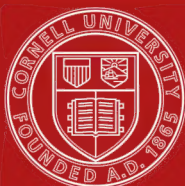


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VETERINARY PARASITOLOGY

VETERINARY PARASITOLOGY

BY

REGINALD H. SMYTHE, M.R.C.V.S.

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PREFACE

OF late years, owing to the increased attention paid to the study of parasitology in our veterinary schools, there has arisen a need in our literature of a textbook, which, although dealing more or less fully with the more common parasites of the domesticated animals, shall yet be concise and of a handy size. It has been the aim of the author to fill the gap with a volume which, while covering the course laid down for the student, shall be at the same time of practical value to the veterinarian as a book of reference. With this end in view, the symptoms produced by the various parasites have been fully described, together with the latest methods of treatment, and, where possible, prescriptions have been inserted.

REGINALD H. SMYTHE.

ALBANY ROAD,
REDRUTH.

November, 1910

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VETERINARY PARASITOLOGY

INTRODUCTION

A PARASITE may be defined as a living organism which, for the purpose of obtaining nourishment, passes the whole or a portion of its existence upon or within another living organism. Parasites may be divided into two main classes :

1. Animal parasites, or zoo-parasites.
2. Vegetable parasites, or phyto-parasites.

Of these, the latter are by far the smaller group, and all those which affect the domesticated animals belong to the fungi. They are a series of very low forms of plant-life, and their common mode of reproduction is asexual, by means of spores. The Dermatomycoses, which embrace the three chief species of ringworm, as found in the domesticated animals, may be taken as the type.

Animal parasites are all obligatory at some period of their existence, but in many the host is only required during a portion of the life of the parasite, and so one speaks of "fixed parasites" and "transitory parasites." The *Tæniæ* serve as an example of the former, as they are unable to maintain their existence apart from their host, while of the latter the *Œstridæ*, the bot-flies, are typical.

Transitory parasites are chiefly confined to those parasites whose habitat is on the surface of the skin, or within or near the natural openings, such as the

mouth and nose. In other words, they are ecto-parasites, or, as they are sometimes called, Epizoa.

Fixed parasites are chiefly endo-parasites, or Entozoa—that is, they live in those cavities which communicate with the exterior, such as the intestines, lungs, and bronchi, or sometimes in closed cavities, as the blood-vessels or peritoneal sacs. The endo-parasites are degenerate, but possess great vitality and enormous fertility, and are often hermaphrodite.

The majority of the Entozoa require more than one host in which to pass their life-history, and these are usually of different species. The host in which they reach the adult reproductive stage is spoken of as the “ultimate” or “definitive host,” while the former host is known as the “intermediate host.” The cycle commences with ova or larvæ which have gained the exterior. These invade the “intermediate host,” within which they undergo certain changes in their development, and are then taken in by the “ultimate host,” in which they complete their process of development and reach the adult stage.

As a general rule each mammal has its own particular parasites, but some of the ecto-parasites are capable of existence on several animals. Hence, the mange parasites of horses may affect man, but their vitality is thereby greatly impaired, and they are unable to exist any length of time away from their natural host.

Entozoa may occasionally invade a host of a different species. For instance, *Trichina* of the pig sometimes invades the muscles of man, while *Bothriocephalus latus*, a tapeworm found in man, in some countries can live in the dog.

Etiology.—The old theory which was supposed to account for the presence of parasites was that of spontaneous generation, but with the advancement of science and research, this theory has been discarded. The great

majority of parasites are acquired by transmission from other animals, either by mediate or immediate contagion, though a few may be hereditary—that is to say, transmitted to the young animal through the genital organs of the mother. The piroplasms and trypanosomes are examples of this method of infection. Mange parasites and lice are transmitted by actual contact or by mediate contagion, as from harness, grooming utensils, or even from attendants. In the case of a great number of parasites, ova or embryos from one animal may be ingested by another, or, as in the case of *Hypoderma bovis* (the warble-fly), the eggs may be deposited on, or in some cases under, the skin of the host.

Some parasites, such as leeches, and probably some of the Nematode worms, may be taken in with the drinking-water.

It may be taken for granted that an animal possesses a certain degree of immunity against parasitic invasion, dependent upon the general constitution and state of health, and upon the condition of the various organs. Worms usually infest the intestines of an animal already in low condition, and in which the intestinal tract is already probably deranged and weakened. In a similar manner lice and mange Acari infest the skin of an emaciated animal or one suffering from some chronic debilitating disease. Tuberculous cattle in the stage of emaciation are usually affected with lice, and it is more reasonable to suppose that emaciation and loss of tone afford an opportunity for the parasites to take up their abode than that they infect a healthy animal and produce these symptoms. It cannot be denied that in many cases, after the invasion of the particular parasite, the previous symptoms are exaggerated, and sufficiently so sometimes to bring about death. *Sclerostomum armatum* and *S. tetracanthum* of the horse afford good evidence of this.

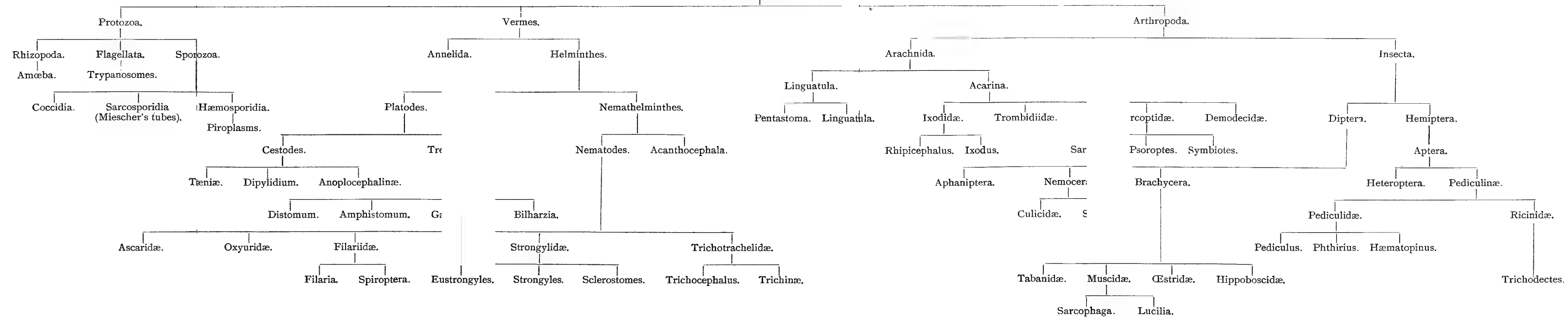
Environment and season have a direct influence on the prevalence and vitality of parasites. A wet season predisposes to fluke disease, providing the locality is one in which flukes and their intermediate hosts (*L. truncatula*) are already present.

Effects of Parasites.—Parasites produce their effects in various ways, according to their position and nature. In the bowel, worms may produce anæmia through draining away blood from their host, and even perforation of the bowel-wall may result, with consequent peritonitis. Flukes at the time of migration act mechanically by blocking the bile-ducts, and so jaundice and ascites result. Strongyles are common in the respiratory tract of young ruminants, and produce bronchitis and even pneumonia.

Some parasites produce toxins, which exert a poisonous effect on their host, but these are rare. *Ascaris marginata* has been credited with the power of excreting a toxin which produces fits in the dog, but this is very doubtful, and it is more probable that the actual cause is reflex action, set up by irritation of nerve-endings in the bowel. Ascarides also may produce mechanical obstruction of the bowel by grouping together into bundles or balls.

Tænia cœnurus will serve as an example of a parasite which produces its effects by reason of the position it takes up in the host's body. The *Cœnurus cerebralis*, which is its cystic stage, exists in some part of the cerebrum or cerebellum, and thereby produces nervous symptoms, which vary according to the exact site.

ZOO-PARASITES.



CHAPTER I

PARASITES AFFECTING THE SKIN

VEGETABLE PARASITES

RINGWORM

THE vegetable parasites affecting the skin of animals are a series of very low forms of plant-life, and are usually classed with the moulds. The skin diseases they produce are grouped together under the term "ringworm," but are caused by variations of the same fungus. The differentiation between them is only marked as regards their mode of reproduction, though each shows a preference for some particular culture medium. They are all parasitic fungi, and chiefly attack the epidermis, at the expense of which they maintain their existence. Several observers have stated that they are capable of saprophytic existence, quite apart from an animal host, and thus infection may take place without any direct connection with an affected animal. It is certain that their vitality is exceedingly great, and they show a marked resistance to desiccation, and various experimenters have found that scabs or crusts will remain active and produce ringworm in an animal after having been removed from another animal for a period of from one to two years.

The common mode of reproduction among the skin fungi is asexual, by sporulation. The spores give rise

to much-branched filaments, known as "hyphæ." These intermingle and produce a matted mass, which is known as a "mycelium." Besides these, there are other branches given off, usually at right angles, which have a reproductive function, and which bear at their extremity spore-cases known as "sporangia." Each sporangium contains a large number of minute spores. In some cases the spore-case contains only one spore, and is then known as a "conidium."

A modified form of sexual reproduction is seen in the Ascomycetes, in addition to the ordinary asexual reproduction. Two hyphæ come together, and a process takes place known as conjugation, and results in spore formation afterwards. The spore-case is known as an "ascus," and contains eight spores, four of which would be seen in a longitudinal section and two in a transverse section.

There are three chief species of skin fungus seen in our domesticated animals. These are, respectively, *Trichophyton*, *Microsporon*, and *Achorion*.

1. *Trichophyton*.—The mycelium consists of fine elongated tubes, showing a single contour. They may be simple, segmented, or dichotomously branched. The hyphæ twine round the hairs, forming a whitish mass at the roots, and also penetrate into the interior. The result is that the hairs become rough, often split, and finally fall out or are cut across.

The spores are spherical or elliptical, and are contained inside the older segments, which they almost entirely fill. They are so numerous as to form a chain, and often obscure the hyphæ themselves, when a scraping is examined microscopically.

On agar-agar *Trichophyton* develop a green culture. The skin fungi will grow on most media, providing a little glucose is added. Both this variety and *Achorion* liquefy gelatine.

2. *Microsporon*.—In addition to ordinary spore formation within the segments, *Microsporon* develops lateral reproductive branches, which bear conidia.

3. *Achorion*.—The mycelium consists of much-branched hyphæ, which may or may not be segmented, and are sometimes straight and sometimes curved. They break up into spores when ripe, and hence, when examined microscopically, one sees between the branches of the mycelium large numbers of triangular, round, or oval spores. The variation in shape depends upon their degree of development. The whole growth forms a crust of a yellowish colour, and is in reality a pure culture of the fungus.

In order to examine these growths microscopically, one proceeds by scraping the deeper parts of the crusts and soaking the material obtained in diluted liq. potassæ, in order to dissolve out the fat. The preparation is then placed on a warm slide, and stained with lactic blue. It is best mounted in glycerin or glycerin jelly, and a cover-glass applied.

Ringworm occurs chiefly in two forms—the *Trichophyton* and the *Achorion* form, which is known as favus, or honeycomb, ringworm. There has been much discussion as to whether these are distinct parasitic affections, or whether they both are variations of a common type. In the skin lesions marked differences between them are apparent, for while the eruption produced by *Trichophyton* is widely dispersed and rounded in shape, that produced by favus is yellow, and occurs in the form of large crusts.

Predisposing Causes.—As in most other parasitic diseases, dirty surroundings and a debilitated condition of the host afford increased facilities for the growth of the fungus. Old animals are less commonly affected. Certain sheds on farms where the disease is prevalent convey infection to each fresh batch of calves, owing

to the walls and uprights being used for rubbing against, and so the disease is propagated from year to year. Among horses, grooming utensils, more particularly curry-combs, act as sources of mediate contagion.

. Rats and mice suffer from a variety of favus, which is very contagious to cats and dogs, in which the lesions develop on those portions of the body which come in contact with the rodents. Hence it is common to find crusts on the paws and around the head, particularly on the ears.

Ringworm in the Horse.

The commonest varieties met with are *Trichophyton* and *Microsporon*. Favus in horses is rare.

The disease is seen chiefly in foals and young horses, but older animals are not uncommonly affected. The eruption occurs in the form of small rounded patches on the trunk, particularly on the croup and shoulders, and also upon the head and neck. The hair on these first becomes erect, then matted. The parasites attack the hairs, which break off level with the skin, and fall out, cemented together by a scab. The bare patches left are of a slaty-grey colour, and covered with silvery scales. At first they are the size of a sixpence or a shilling, but spread from the periphery, and may attain the size of a two-shilling-piece, or become even larger still. After recovery, the hair covering the patches is at first darker in colour.

Several varieties of trichophytosis are seen in horses. *Trichophyton mentagrophytes* affects the hair-follicles, and so, in addition to the bare patches described, one sees small pustules, which are quite visible after removal of the scab. The patches grow larger than in the variety just described, and may attain the size of a crown-piece.

Prognosis.—Trichophytosis in the horse runs a benign

course, and produces no systemic disturbance, and is spontaneously curable, providing cleanliness is maintained. In dirty, emaciated, half-starved animals it tends to remain. Trichophytosis is transmissible from horses to the attendants, and produces serious lesions on unprotected parts, such as the arms and face. It is also transmissible to cattle.

Favus in Sucklings.

This is a rarer condition, and is characterized by the presence of scabs or discs of a greyish colour externally,

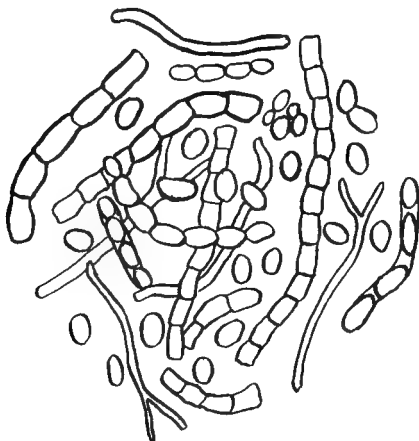


FIG. 1.—TRICHOPHYTON TONSURANS.

and which are yellow in their deeper parts—that is to say, when the surface is scratched away. They seldom exceed $\frac{3}{4}$ inch in diameter, and are confined chiefly to the region of the head; but a few isolated crusts may appear on various parts of the abdomen, and more particularly on the quarters. Favus is never transmitted to other animals.

Ringworm in the Ox.

The only variety affecting cattle is a trichophytosis, and it rarely affects animals over one year old. The lesions are found in the region of the head, particularly round the eyes and on the neck and shoulders. They assume the form of more or less rounded patches of a silvery grey colour, ranging from 1 to 3 inches in diameter in the early stages, but later become larger by confluence, until the whole of the head and neck may eventually be left bare. The follicles are affected at the same time, and give rise to small pustules, which raise the scab, and this, if removed, leaves a raw bleeding surface exposed.

Prognosis.—Except in weak undersized calves, trichophytosis is spontaneously curable, and runs its course usually in from one to three months. It is easily transmitted to the attendants, and produces much more serious lesions. Occasionally the mouths of sucking calves become affected, and this form is very difficult to treat successfully, owing to its position.

Ringworm in the Dog and Cat.

Both *Trichophyton* and *Microsporon* affect the dog, but more commonly a favus (*Oöspora canina*). Trichophytosis appears in the form of round, sharply defined areas, usually of the size of a shilling, starting at the head, and extending to the body, particularly to the skin of the chest under cover of the elbows. These bald spots are often covered with dirty grey scales, but often there is no sign of inflammation. As a result of scratching, they may become raw, and a little blood may exude. As they get older, the patches become lighter in colour, and gradually revert back to the original colour of the skin.

The variety of favus attacking the dog and cat is known as the *Achorion Quinckeanum*. It affects chiefly

the tips of the ears, the paws, and the face, and is seen more often in kittens and rather seldom in old cats. The lesions take the form of lemon-yellow crusts, which are at first firm and moist, but later become dry and inclined to crumble on pressure. Their appearance is very characteristic.

Therapeutics.—In treating a case of ringworm, as in other parasitic skin diseases, it is first necessary to isolate the affected animals, and to provide fresh litter. All clothing and grooming utensils should be thoroughly disinfected.

Horses suffering from trichophytosis should have the affected parts thoroughly washed with hot soda-water. When quite dry, they should be dressed with parasiticides. If the areas are small in extent, nothing is better than ung. iodi, or even half-strength tinct. iodi.

Formalin $\frac{1}{2}$ per cent. in water, to which 5 per cent. glycerin has been added, is useful.

Lysol, creolin, naphthol, or salicylic acid may be used. In calves, where the areas affected are large, a dressing composed of sulphur, combined with ol. picis and an alkali in oil, is best, such as the following :

R.	Sulph. flores.	..	..	..	..	℥iv.
	Liq. potassæ	..	..	..	..	℥ij.
	Ol. picis	..	..	..	..	℥ij.
	Ol. rapii	..	..	..	..	ad O.j.
	M.	Fiat lin.				

In dogs and cats preparations of iodine are probably best, and care must be taken to prevent access to mice and rats, which may have introduced the disease.

The treatment of favus is similar to that of trichophytosis. The crusts should be first removed, and the affected areas well washed, after which any of the parasiticides mentioned may be used. In treating ringworm it must be remembered that the patches extend from

their edges, and hence the dressing used should be applied beyond the apparent margin.

The most hopeful sign of recovery is the appearance of a smooth crop of fresh hair.

DISEASES OF THE SKIN CAUSED BY ANIMAL PARASITES.

PSORIC ACARIASIS (MANGE).

Mange is the name given to that condition of the skin produced by the presence of mange-mites, which belong to the Acarina.

It is a very contagious disease, as the parasites can leave the host and pass on to another animal with ease.

The Sarcoptidæ are small round or oval parasites, with a striated cuticle (usually transversely), and the majority are barely visible to the naked eye. When adult, each possesses four pairs of legs, composed of five segments, and terminating in suckers, used in walking as prehensile organs, and known as "ambulacra." They are each carried on a stalk, known as the "pedicle." In addition, there is usually a long bristle at the end of each terminal segment. The body is short, thick, and non-articulated, the head, thorax, and abdomen being united together into one piece. The head bears a projection known as the "rostrum." This is the buccal organ, and is composed of two prominent trophi, the jaws being scissor-like in some, and serrated, or even arranged in the form of stiff bristles, in others. They have no eyes.

The males are less numerous and smaller than the females. Many varieties bear copulatory suckers on their posterior extremities.

Life-History.—The mange parasites pass their lives either on the skin or in burrows made beneath the surface. The ovigerous female lays from twenty to

twenty-four oval-shaped eggs in one batch, each containing an embryo, just visible when examined microscopically. About a month after the completion of this function the female dies. In a week each egg hatches out a larva, which possesses only six legs, and hence is termed the "hexapod larva." It possesses no sexual organs.

In its turn the larva becomes a nymph, with eight legs, but is still asexual; but in a few more days it develops generative organs, and becomes a sexually adult parasite. The whole process, from the egg stage to the adult, takes about three weeks.

The males crawl about, and each, after fertilizing a number of females, dies in about six weeks. The mange parasites can exist away from any animal host for a period of from two weeks to two months.

Rugs and grooming implements remain infective for three weeks or longer, but on damp walls and partitions the parasites may remain active for two months. In warm surroundings and in sunlight they become more active.

There are four chief varieties of mange parasites, viz. : *Sarcoptes*, producing sarcoptic mange; *Psoroptes*, producing psoroptic mange; *Symbiotes*, sometimes known as *Chorioptes*, producing symbiotic or chorioptic mange; and *Demodacidæ*, producing follicular or demodectic mange.

1. *Sarcoptes*.—These are the smallest of the mange parasites, and are burrowers—that is, they live beneath the surface of the skin in tunnels, which they bore out. They usually reach the rete Malpighii, where they live on lymph.

The body is rounded, as is also the rostrum. The legs are short, and bear simple unsegmented long pedicles. These are absent in the third pair in the male, and in the third and fourth pairs in the female. The posterior two pairs of legs are ventrally placed and

hidden under the body, so that from the dorsal aspect only two pairs are visible.

2. *Psoroptes*.—These are comparatively large oval-shaped parasites, just visible to the naked eye when viewed against a black background. The legs are long, and all are visible from the dorsal aspect. The suckers are carried on long trumpet-shaped three-jointed pedicles, and are absent in the female on the third pair of legs and in the male on the fourth pair. The rostrum is long and conical. The posterior extremity of the male bears two triangular abdominal prolongations, each of which bears five bristles. These are the copulatory suckers, and are absent in the female.

3. *Symbiotes*.—These, again, are oval in shape. The legs are long and thick, but the posterior pair is poorly developed and placed ventrally, so that, on viewing the parasite from the dorsal aspect, only three pairs are visible. The suckers are carried on short, broad, unsegmented pedicles.

The rostrum is short and is broader than long. The male carries square abdominal prolongations, each bearing five bristles, and in the female these are represented by two short cylindrical projections. The *Symbiotes* show a serrated edge, and the body is usually mapped out by broad lines, which extend from the proximal margins of the legs.

4. *Demodecidæ*.—These will be described when discussing follicular mange in dogs (p. 21).

Symptoms and Diagnosis of Mange.—The first sign of mange noticeable in any animal is a hyperæmic condition of the skin, accompanied by the usual signs of skin irritation, such as scratching and rubbing the part. Gradually the hair is lost and the epidermis becomes thickened, and a collection of scales may appear on its surface. The desquamated epithelium soon becomes caked together by exudate and blood into

crusts. Pruritus becomes more intense, and, unless treated, the animal may lose condition through the continuous irritation and loss of rest. To diagnose with any degree of certainty a microscopical examination must be made, and the parasites discovered.

The method of procedure is as follows : Find a recent lesion which has not been dressed with a parasiticide, remove all scabs, and scratch the surface exposed with a scalpel until bleeding is produced. It is advisable, some while before commencing, to have the animal stood in sunlight, as this increases the activity of the parasites, and brings them nearer the surface. The scales of epithelium, portions of hair and blood, thus procured are placed in a shallow watch-glass, covered with a little diluted liq. potassæ, and allowed to stand for about five minutes, in order to dissolve the fat. The scrapings are then placed on a glass slide as thinly as possible, and covered with another of the same thickness. The two slides are then held between the finger and thumb of each hand, and each is gently moved about upon the other. This distributes the epithelial scales, and on examining with a 1-inch objective, there should be little difficulty in detecting the parasites, if present, in the scrapings. Time and a great deal of patience are necessary, and care must be taken to scrape deeply, more especially when examining for *Sarcoptes*. If the scabs are exposed to strong sunlight for an hour before examining, the mites will come to the surface, and are more easily demonstrated.

In the case of *Acari* in the external ear, it is only necessary to treat the wax obtained as described.

The presence of the *Demodex folliculorum* is not difficult to demonstrate, providing a fresh pustule is discovered. This should be pricked with a fine needle, and the contents squeezed out and placed on a glass slide. No alkaline treatment is necessary.

Predisposing Causes, etc.—Mange arises from contagion, which may be either mediate or immediate. The condition of the animal and its environment have a great influence upon the chances of contagion, and upon the severity and duration of the disease.

Army horses, under ordinary conditions, become affected with mange, with usually mere reddening of the skin. The symptoms rarely last more than a few days under these circumstances.

Mange in Horses.

Three forms of mange affect horses—viz., sarcoptic, psoroptic, and symbiotic. Of these, psoroptic is the most common, and symbiotic the least. Sarcoptic mange offers the greatest difficulty in treatment, as the mites burrow and are little affected by parasiticides smeared on the surface.

Sarcoptic Mange in Horses.—In horses the parasite is known as the *Sarcoptes equi*, and is extremely small. This form of mange principally attacks the trunk, more particularly the shoulders, neck, withers, and that portion of the body covered by the saddle. It then extends on to the quarters, and the patches may increase in size until the whole of the trunk is covered. It avoids the limbs and those parts covered with long hair, such as the mane and tail. It begins as small patches, which gradually increase in diameter. The areas are denuded of hair, become irregular in size and shape, and exhibit a greyish or pinkish surface, almost completely covered by a scab, usually thin and composed of dried blood and exudate. Occasionally the parts may bleed from rubbing. The skin becomes thickened and may crack, and, as a result of infection, pus may appear in the fissures. It is most commonly seen in horses in low condition and during emaciation resulting from various causes, but it may attack

healthy, well-nourished animals; but in this case the natural defences are stronger, and so the disease is comparatively easy to eradicate.

Sarcoptic mange in horses produces *symptoms* of great skin itching, especially when the animal is exposed to sunlight and during the night. If the parts are scratched with the fingers, the horse shows symptoms of apprecia-

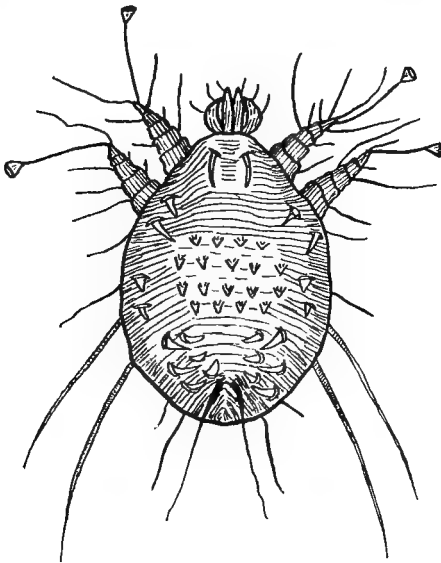


FIG. 2.—SARCOPTES EQUI: DORSAL SURFACE.

tion by smacking the lips together and nodding the head, and these signs were formerly considered diagnostic of the disease.

Diagnosis is verified by the discovery of the parasite, but as this is merely a matter of chance, and may require many hours' patient searching, it is but seldom that the practitioner exceeds a naked-eye diagnosis.

Prognosis should be guarded, as the disease often resists treatment, and relapse is very common. It is extremely difficult to impress upon owners and stablemen the necessity of absolute disinfection of harness, rugs, and grooming utensils, and the prevention of reinfection.

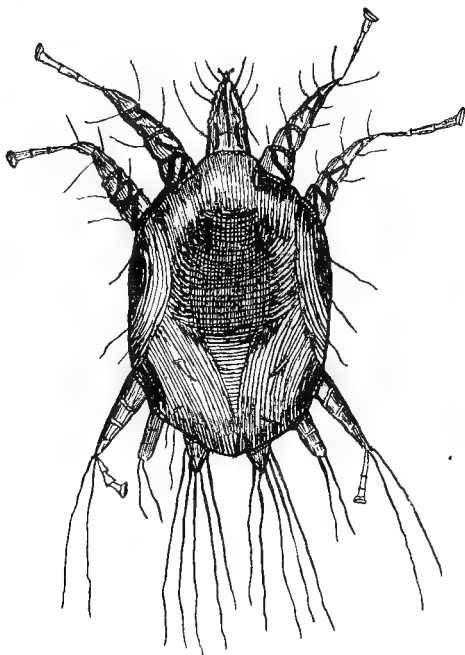


FIG. 3.—PSOROPTES EQUI (MALE) : DORSAL SURFACE

Psoroptic Mange in Horses.—The parasite responsible is the *Psoroptes communis*, var. *equi*. This form of mange attacks sheltered positions, as the mane and tail, the intermaxillary space, the breast, sheath, and inner side of the arm and thigh. It does not extend below the knees and hocks, but may occasionally occur on

the withers and back. It is transmitted from horse to horse. It produces intense pruritus, and the animal rubs the parts, and may produce serious sores. The

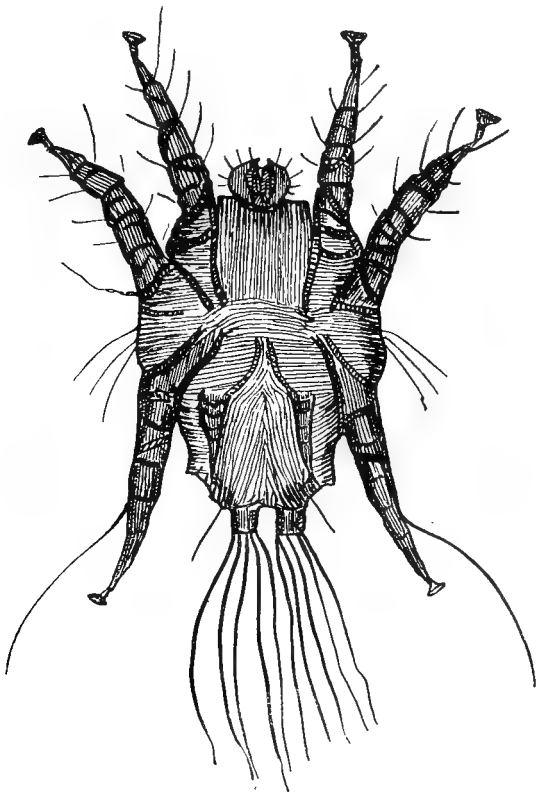


FIG. 4.—SYMBIOTES EQUI (MALE), VENTRAL SURFACE.

parasite lives on the surface, and is more easily discovered.

Symbiotic Mange in the Horse.—The *Symbiotes equi*

confines its attacks to the legs and feet, chiefly to the pasterns and fetlocks, and up as far as the knee and hock. Its progress is very slow. The skin becomes denuded of hair, then thickened. Fissures appear and discharge, and the exudate runs into the cracks and dries into scabs. The entire skin over the part takes on a wrinkled leathery appearance, and, owing to irritation, serious sores may be produced from rubbing.

The symptoms of violent skin irritation are shown by stamping the feet, jerking up the limbs, often in a manner simulating "shivering," and rubbing the part with the opposite foot. It may be mistaken for grease or the condition known as mud-fever, but the intense pruritus characteristic of symbiotic mange and the presence of the mite are sufficient to verify the diagnosis.

Treatment of Mange in the Horse.—In psoroptic, and more particularly in sarcoptic, mange the horse should be scrubbed all over with warm soda-water, followed by a weak solution of any creolin preparation. This should be rinsed off with clean water, and the horse scraped down and allowed to become thoroughly dry.

One should next proceed to dress one half of the body, supposing that the disease is well advanced, with a suitable parasiticide, such as the sulphur, tar, and alkali dressing, of which the prescription was given when referring to the treatment of ringworm in calves. This should be left on for four days, when the horse should be washed again and the other half of the body treated in a similar manner. To complete the process, the horse must be thoroughly washed again with hot soda-water, and all the grease removed.

The dressing should be applied with a brush, such as an old dandy, and thoroughly rubbed in, not simply smeared on.

Among other dressings which may be used is the so-called Vienna liniment :

R.	Ol. picis	}	..	..	..	..	1 part
	Sulphur nig.		..	..	..	..
	Sapo. mollis	}	..	..	..	..	āā 2 parts
	S.V.R. ..		..	..	..	..
			M.	Fiat lin.			

This dressing is not as satisfactory as the one previously mentioned, but is less objectionable, as it is non-greasy and easily washed off.

Lysol, creolin, creosote, and chinosol, are efficacious in suitable dilution, but need to be frequently applied.

Symbiotic mange yields to similar treatment, but it is unnecessary to wash above the knees and hocks in most cases, and any of the dressings enumerated may be applied.

Mange in Cattle.

Sarcoptic mange in cattle is of very rare occurrence. Psoroptic and symbiotic mange are not uncommonly met with.

Psoroptic Mange in Cattle.—This form of mange affects the root of the tail, and extends up the rump and on to the croup. Occasionally it affects the fore-part of the body, as the withers and neck. It usually occurs in cold weather, when the animals are housed, and rarely in cattle at pasture. It is somewhat difficult to diagnose, as it bears some resemblance to eczema and other skin diseases. It is contagious only from ox to ox.

Symbiotic Mange in Cattle.—*Symbiotes bovis* attacks cattle in the neighbourhood of the perineum, and especially around the anus and the anal fossa. Eventually it extends to the inner surface of the thighs, and may even spread along the back. The lower portions of the limbs, as the fetlocks and pasterns, are fairly common seats of the disease. It seldom affects animals which are kept under hygienic conditions, and which are in good health.

Treatment.—Any of the common dressings, as previ-

ously described, may be used. The following is of great service in any animal in which the patches are localized and not of great extent :

℞	Formalin (formaldehyde 40 per cent. sol.)	..	..	..	..	℥xxx.
	Glycerin	..	..	..	..	℥ij.
	Aqua	..	..	..	..	ad ℥xij.
	M. Fiat lotio.					
	Sig. . To be applied once or twice daily.					

Mange in the Dog.

The three varieties of mange which may occur in the dog are sarcoptic, symbiotic, and follicular mange.

Sarcoptic Mange in the Dog.—This form of mange in dogs is due to the attacks of *Sarcoptes squamiferus*. It may affect any portion of the body, but usually appears on the head, especially the ears, the lower surface of the body, and along the back, near the root of the tail.

The first sign is the appearance of red patches, usually small at first, which the dog constantly rubs. The skin on these patches is red and inflamed, and shows on careful examination small papules and sometimes vesicles, and the general appearance is not unlike that of eczema. The hair is shed, and the skin then becomes thickened and covered with a grey scurf, and in some cases shows wrinkling. The disease quickly spreads, and in a few weeks the whole body may be involved, and the dog becomes emaciated and anæmic. Sarcoptic mange must be distinguished from follicular mange, from eczema, and from areas which have been bitten by fleas and scratched by the dog until they have become hairless and sore.

Eczema starts more often along the middle line of the back, on the sides of the neck, and between the thighs.

It shows more vesicles than mange, and usually there is more serous discharge. It is non-infectious. No parasite can be found, though it is a matter of difficulty to find the *Sarcoptes* under any circumstances, owing to the depth to which they burrow. Moreover, dry eczema, except when it has become chronic, yields more readily to treatment, and its appearance on the dog is usually much more rapid than in the case of mange.

Mange in Cats.

The *Sarcoptes minor*, which attacks the cat, is, as its name implies, very small. It is distinguished by the presence of numerous bristles along its dorsal aspect, and the anus is remarkable in that it opens on to this surface.

The favourite situation is the head, and less commonly the limbs. The feet and paws often become affected also, from scratching the affected areas. The eyelids become denuded of hair in the majority of cases, and the skin over the whole area is much wrinkled. The cat frequently shakes the head, and constantly rubs against hard objects. Emaciation quickly sets in, and death may result.

Treatment of Mange in the Dog and Cat.—It is absolutely essential to disinfect and destroy all bedding, rugs, etc., upon which the affected animal is accustomed to sleep; otherwise a permanent cure is impossible.

In treating terriers and the larger dogs, a soda-bath should first be given, and, when thoroughly dry, one half of the body should be dressed with the oily mixture previously described. In from four days to a week the dog should again be washed, and the other half dressed, and in the course of another week all grease should be removed by a soda-bath. Cure in most cases should then be complete. Unless the dog is kept out of doors, ol. picis and oily dressings are objectionable. The

ol. picis may be replaced by ol. tereb., or by tinct. iodi, and soap may be substituted for oil—viz. :

R.	Sulph. nig.	..	..	..	..	ʒij.
	Liq. potassæ	..	..	..	..	ʒss.
	Ol. tereb.	..	..	..	..	ʒvj.
	Sapo. mollis	..	..	..	..	ʒj.ss.
	S.V.R.	..	..	..	..	ʒij.
	Aqua	..	..	..	..	ad ʒviiij.
	M.	Fiat lin.				

Creosote, carbolic acid, and tar dressings must not be used on small dogs, and only with caution on the larger breeds, and must be avoided altogether in the case of cats.

Chinosol, lysol, and iodine are safer, but precautions must be taken against licking off the dressing.

In cats sulphur ointment is most useful, but only a small portion of the body should be covered at one time with any greasy dressing.

Symbiotic Mange in Dogs and Cats.—*Symbiotes auricularum* confines itself to the inside of the ear. The parasite produces a great variety of symptoms, some of which arise from irritation and some as the result of nervous reflexes, while others may be ascribed to changes in the ear, such as abscess formation.

The most characteristic symptoms are flapping of the affected ear or ears, shaking the head, and rubbing the ears against hard objects. Often the head is carried to one side.

In other cases epileptic fits result from the irritation produced, and on several occasions cases have come to our notice in which the dog continually turned somersaults along the ground, and this, in fact, seemed the only mode of locomotion. When deeply seated, the *Symbiotes* may be responsible for the formation of abscesses, which may account for the aggravated symptoms just described. The abscesses develop in the middle or internal ear, with accompanying loss of

equilibrium and inco-ordination of movement. The ear, on examination, may present a fairly normal appearance, but more often shows a deposit of dark-coloured sticky wax.

If this is thinly smeared over a glass slide and examined microscopically, often quite a number of parasites may be seen moving across the field.

Treatment.—This consists in first cleaning out the ear with cotton-wool soaked in dilute spirit. The following dressings are suitable for application :

℞	Creosote	..	..	..	..	℥x.
	Ol. caryoph.	..	..	..	..	℥xv.
	Ol. olivæ	..	..	..	..	ad ʒij.

M. Sig. : Pour a few drops into the ear twice daily, and apply massage.

Nocard advises the following :

℞	Beta-naphthol	..	..	..	..	1 part
	Æther meth.	..	..	..	..	3 parts.
	Ol. olivæ	..	..	..	..	10 parts

Friedburgher and Fröhner recommend equal parts of Peruvian balsam and glycerin.

Ear-cones, with a basis of cacao butter, and containing zinc sulphate and ext. belladonnæ vir., are very useful.

If nervous symptoms are marked, nerve sedatives, as pot. bromid., strontium bromid., or chloral hydrate, should be employed in addition.

Follicular (Demodectic) Mange.—This disease is common in dogs and cats, especially in large towns, and has also been observed in cattle and pigs, but in these is comparatively rare. *Demodex folliculorum*, the causal parasite, is of common occurrence in the skin of man, but without producing symptoms. The parasite is a representative of the Demodecidæ, which, like the Sarcopitidæ, are a division of the Acarina.

It is a very degenerate parasite, is oviparous, and goes through a life-cycle similar to that of the Sarcophtidæ.

In shape and general appearance, especially when viewed under a low power, the parasite much resembles a maggot, though when closely observed the differences in structure are obvious. It is about $\frac{1}{100}$ inch in length.

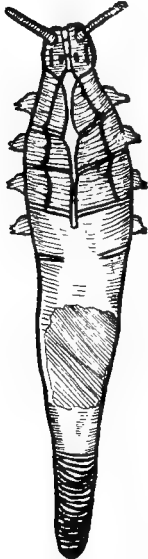


FIG. 5.—ACARUS
DEMODOX FOL-
LICULORUM.

Highly magni-
fied.

The head is rounded from side to side, and is somewhat longer than wide. It carries two pairs of jaws, placed one above the other. The lower pair, or maxillæ, act somewhat like a pair of miniature tongs, and grasp the substances which the upper pair or mandibles masticate. In addition, the head bears a pair of feelers, which are finely segmented, and there is also present a structure known as the oral valve. The eyes are two in number, and are situated laterally.

The body consists of a thorax and abdomen. The thorax is the widest portion, and bears four pairs of short three-jointed legs. The abdomen is triangular, the base being formed at its junction with the thorax. It shows a dark area about its centre, supposed to represent viscera. The whole length of the body is transversely striated, and the edges are correspondingly notched. In the hexapod larva and nymph stages the parasite has only small tubercles, in three pairs, in the place of legs, and the body shows no transverse striation.

The Demodex inhabits the sebaceous glands of the skin, and one gland may contain from only a few up to a hundred or more parasites. The number

present determines to some extent the symptoms produced.

Symptoms in the Dog.—There are two types of follicular mange commonly seen in the dog :

1. Pustular type (*see also* Appendix I.).
2. Squamous type.

Follicular mange usually begins at the head, in the neighbourhood of the eyes, and extends to the ears, sides of the face, and forehead. It then appears on the feet and legs, especially inside the elbows, and gradually extends over the whole body. The first symptom noticeable is the presence of patches denuded of hair. The skin is hot and usually of a peculiar purple tint. Its surface shows a varying number of small papules and pustules. As the patches increase in extent, the skin thickens and becomes puckered into folds. These are most apparent on the head, and are especially noticeable in bulldogs, in which the skin becomes one mass of wrinkles. The bare patches now take on a dark slaty-grey colour, and the skin emits a most unpleasant penetrating doggy odour. If the pustules are squeezed, a small core of pus escapes, and this, if examined microscopically, is found to contain a large number of parasites. There is very little pruritus, and the dog seldom scratches, but more often shakes the body (formication), very much as a dog does when leaving the water. The skin becomes dry and frequently cracks, leaving fissures, from which a small quantity of blood may ooze. It is not uncommon to find one side of the head much swollen in an advanced case from subcutaneous œdema. This is more often observed in bulldogs.

In the squamous type of the disease there are few or no pustules. The eyelids are most commonly affected, especially in Poms and small dogs, but the whole body

is frequently attacked, and becomes denuded of hair. It assumes the same dark slaty-grey colour as in the pustular type, and is hot to the touch. Itching is very slight. The surface of the skin is dry and covered with desquamated epithelial scales. The absence of pustules is probably due to the fact that the parasites in this type of case are few in number in each sebaceous gland, and the inflammation set up is not sufficiently intense to cause pouring out of exudate and escape of leucocytes, and so pustules are not produced. In both types of the disease the animals appear wretched, become very emaciated, and often die.

In the cat the eruption is similar, but it is more frequently confined to the head.

Symptoms in Other Animals.—In cattle the skin covering the whole body may be affected. The eruption takes the form of pustules about the size of a pea, but it is stated that cattle spontaneously recover from the disease.

In pigs the *Demodex* is much broader than the *Demodex folliculorum* of dogs, and the pustules they give rise to show a great tendency to become confluent, and so large swellings are produced. They attack the head, snout, and lower surface of the body.

Prognosis.—This must be considered unfavourable, especially if the disease has been existent for any length of time. It is usually the case that, when one portion of the skin is apparently cured, the disease breaks out again in some other part, and although months may be spent in treatment, little benefit may result.

Treatment.—Among the commonest agents employed are the following: Sulphur, tar, iodine, potassium sulphurata, zinc chloride, Peruvian balsam, ung. cantharides, sublimate ointment, creolin, etc.

1. In early stages, when the patches are few in number and of small extent, it has been thought ad-

visible by some observers to cover the affected portions of skin with an agent which will exclude air, and so destroy the parasites. Collodion containing an antiseptic, such as acid salicylic or iodoform, has been used, and it is claimed to have been very successful.

A solution we have found particularly useful in these cases is the following :

℞	Iodi resublim.	..	..	..	℥j.
	Pot. iodid.	..	..	..	℥j.ss.
	Hydrarg. biniodid.	..	..	..	℥ss.
	S.V.R.	..	..	..	℥j.
	Aqua	..	..	..	ad ℥iij.
	M. Fiat lotio.				

This is applied once daily with a brush until the part becomes sore, when it is applied on alternate days.

A lotion containing $\frac{1}{2}$ per cent. formalin in glycerin and water will often effect a cure when the area affected is small in extent.

2. When the disease is more advanced, a course of treatment with the oily dressing previously described will often effect a cure, providing that the two separate halves of the body are thoroughly dressed.

Another method of treatment recommended quite recently is the internal administration of pot. iodid., combined with inunction of the skin with white precipitate ointment, with the idea of producing iodide of mercury in the skin as the pot. iodid. is excreted. We have seen little, if any, benefit accrue from this line of treatment.

Hunting and Duguid's dressing is frequently employed—viz. :

℞	Creosote	..	..	..	℥j.
	Liq. potassæ	..	..	..	℥ij.
	Ol. olivæ	..	..	..	ad O.i.
	M. Fiat lin.				

Mr. Gray recommends an ointment composed of salicylic acid, 1 ; gum styrax, 1 ; sulphur, 1 ; lard, 9.

The styrax causes this composition to penetrate well into the skin, and it is decidedly useful.

Whatever treatment be adopted, the skin should be first washed and well kneaded with soap and water, and as many pustules as possible squeezed out. The dressing, when possible, should be applied with a good deal of friction.

The general condition must be attended to, and arsenic in some form should be given in combination with laxatives.

Sarcoptic Mange in the Pig.—This variety of mange first attacks the head, especially in the neighbourhood of the orbit and ears. The inner surface of the thighs is a common seat, but the whole body may eventually become involved.

The affected areas become covered with silvery-grey scales of a considerable thickness. When removed, the skin appears very much thickened and inflamed, and often shows wart-like elevations, which are in reality hypertrophied papillæ.

The *Sarcoptes suis* is one of the largest of the mange-mites, and the females may measure $\frac{1}{2}$ millimetre in length, and hence be visible to the naked eye.

Treatment.—Sulphur and tar dressings in oil are usually quite efficacious.

Mange in Sheep.

All three varieties of mange are found in the sheep, but of these the psoroptic type, which gives rise to "sheep scab," is the most important.

Sarcoptic Mange in Sheep.—The *Sarcoptes ovis* confines itself to those portions of the body which are covered with hair, and seldom attacks parts which bear wool.

Its favourite seat is the head, particularly the upper lip, sides of the cheek, and ridge of the nose. The ears are less commonly affected. The disease may extend down the breast in a bad case. The skin shows a large number of vesicles, which burst and discharge a fluid, which dries into yellowish crusts. Pruritus is intense, and the sheep constantly rub their heads against the ground, trees, posts, or their neighbours. The scabs are thus torn off, and the bare patches bleed, and crusts of congealed blood are left on the face. Conjunctivitis is not an uncommon sequel, and may be followed by purulent ophthalmia and blindness. The sheep lose condition and may cease feeding, while the wool is rendered useless.

The disease is very contagious, and so isolation is a matter of great importance, and care must be taken in parts where the disease exists not to introduce affected animals into a clean flock.

Treatment.—The scabs must be first softened with alkalis, such as liq. potassæ, mixed with oils or fats. This dressing must then be washed off, and one of the following parasiticides applied: Infusion of tobacco, sulphur ointment, creolin solution, or diluted tincture of iodine. The simplest and most efficacious is the sulphur turpentine and oil dressing previously mentioned.

In this country "head mange" is not a scheduled disease.

Psoroptic Mange in Sheep (*Sheep Scab*)—*Etiology.*—The cause is the presence of *Psoroptes ovis* in the fleece. The parasite is usually conveyed to the sheep by immediate contact with one previously affected; but as sheep have been known to contract the disease in places where there have been no flocks kept for as long as one or even two years, it is probable that the parasite is able to live for some considerable time apart from the host. It is certain that the mites can retain their

vitality on a cast-off scab for a period ranging from one to two months, providing that the scab is kept in a moist situation.

The parasite is quite visible to the naked eye, especially when viewed against a dark background, and if exposed to the rays of the sun.

The length of the adult male parasite is about $\frac{1}{2}$ millimetre, or $\frac{1}{50}$ inch, while the female is rather larger.

Crows and other birds which perch on the backs of sheep have often been accused of spreading the disease, and there is no reason to believe that this theory is incorrect.

Symptoms.—Psoroptic mange may attack sheep of any age, but the members of the flock which usually show the earliest and most serious symptoms are lambs and yearling lambs, with fine, supple skins.

Some breeds of sheep seem particularly predisposed to scab, though lack of condition plays a far greater part.

Unlike sarcoptic mange, it is the parts most thickly covered with wool that become attacked, such as the neck, withers, back, and sides. The first symptom noticeable is intense pruritus, and the animals constantly scratch and rub the affected areas. The fleece becomes matted, much stained from scratching, and in many places it is torn out in the attempts of the animal to allay the itching. These symptoms are especially evident if the flock is driven, when the sheep so affected constantly halt and rub the bare patches. If one of these is gently scratched with the finger, the animal evinces signs of great satisfaction by nodding the head, smacking the lips, and wriggling the hinder parts of the body.

If the fleece is parted at this stage, the underlying skin will be seen to be intensely inflamed and covered with numerous yellowish-white papules. These go through

the vesicular and the pustular stages, and finally burst, allowing the escape of a sticky yellow exudate with an acid reaction, which soon dries into a scab. This scab grows in area, as the parasites now leave the centre and proceed to the margin, where they once more attack the skin, producing a fresh crop of pustules, and eventually a fresh scab, which becomes confluent with the original one. The large crust thus formed has the appearance of dirty parchment. It drags out the fleece by which it is attached, and becomes raised from the skin. It then begins to show fissures, and is finally lifted off by the crop of new wool which grows beneath it.

The surface of the body thus shows several different appearances. We will suppose that in a typical case some portions, such as the rump and the under surface of the body, are covered with sound normal wool. On the neck a recently affected patch shows matted, tangled wool and pustules beneath it. On the back we may see a parchment-like scab lifted off from the body, and close beside it an area of dry, thickened leathery skin, covered with desquamated epithelium, and in parts showing traces of a new growth of wool.

On the sides where the sheep has been able to bite and scratch we may see an ulcerated patch, showing signs of sloughing or local necrosis.

Diagnosis.—1. There should be no difficulty in distinguishing psoroptic mange from sarcoptic. The latter attacks the head, while the former seeks only parts covered with wool.

The parasite in psoroptic mange is not difficult to discover. A portion of scab should be taken from the periphery, softened in diluted liq. potassæ, well teased out, and examined microscopically.

2. *Rain-Rot.*—This is really a sebaceous folliculitis, occurring in autumn, after excessive rain, and may affect many members of a flock at one time. It is non-

parasitic, and there is little pruritus. The wool often falls out in patches, but the typical symptoms of scab are absent.

3. *Phthiriasis*.—Trichodectes are found around the point of the shoulder, and could be only with difficulty confounded with Psoroptes.

4. Sheep are sometimes the subjects of an ecthyma, which is seen on the inside of the elbows and between the thighs, but this could scarcely be confused with scab.

Treatment.—This must be divided into preventive and curative.

Preventive treatment comprises the prevention of primary infection and of infection of the rest of the flock after the disease has appeared in certain members of it.

As sheep scab is a scheduled disease, the Board of Agriculture lays down a series of regulations, with the object of preventing and stamping out the disease.

The Sheep Scab Order of 1905 is the last issued, and its provisions, in brief, are as follows :

All suspected cases must be reported to the police, who call upon a veterinary surgeon to verify the diagnosis. The premises on which the sheep are kept are disinfected and the sheep dipped. It is illegal to expose infected sheep in a market for sale, and no sheep are allowed to be removed from the scheduled area without a licence. In districts where the disease is prevalent dipping of all sheep is made compulsory, and every owner of sheep is compelled to send in a return of the number he possesses.

Before an owner can remove sheep from the scheduled area, he must produce an order, showing that they have been dipped satisfactorily, within a period of twenty-eight days from the time at which he wishes to remove them.

In districts where the disease is prevalent the farmer

should carefully dip all new sheep purchased or brought from another farm before introducing them into a clean flock. Isolation is a matter of the gravest importance, and pastures in which the disease has broken out should be avoided if possible (*see also* Appendix II.).

Curative Treatment.—The first proceeding is to shear all affected sheep, whatever the season, for under cover of the fleece it is practically impossible to destroy the Psoroptes. The second is to supply the animals with large quantities of nutritious food, as an improvement in condition materially aids cure.

Curative treatment is divided into two methods :

1. "Salving" and "bottling."
2. Dipping.

"Salving" consists in parting the fleece, and following this by inunction of the skin with mercurial ointment.

"Bottling" is similar, but the medicaments employed are usually in the form of liniments, such as creolin, carbolic acid, tar, etc., in oil.

Dipping is by far the best treatment. This must be performed twice, the second dipping being carried out after the seventh and before the fourteenth day, this having been found to be the period after destruction of the adult mites in which the eggs that have escaped destruction by the first dipping will have hatched out.

This proceeding should be carried out three or four days after shearing.

Various dips, many of which are proprietary, are in use, but the following are the most efficient :

I.				
℞	Arsenic .. ..	..	..	1 lb.
	Zinc. sulph. .. ..	..	..	5 lb.
	Aloes .. ..	..	..	½ lb.
	Aqua .. ..	..	..	100 lb. = 12½ gals.

The aloes must be first dissolved in a sufficient quantity of boiling water, and added to the remainder.

II.

℞	Arsenic	}	..	..	..	āā 2 lb.
	Pot. carb.					
	Sulphur					
	Soft soap					
	Water ..		..	..	..	100 gals.

Due precautions must be taken against poisoning by providing a draining-pen, and by placing dipped sheep in a yard free of herbage. Lambs must be kept apart from the ewes, or they may become poisoned by sucking.

The arms of the men employed in dipping must be free from wounds.

The following dips are recommended by the Board of Agriculture :

III.

℞	Sulphur	..	..	..	..	25 lb.
	Quicklime	..	..	..	..	12½ lb.

Triturate until free from lumps, and boil with 20 gallons of water until dark red in colour, adding water up to 20 gallons to allow for loss by steam. When cool, decant and make up to 100 gallons.

IV.

℞	Carbolic acid (97 per cent.)	..	..	..	..	3 quarts
	Soft soap	..	..	..	..	5 lb.
	Water ..	..	..	..	..	ad 100 gals.

Dissolve the soap in the carbolic acid and add the water.

V.

℞	Offal tobacco (finely ground)	..	..	..	..	35 lb.
	Water ..	..	..	..	..	21 gals.

Steep for four days; strain and press residue to obtain all the extract; mix together; add flowers of sulphur, 10 lb.; stir, and add water to 100 gallons.

Symbiotic Mange in Sheep.—The *Symbiotes ovis* is a small parasite. It affects the limbs, especially the pasterns, and slowly extends upwards, and may reach above the knee and hock. Occasionally the armpits and groin are affected, with subsequent swelling of the limbs.

Treatment consists in passing the animals through a trough containing copper sulphate solution, and inunction of parts above the knee and hock with creolin ointment.

This form of mange is very amenable to treatment.

NON-PSORIC ACARIASIS.

The non-psoric Acari comprise the Ixodidæ, or ticks, and the Trombidiidæ, or running mites. The Ixodidæ are by far the larger and more important group. They are large insects, macroscopic, and live in coarse grass and undergrowth. Dirty farms, with rough herbage, moorland, and untrimmed hedges, provide their ideal habitat.

Ticks have flat bodies, protected by horny shields on both their dorsal and ventral surfaces. They are blood-suckers, and pass the parasitic portion of their existence on the bodies, chiefly on the limbs, of animals, on which they gorge themselves with blood until spherical in shape.

The rostrum is composed of two barbed harpoons above and below a dart. In the middle is a sucking mouth. The anus is near the mouth, and when ovipositing, the eggs form clusters round the anterior extremity of the parasite. The feet terminate in hooks, for clinging. The larvæ possess great vitality, and can live many weeks without food. The adult females are very prolific, and may produce three broods in one year.

There are two divisions of the Ixodidæ—viz., Rhipicephalus and Ixodes. In Rhipicephalus, or, as it is sometimes called, Boophilus, the rostrum is broad and the body rounded; the legs are all inserted within a short distance from the head, and the tick possesses a pair of eyes.

In Ixodes the rostrum is long and fine and eyes are

absent. The body may be oval or conical, and there is a marked space between the limbs, the hindmost pair of which often take origin even from the lower half of the body.

Life-History.—Ticks pass through the usual four stages in the course of their existence—viz., egg, hexapod, larva, nymph or pupa, and finally the adult sexual stage.

The eggs are laid on the rough pasture which the ticks inhabit, usually at the roots of the tufts of long coarse grass and bracken. As each of these hatches

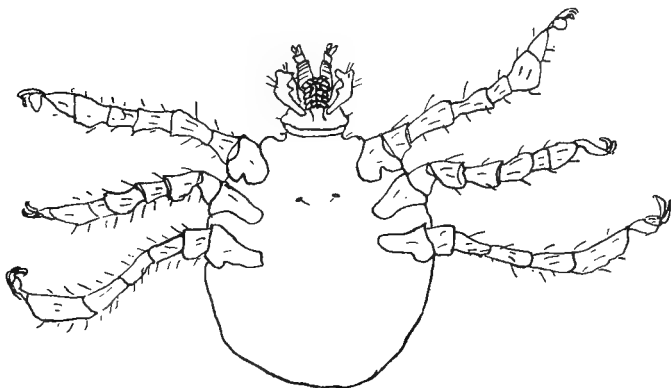


FIG. 6.—HEXAPOD LARVA OF RHIPICEPHALUS ANNULATUS (Enlarged).*

there emerges a white six-legged or hexapod larva, at first destitute of any hard covering. This larva proceeds to climb a convenient blade of grass, to which it attaches itself by its two posterior pairs of legs. When an animal passes, the larva fastens on to the leg with its anterior limbs, and crawls up out of reach of the bushes and foliage, which might otherwise brush it off. It then buries its rostrum in the skin, and sucks blood

* After Stiles (?) compare "Moussu and Dollar's Disease of Cattle, Sheep, Goats, and Swine," p. 418.

for about two days, when it loses its clinging power and drops off. Some of the ticks complete their life-cycle on one animal, and in these the piroplasm is transmitted through the egg. It now proceeds to moult, and becomes the nymph, with eight legs, but differing from the adult in being destitute of sexual organs. It again seeks the summit of a blade of grass, and becomes attached to another animal host, on which it remains for about four days. It again gorges, and becomes black with blood, when it falls off, to again moult, and finally

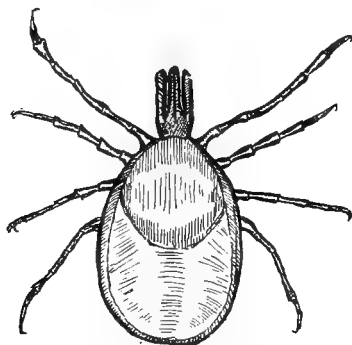


FIG. 7.—*IXODES REDUVIUS*.*
Enlarged.

develop into the sexually adult tick. The females are now fertilized by the males, gorge, fall off, and lay their eggs.

When full of blood, the ticks are dark in colour and opaque, and easily removed from their host. In the grass the tick abstains from food, and often fasts for a considerable period. In the asexual stages the tick shows no desire for any particular animal, but in the adult stage each variety of tick attaches itself to an animal of one definite species. In those ticks which require more than one host it is in the nymph stage

* See p. 432 "Moussu and Dollar."

that the parasite first becomes a carrier of the various piroplasms, which cause those diseases grouped under the heading of "piroplasmoses," and it is as an adult that it transmits the piroplasms to another animal.

Except in the rôle of a transmitter of disease, none of the ticks harm their host to any extent. At the most, and only then when in considerable numbers, they give rise to itching, and possibly anæmia. We append a list of a few of the diseases due to piroplasms, together with the ticks which transmit each :

<i>British Redwater</i> ..	..	<i>Ixodes reduvius</i> } Probably <i>Ixodes ricinus</i> } identical. <i>Hæmaphysalis punctata</i> . (In the pig) <i>Ixodes plumbus</i> .
<i>Texas Fever</i> ..	..	<i>Rhipicephalus annulatus</i> or <i>bovis</i> .
<i>South African Redwater</i>		<i>Rhipicephalus Australis</i> , var. <i>decoloratus</i> (blue tick).
<i>Rhodesian Redwater</i> ..	..	<i>Rhipicephalus appendiculatus</i> (brown tick).
" <i>Carceag</i> " of Sheep ..	..	<i>Rhipicephalus bursa</i> .
<i>Malignant Jaundice</i> , or <i>Canine Piroplasmosis</i>		<i>Hæmaphysalis Læchi</i> .
<i>South African Heartwater</i>		(In sheep) <i>Amblyomma Hebræum</i> .

It is difficult to eradicate ticks from a farm, but the following methods are adopted :

1. Ploughing all rough pasture, trimming hedge-bottoms, and dressing the land with salt or lime.

2. Removal of ticks from infested animals by hand and by dipping.

3. Pasturing animals of a different species on the land, in order that the piroplasms may gradually die out. The ticks, however, are not easily destroyed by this means.

The other non-psoric Acari are of little importance. The autumn grass mite *Leptus autumnalis* is the hexapod larva of the harvest mite (*Trombidium holo-*

sericeum). It occasionally attacks horses and dogs, producing a pustular eruption and a considerable amount of itching. The pustules are at first small, but may reach the diameter of a shilling, and are seen on the back, on the muzzle, and between the thighs. The condition is quite amenable to treatment with parasiticides.

PHTHIRIASIS (LOUSINESS).

The lice include all the Aptera, with the exception of the fleas. The Pediculinae are divided into Pediculidae and Ricinidae. The two chief types of louse are *Hæmatopinus* and *Trichodectes*, the former being a division of the Pediculidae, and the latter of the Ricinidae.

The true lice (*Hæmatopinus*) have a projecting rostrum, with barbed hooks, and in addition a hollow extensile sucker. The legs are provided with hooked terminal joints. They have simple eyes, are wingless, and pass through none of the ordinary intermediate stages between the egg and the perfect parasite, as in the Acari. The eggs are oval in shape, are attached to the hairs, and are commonly known as "nits." In *Hæmatopinus* the shape of the body is generally said to resemble that of a Dutch doll—that is to say, the thorax is larger than the head, and the abdomen larger than the thorax. With the exception of the sheep, all animals may be affected with one or more varieties of *Hæmatopinus*.

The *Hæmatopinus* forms are blood-suckers.

Trichodectes.—These are epidermis-eaters, and the head is modified for this purpose. Instead of being terminal, as in *Hæmatopinus*, the mouth is situated on the under surface of the head, which is broad and shield-shaped. In these the thorax is the smallest segment of the body.

The various lice found on each animal are enumerated below :

Horse	..	{	Hæmatopinus macrocephalus.
			Trichodectes pilosus.
			Trichodectes pubescens.
Ox	..	{	Hæmatopinus eurysternus.
			Hæmatopinus vituli.
			Hæmatopinus tenuirostris.
			Trichodectes scalaris.
Sheep	..	{	Hæmatopinus pedalis.
			Trichodectes sphærocephalus.
Pig	..		Hæmatopinus urius.
Dog	..	{	Hæmatopinus piliferus.
			Trichodectes latus.
Cat	..		Trichodectes subrostratus.

Symptoms.—These vary a good deal, in accordance with the variety of louse present. The Hæmatopinus

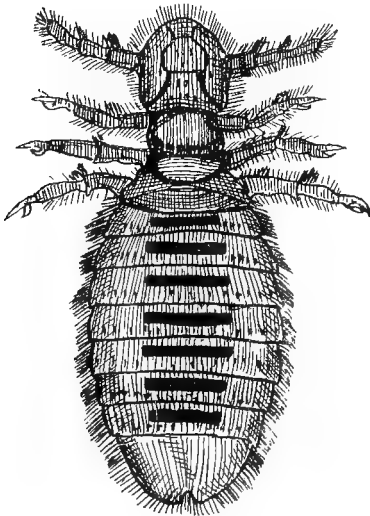


FIG. 8.—TRICHODECTES SCALARIS.
Greatly enlarged.

forms suck blood, and hence cause more irritation than those which live on desquamated epidermis and secretions. The usual signs are emaciation, irritation, and rubbing, scurfiness of the skin, with the hair erected, and sometimes crusts or blood from rubbing. Usually the lice themselves or their "nits" can be found. They are more active in summer than in winter, and may remain on one animal a very long time.

In the Horse.—They may be found under the mane, at the root of the tail, and on the shoulders and quarters in advanced cases, and seldom or never under the belly.

In Cattle.—*Trichodectes scalaris* is much the commonest. It has no predilection seat, and may be found all over the body.

Hæmatopinus forms are located along the neck and spine. In sheep, *Trichodectes* are commonest round the point of the shoulder, and leave bare patches.

In Pigs.—*Hæmatopinus wrius* is the largest of all lice. It attacks the neck, head, and armpits, and frequently causes death in young pigs.

Treatment.—Care must be taken to prevent the spreading of the parasites to other animals by grooming utensils or any other means.

To destroy lice, creolin baths are best, repeated in a week.

Jeyes' fluid (1 in 60) is very efficacious, especially if some soft soap is previously dissolved in the water.

Other agents which may be employed are : Decoction of stavesacre (1 in 20) ; mercurial ointment rubbed down

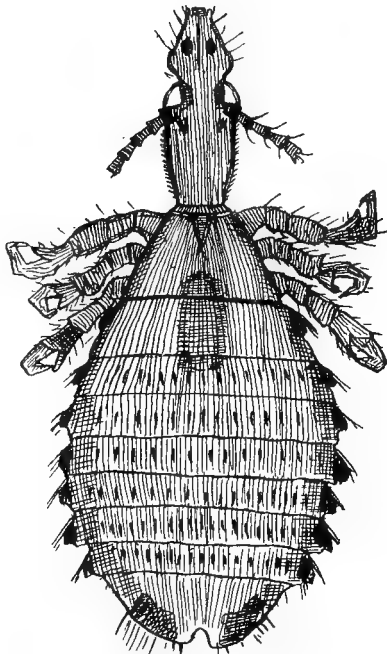


FIG. 9.—HÆMATOPINUS MACRO-
CEPHALUS.

Greatly enlarged.

the back in cattle; and various so-called insect powders, such as pyrethrum, stavesacre seeds, etc.

Decoction of tobacco (1 in 20) is often used.

Sheep may be dipped.

The same precautions as regards disinfection should be taken as in mange.

A mite which sometimes causes symptoms allied to those of Phthiriasis is the *Dermanyssus gallinæ*, or fowl mite. This often attacks horses kept in a stable in which fowls are in the habit of roosting. *Dermanyssus avium* may cause similar symptoms, and their presence is said to result from swallows or sparrows nesting in the roof of the stable. The mites attack chiefly the neck, withers, and back, causing loss of hair and a scurfy appearance of the skin, accompanied by intense pruritus and constant rubbing.

The mites can usually be found on the skin.

Treatment is similar to that for phthiriasis.

Pulicidæ (Fleas).

On dogs *Pulex serraticeps* is common. It is large, and brown in colour, while *Pulex irritans* of man is smaller and darker.

The complex life-cycle may take place on one host. This is often observed in the cat, especially in long-haired varieties, on the skin of which often a considerable number of comparatively large white eggs may be found.

Symptoms.—There is constant irritation and scratching, and occasionally an eruption may be seen on the back. Fox-terriers seem particularly liable to this eruption, and in these it takes the form of dark-coloured circumscribed hairy patches, with irregular surfaces. They are frequently confounded with mange, ringworm, and other skin affections.

Treatment.—Creolin baths are most useful. In the

smaller varieties of dogs and in cats ol. anisi or ol. eucalypti in spirit are best, though these do not necessarily destroy the parasites.

All mats and bedding should be destroyed, and kennels disinfected and limewashed.

Cutaneous Filariasis.

In Russia, Hungary, and some few other countries, horses, more particularly thoroughbreds, often exhibit symptoms of what is known as "parasitic skin-bleeding."

The cause is a worm, either *Filaria multipapillosa* or *Filaria hæmorrhagica*.

Filaria multipapillosa is from $2\frac{1}{2}$ to $2\frac{3}{4}$ inches in length. Its cephalic end shows a series of papillæ, arranged in rows, from which it derives its name. The body is transversely striated. Within the nodules the worm is coiled into a spiral. It is ovo-viviparous, and is probably carried to various parts of the body at some stage by the blood-stream.

Symptoms.—These are more apparent in warm weather, and may recur during several successive summers.

Non-inflammatory nodules about the size of a pea occur on the neck, shoulders, and breast. From these there exude drops of blood at intervals. The hair becomes matted, and after a while streaks of blood are seen on the skin. The general health is unimpaired. They often cause inconvenience owing to their position under the harness.

Treatment.—Clip the part, and apply alcohol or tinct. iodi. Any parasiticide may be employed. Arsenic should be administered internally.

In Hungary the swelling is incised, and the worm extracted just at the time when it is about to open.

Filaria Irritans.

This parasite in the larval state causes a disease of the skin known as "parasitic granular dermatitis," or "summer sores." The parasite is found in South Europe, Algeria, and India. It becomes surrounded by a calcareous capsule, and remains in the skin all the summer. Probably it gains entrance from the surface.

The nodules are commonest on the parts normally covered with harness, and probably friction plays a part in introducing the parasite.

Treatment.—Sulphide of arsenic has been successfully used.

Phenol or iodoform collodium are of service.

Dracontiasis.

In India, Africa, Egypt, Persia, and South America, the guinea-worm (*Filaria Medinensis*) sometimes lives in the skin of the horse, dog, or cow.

It is a large worm, and buries itself in the connective tissue. In time one end emerges through an orifice in the skin, and the Indians then remove it. It is stated that if the worm is broken in the process, death of the patient at once follows, but this is open to grave doubt.

Embryos are set free by the rupture of the body of the worm, and pass this stage of their existence inside small crustaceans. After some while they are taken into the body of one of the larger animals during the act of drinking, and reach the stomach, where fertilization takes place. The males then die, and the females bore to the surface.

Fleming has recorded chronic lameness in horses caused by this parasite.

DIPTERA AFFECTING THE SKIN.

Besides the Aphaniptera, or fleas, already described, members of the Nemocera and Brachycera may attack animals in the rôle of transitory parasites.

The Nemocera possess long, extremely fine antennæ, made up of six distinct segments, and are thus distinguished from the flies. The larvæ have distinct heads. They include the Culicidæ, or mosquitoes, and the Simuliidæ, or sand-flies.

The Brachycera are divided into the Tabanidæ (breeze-flies) and Hippoboscidæ, or Pupipara.

I. *Culicidæ* (the Mosquitoes).

These are of more importance in human than in veterinary medicine, as they are the carriers of the organism which causes malarial fever of man. The females are the more important, as the males are not blood-suckers, but live on the juices derived by suction from flowers and plants. Several generations are produced in one season. The females are fertilized by the males late in autumn, and then proceed to hibernate. In the early spring they search for a marshy spot, and lay their first batch of eggs in close vicinity to water. The larvæ are aquatic, and in about a fortnight they become pupæ. A few days later the perfect insect emerges.

The gnats are a well-known species, extremely common in the neighbourhood of trees and bushes, among the foliage of which they rest after feeding. The buzzing sound caused by the rapid movement of their wings is only too well known.

2. *Simuliidæ* (the Sand-Flies).

These are often spoken of as buffalo-gnats. They are small and thick-set, and have not the characteristic

buzz of the mosquito when flying. They are gregarious, and move in flocks, settling occasionally, but never appearing to rest for any length of time. The larvæ are aquatic. Only the females are blood-suckers. They attack only unprotected portions of the body, as the mucous membranes, especially the conjunctiva and the skin over the inside of the thighs and ears. They puncture the skin, producing raised swellings and intense irritation, followed by desquamation of the epidermis. Occasionally, when a large number attack the skin, serious symptoms may result. The chief are dyspnoea, associated with fever, which may be followed by death.

The Brachycera

are flies with short antennæ. Usually they are winged, and have the posterior pair rudimentary. Larvæ apodal, with no distinct head. The chief families are :

1. Tabanidæ (breeze-flies).
2. Muscidæ (house-flies).
3. Œstridæ (bot-flies).
4. Hippoboscidæ, or Pupipara.

I. Tabanidæ (Breeze-Flies).

These have a broad, flattened body, and the head broad and flattened from before to behind. The proboscis is capable of piercing the thickest hide. These flies are distributed all over the world, and are to be seen in the heat of the day, usually in the neighbourhood of woods, where, by the buzzing sound they make during flight, they strike terror into cattle and horses in the neighbourhood.

The breeze-flies are responsible for the spread of surra, and it is not unlikely that they might convey the bacilli of anthrax.

There are hundreds of species, of which may be mentioned :

The Autumnal Breeze-Fly.—18 to 20 millimetres long. Thorax grey, with four brown longitudinal bands ; abdomen with three rows of white spots ; legs yellowish-white.

The Ox Breeze-Fly.—A very large fly, 27 millimetres long. Thorax covered with yellow hairs, with black longitudinal bands ; abdomen brownish, striped with fawn. Each ring bears on the middle of its dorsal surface a white spot.

Allied are the Hæmatopota, of which may be mentioned the small rain breeze-fly (*Hæmatopota pluvialis*).

2. Muscidæ (House-Flies.)

These have a large number of genera and species.

Two groups are parasitic during the larval stage : (1) Sarcophaga ; (2) Lucilia.

The following are parasitic (blood-suckers) during adult life :

- (1) Stomoxys.
- (2) Glossina (tsé-tsé).
- (3) Hæmatobia.
- (4) Muscidæ.
- (5) Ectridæ.
- (6) Hippoboscidæ.

Stomoxys Calcitrans much resembles an ordinary house-fly, but its head bears an elongated proboscis, extending far in front.

It attaches itself usually to the legs or neck of a horse, and can only with difficulty be knocked off. It causes great irritation, and in fine-skinned horses the attack gives rise to a papule.

Glossina Morsitans (Tsé-tsé Fly).—Similar in appearance to a house-fly. Proboscis very long and slender ;

thorax chestnut, with four black longitudinal stripes ; abdomen yellowish-white, composed of five segments (the last four each carry a large black spot) ; wings more opaque and more leaden in colour than those of the house-fly. It is this fly that conveys the dreaded nagana of Africa.

3. The *Œstridæ*.

These are exclusively parasitic. They have large wings, and the body is usually covered with downy hair. The abdomen is composed of six rings, and terminates in an extensile ovipositor. By means of this the female deposits eggs on some portion of the body. The larval stage is parasitic.

Hypoderma Bovis.—Length, 13 to 15 millimetres. Head grey ; thorax grey on anterior half, black on posterior half, and bears wide longitudinal black bands ; abdomen black, shows three bands of coloured downy hair, anterior yellow, middle black, posterior orange ; wings brownish.

The fly is active from the beginning of July to the beginning of September. It lays its eggs along the back, shoulders, and occasionally on the fore-limbs. The flight of this insect is accompanied by a loud buzzing noise, which terrifies cattle, although no pain is caused by the fly, as the ovipositor is soft, and does not penetrate the skin. The female deposits only one egg at a time, and then leaves the host, makes a short flight, and returns to repeat the process ten or twelve times. The eggs are white and elongated, and carry a brown terminal appendage, which fastens them to the hairs.

The larvæ are known as “ warbles,” and live in the subcutaneous tissue. Probably the eggs or young larvæ are licked off, and after passing into the alimentary tract, finally reach this position. Nothing is noticeable during the winter, but in the following spring small non-

painful elevations about the size of a hazel-nut appear on the skin of the back and arms. In each of these is a "warble." At the summit of each elevation is a small hole, and the larva applies its posterior extremity with its "breathing-holes" to this. In June the larva emerges through this apical orifice, after it has become enlarged. The "warble" now becomes buried under leaves or straw, and after passing through the chrysalis stage, finally develops into a fly.

The larva is brownish in colour, and composed of eleven rings. In shape it is conical, and much resembles a "bot." The head bears two hooks for anchoring, arranged at right angles. The spines are arranged in three rows on each side, leaving out the centre portion, except in the last two segments, which are unarmed. The lateral prominences consist of an upper and lower in each segment, and are well marked.

When mature, the larva measures 22 millimetres to 28 millimetres in length, and about 15 millimetres in breadth at the widest part.

Treatment is usually unnecessary. If desired, the elevations may be coated with salicylic acid, or iodoform collodion, or even Stockholm tar. These suffocate the parasite by closing the air-holes.

When the larva is ripe, it may often be squeezed out, especially if the skin over the elevation is first slightly nicked with a bistoury.

Prevention is of more importance. The backs of cattle should be dressed during the months the fly is active with a mixture of sulphur, ol. picis, train-oil, and rape-oil, at least once weekly, to ward off the attacks of flies.

Hypoderma Equi (Loiset).—This parasite is found in Holland, Belgium, and France. It produces cutaneous tumours containing a larva, and in all its characteristics much resembles *Hypoderma bovis*.

The larva is only 9 to 10 millimetres in length. It has no spines and no oval hooks, and the skin is very thin and transparent.

The tumours usually arise under parts which are commonly covered by harness, such as the neck, withers, and back.



FIG. 10.—*CÆSTRUS EQUI*.

Curative treatment may be applied, as in the ox.

Æstrus Ovis is a small greyish-coloured fly, 10 to 12 millimetres in length. Thorax brownish-grey, streaked with dark obscure lines; abdomen slightly hairy, marbled with yellow, black, and white. The wings carry at their bases three black spots.

The fly is active from May to October.

The larvæ enter the nasal cavities of sheep, and finally reach the sinuses and horn-cores. They will be discussed more fully later.

4. *Hippoboscidæ*, or *Pupipara*.

The female deposits the nymph.

There are two species of importance :

1. ***Hippobosca Equina* (the Spider-Fly)**.—This fly attacks the soft parts of the skin of the horse, or even ox or dog, especially around the anus, eyes, and groin. It does not puncture the skin, but merely irritates. It is only 8 millimetres in length.

It is a very obstinate insect, and can only with difficulty be driven away. It causes great stamping and kicking among animals with fine sensitive skins.

Hippobosca rubripes is a native of South Africa, and is

believed to transmit the *Trypanosoma Theileri*, which causes the so-called biliary fever of cattle.

(2) **Melophagus Ovinus (Sheep-Ked).**—This insect is without wings, and much resembles a louse. It lives in the wool of sheep, and finds its nourishment in the grease, scurf, and droplets of exuded blood.

It is greyish-brown in colour, with a small narrow thorax and a large oval abdomen. Length, 3 to 5 millimetres.

Muscidæ.—Some of the Muscidæ exist on the skin while in the larval state.

Sarcophaga Magnifica is a greyish fly, 10 to 30 millimetres in length. It is viviparous, and deposits its larvæ on wounds or moist surfaces. Cattle are most commonly attacked.

In the British Isles *Lucilia Cæsar* and *Lucilia sericata* are the commonest.

Lucilia macellaria is common in America.

Lucilia sericata is of a greenish-blue colour, and smaller than *Lucilia Cæsar*, which has a golden sheen.

The former has the first ring of the abdomen black, and the latter the first two rings. These flies deposit their eggs on the fleece of sheep, particularly round the anus or where there is a wounded surface.

The eggs hatch the same day.

Cupri sulph. is the best agent in use for the purpose of destroying the larvæ.

CHAPTER II

PARASITES OF THE ALIMENTARY TRACT

VERMES

THE Vermes are non-vertebrate animals, possessing soft contractile bodies, devoid of an endo-skeleton, but constituted of a number of segments. They possess no articulated limbs. The organs comprising the secretory system are arranged in pairs. With the exception of the leeches, all the members of the Vermes under this heading which we are about to discuss are classed as Entozoa, or intestinal worms. Their natural habitat is to be found in some portion of the alimentary tract of a larger animal, apart from which but few can maintain their existence. They have no respiratory system, and hence need no circulatory system.

The Vermes are divided into two chief groups :

1. Annelida.
2. Helminthes.

I. ANNELIDA.

The only members of the Annelida which are parasitic are the leeches, of which *Hæmopsis sanguisuga*, the horse-leech, serves as an example. The Annelides are the only invertebrates which have red blood circulating in a double system of bloodvessels. The body is soft, flat or cylindrical, and shows distinct transverse rings.

Hæmopsis sanguisuga is a member of the Hirudinæ.

It has an elongated body, flat on the ventral surface and rounded on the dorsal surface. The mouth carries a tri-radiate, three-lipped sucker, used both for the purposes of assimilation and locomotion, and there is an anal sucker in the form of a flattened disc. The oval sucker is soft, and so the horse-leech is unable to attach itself, except to an abraded surface or a mucous membrane.

The *Hirudo medicinalis*, on the other hand, has hard jaws, and is able to puncture sound skin. Although the leeches are hermaphrodite, a pair are necessary for fertilization, the penis being situated at the anterior end of the body, and the vulva a short distance behind it.

The horse-leech frequents muddy pools, and the young parasites enter the pharynx of horses, asses, mules, or even man. During the process of drinking they become attached to the mucous membranes, from which they suck blood.

Symptoms.—When the leeches are present in great numbers anæmia and debility arise from loss of blood. The patient frequently coughs, and such attempts to remove the parasites are followed by discharge of blood, which has accumulated in the pharynx, down the nose. This is particularly seen when the animal is at work. Sometimes hundreds of leeches may be present at one time, and cause dyspnoea through obstruction of the pharynx.

Treatment.—Prophylactic treatment consists in preventing the animals from drinking water from streams or pools infested with leeches. When this is impossible, the water should be filtered through finely perforated metal trays, or net muzzles may be used while drinking.

Curative treatment is usually successful. Strong salt solution on a sponge should be applied to the pharynx, as this dislodges the parasites.

2. HELMINTHES.

These are divided into :

1. Platyhelminthes, or Platodes (flat-worms).
2. Nematelminthes, or Nematodes (round-worms).

The former are practically all hermaphrodite.

They are again divided into two classes :

- (1) Cestodes.
- (2) Trematodes.

(1) The **Cestodes** contain the tapeworms. They have long, flattened, ribbon-like bodies, distinctly segmented, and a head provided in most cases with hooks and suckers.

The Tænioidæ are the most highly developed.

The Bothriocephalidæ are allied.

In the Tænioidæ in general the head bears from two to four suckers. Between these, and centrally placed, there may be a rostellum, armed with one or more circles of hooks or spines, or in some cases there is merely a depression provided with a pore.

The body tapers anteriorly, and the segments gradually become ripe from behind forwards; hence the terminal segments are usually crammed with eggs. The segments multiply by a process of division from behind the head at the same rate as the terminal segments are shed or have withered, as the case may be. Each segment is hermaphrodite, and provided with one or two genital pores opening out from a uterus, usually consisting of a median trunk and numerous lateral branches.

The position of the genital pores varies. Thus, in *Tænia cucumerina* there is one on either side of each segment, while in *Tænia marginata* they are arranged on opposite sides, one in each segment. In *Tænia litterata*, again, the genital pores are centrally placed.

In all the Tænioidæ the embryo escapes from the ovum and enters the alimentary tract armed with six

hooks, and is known as the "prosclex." It leaves the intestine, penetrates into the tissues of the host, loses its hooks, and becomes a vesicle, from the inner surface of which develops the head of the future tapeworm. This head has received the name "scolex."

When the carcass or portion of the carcass of an animal thus infested is eaten by another animal, the scolex is liberated, attaches itself to the mucous membrane of the intestine, and develops a number of segments, or proglottides. The terminal segments pass out, and are ingested by yet another animal, and so the cycle commences afresh.

(2) The **Trematodes** have a flattened, oval, or lanceolate body, which is non-segmented. Those which are parasitic belong to the Distomata—that is to say, they have an anterior oval sucker and a round or oval ventral sucker, varying in position in the different members. They are hermaphrodite, but individual coitus is essential.

The genus *Bilharzia* (*Bilharzia crassa*) inhabit the blood. They are not hermaphrodite, and the male and female are always attached, the male lying in a groove running the length of the female.

The Distomata comprise :

- (a) Distomum.
- (b) Amphistomum.
- (c) Gastrodiscus.
- (d) *Bilharzia*.

The flukes are of great importance, as they inhabit the bile-ducts, and cause the disease known as "liver-rot."

Nemathelminthes.

These are round-worms, as opposed to the Platyhelminthes, or flat-worms. The sexes are nearly always distinct.

They are divided into two chief orders :

1. Nematodea (the Nematode worms).
2. Acanthocephala (the thorn-headed worms).

I. THE NEMATODES

have a transversely striated skin. They possess a digestive canal running the whole length of the body, but no circulatory apparatus.

They may be found in any tissue of the body, except the osseous skeleton. Their colour may be white, red, or brownish. The head may be armed, but definite hooks, such as are seen in the *Tæniæ*, are absent. In many the anterior end of the body carries just behind the head a pair of small membranous wings. Often there is a caudal pouch into which the genital duct and intestinal canal open by means of a cloaca. In the males chitinous spicules are often present, and are used in the process of copulation as "claspers." The Nematodes are oviparous or viviparous, and the females have a vulva on the floor of the body. Into this the uterus opens. This organ is provided with one or two ovarian tubes. In the majority the life-history has not been thoroughly worked out, but it is evident that some members complete their life-cycle in one host, while others require an intermediate host. The females are by far the commoner, and are larger. The males often exhibit spiral coiling of the posterior extremity.

The Nematodea are divided into :

- (1) *Ascaridæ*.
- (2) *Oxyuridæ*.
- (3) *Filariidæ*.
- (4) *Trichotrachelidæ*.
- (5) *Strongylidæ*.

(1) ***Ascaridæ***.—The body tapers towards each extremity. The mouth has three lips, and between these

is a short tube, which can be slightly protruded. The male has no caudal pouch, but has two spicules, or "claspers." The females have a straight digestive canal, and two tubular, spirally-arranged ovaries, several times longer than the body. They open at the vulva, which is situated at about one-fourth of the length from the anterior extremity.

The *Ascarides* inhabit the small intestine, and may enter the stomach. The lumbricoid worms are found in the large intestine.

(2) **Oxyuridæ.**—These worms inhabit the large intestine. They are oviparous. The mouth is provided with three lips, and the tail is tapered and much finer than the remainder of the body. The caudal pouch is absent in the male.

(3) **Filariidæ.**—The body is long, slender, and thread-like, and the rings are less pronounced. The mouth is a circular opening. In females, the vulva is situated at the anterior end of the body. The males usually have the tail rolled up. They are not found in open cavities, but inhabit the parenchymatous tissues, being frequently embedded in the subcutaneous tissues (see Cutaneous Filariasis, p. 34), tendons, or within the anterior chamber of the eye. These represent the *Filaria* type; but the *Spiroptera* embed themselves chiefly between the layers of the viscera, such as the œsophagus and stomach, in the form of nodules, under the mucous membrane.

(4) **Trichotrachelidæ.**—These are so called on account of the beaded or constricted œsophagus. The body is extremely slender, and tapers at the anterior extremity.

There are two genera :

(a) *Tricocephalus*, usually inhabiting the intestine.

(b) *Trichina*, usually found encysted in muscular tissue.

(5) **Strongylidæ**.—In these the body is rounded, and but seldom thread-like. The mouth bears six oval papillæ. The males have the vent enclosed in a divided or entire caudal pouch, from which the organ of generation can be protruded. There are usually one or two “claspers.”

The three chief groups of the Strongyles are :

- (a) The Eustrongylines.
- (b) The Strongylines.
- (c) The Sclerostomines.

The chief differences are set out in the following table :

	<i>Mouth.</i>	<i>Caudal Pouch.</i>
Eustrongylines ..	Non-chitinous	Not ribbed
Strongylines ..	Non-chitinous	Ribbed
Sclerostomines ..	Chitinous	Ribbed

2. THE ACANTHOCEPHALA.

These worms are provided with a sort of proboscis, set with recurved spines, by means of which they attach themselves to the intestinal mucous membrane.

Echinorhyncus gigas of the pig is the largest known member.

Digestive organs are absent, with the exception of two small blind tubes arising at the base of the proboscis.

The males probably fertilize the ova after they have been excluded.

PARASITES INHABITING THE ALIMENTARY CANAL OF THE HORSE.

Œsophagus and Stomach.

Strongylus Axei.—This is a small filiform worm, usually about 6 or 7 millimetres in length. It coils itself up under the mucous membrane in the form of a small nodule. It causes no symptoms, and is of little clinical importance.

Filariidæ.—Two Spiroptera may inhabit the stomach of the horse. These are *Spiroptera megastoma* and *Spiroptera microstoma*—*i.e.*, the large-mouthed and small-mouthed Spiroptera. Their average length is 1 centimetre ($\frac{2}{5}$ inch). They may be found free in the cavity of the stomach, but more frequently embedded in raised nodules in the mucous membrane, chiefly in the cardiac portion, and ranging in size from a pea to a walnut, with a small aperture at the summit. As the nodules grow older they become surrounded by connective tissue, and finally by a calcareous capsule. They appear to be more common in the ass than in the horse.

They may produce chronic indigestion, or even gastritis, with ulceration and slight hæmorrhage.

Gastrophilus Equi Larvæ.—The common horse "bot" is the larva of the fly known as the *Gastrophilus*, or *Æstrus equi*. The latter is a comparatively large fly, with the proboscis directed forwards. The colour is a mixture of orange, yellow, and brown. The wings each show a light brown bar and two terminal spots of the same colour. It is a common parasite in the stomach of the horse, especially in those



FIG. II.—LARVA OF GASTROPHILUS EQUI. The horse "bot."

horses which have been at grass during the months in which the fly is active.

The eggs are laid by the adult female, and glued to the hairs of the fore-limbs of the horse, or in some position from which they may be easily reached by the mouth. The eggs are provided with "opercula," or lids, which open and liberate small maggot-like larvæ. These cause irritation, and are licked off by the horse, and on reaching the stomach attach themselves by means of their hooked mandibles to the mucous membrane of the cardiac end of the stomach. They then undergo two moultings, and finally develop into the so-called "bots."

Each bot is pyriform in shape, tapering towards the head, and is composed of eleven segments, the first eight of which carry a double row of stiff spines directed backwards. The anterior tapered end carries two smooth antennæ, while the posterior end has two pores or apertures for breathing. This bot is a dirty white in colour.

Bots may migrate, and so reach the brain, larynx, pharynx, or bladder. The larvæ remain in the horse's body for about nine months, and pass out with the fæces in the spring. After excretion, they shrivel and take on the chrysalis stage. They then undergo three moults, and finally emerge as adult perfect insects.

Another variety of bot which is fairly common in this country is the *Gastrophilus hæmorrhoidalis*. In this case the fly lays a number of brownish eggs around the muzzle and lips of the horse. These bots are of a dirty green colour, and may be frequently seen after the horse has passed fæces, attached to the inner rim of the anus.

Its habitat is identical with that of *Gastrophilus equi*, but it remains in the rectum for a little while instead of passing out at once.

In Russia *Gastrophilus pecorum* is the common bot, and is occasionally seen in Russian ponies brought over

into England. It is of a dark red blood tint. The colour is densest at the head, while at the tail end it is much lighter.

In Australia *Gastrophilus nasalis* is common, and it is occasionally seen in England. The bot attaches itself to the pyloric end of the stomach and to the duodenum. It is frequently found in the pharynx and œsophagus, causing dyspnoea and coughing.

Symptoms.—As a general rule, bots cause little or no disturbance. Occasionally chronic indigestion may result, and this may be associated with ulceration or perforation of the stomach wall. Colic occasionally results from their presence, and spasm of the œsophagus, associated with retro-peristalsis, has been noticed when bots have been present in sufficient number to cause obstruction.

Treatment.—Owing to their great vitality, it is practically impossible to introduce medicinal agents into the stomach in sufficient concentration to destroy the bots. In the spring they leave the horse, and should then be destroyed, in order to prevent increase in the number of bot-flies in the succeeding year.

The following prescriptions are in common use :

R̄	Creolin	..	..	..	..	ʒij.
	Ol. tereb.	..	..	..	..	ʒj.ss.
	Ol. lini ..	..	..	..	..	ad O.j.
	M. Fiat haust.					

R̄	Carbon disulphide	..	..	..	..	ʒss.
	This is best given in a capsule.					

R̄	Benzene	..	..	..	..	ʒj.
	Tinct. iodi.	..	..	..	..	ʒss.
	Ol. lini ..	..	..	..	..	ad O.j.
	M. Fiat haust.					

R̄	Creosote	..	..	..	..	ʒj.
	Chloroformi	..	..	..	..	ʒij.
	Ol. tereb.	..	..	..	..	ʒj.ss.
	Ol. lini ..	..	..	..	..	O.j.
	M. Fiat haust.					

Gastrophilus hæmorrhoidalis may be removed from the rectum by injections of salt solution.

Bots, when present in the pharynx, may be removed by the use of the above mixture applied on a long brush or on a sponge fastened on a stick.

Among the parasites sometimes found in the stomach of the horse, *Ascaris megalocéphala* must be included, but will be discussed later.

Ganglyonema scutatum may sometimes be found in the œsophagus.

Intestinal Parasites of the Horse.

TÆNIA.

The Tænia which inhabit the intestine of the horse are only three in number, and all belong to the Anoplocephalinæ (the unarmed tapeworms).

The three Tænia are :

1. *Tænia perfoliata*.
2. *Tænia plicata*.
3. *Tænia mamillana*.

Of these, *Tænia perfoliata* is by far the commonest. It inhabits the large intestine, particularly the cæcum. *Tænia mamillana* is very rare, and has seldom, if ever, been seen in horses in the British Isles. It inhabits the small intestine, as does also *Tænia plicata*, which is by no means uncommon.

Tænia Perfoliata.—This worm ranges from 25 to 40 millimetres in length (1 to 1 $\frac{3}{4}$ inches), and is about 10 millimetres ($\frac{2}{5}$ inch) wide. The head is four-sided, large, and rounded, while the four suckers are rounded and placed at the extreme end of the head.

Tænia perfoliata may easily be recognized by the presence of two flaps on each side, which project backwards, and are quite easily visible to the naked eye.

Tænia Plicata is by far the largest of the three. In length it ranges from $1\frac{1}{2}$ to 8 centimetres. Its width is about 15 millimetres. The head is more flattened than that of *Tænia perfoliata*, and is destitute of flaps. It carries four round terminal suckers.

Tænia Mamillana is the smaller. In length it ranges from 10 to 30 millimetres, and its width is about 5 milli-

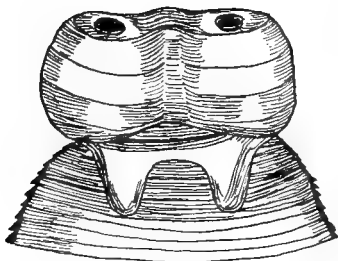


FIG. 12.—HEAD OF TÆNIA
PERFOLIATA.



FIG. 13.—TÆNIA
PERFOLIATA.

metres. Its head is peculiar—short and broad, and somewhat resembles a rose-bud in shape. The suckers are merely slits, and are laterally placed.

Symptoms.—In the horse there is usually little evidence to show that *Tænia* are present in the intestine. Anæmia and slight debility may be observed when the number present is very large. Cases of septic peritonitis following perforation of the intestine have been recorded, but must necessarily be very rare.

Treatment.—When the presence of tapeworms is

demonstrated by their occasional appearance in the fæces, treatment is sometimes resorted to. As they are unarmed, there is little difficulty in expelling them. The following draught is usually efficacious :

R.	Ol. tereb.	..	..	..	..	ʒij.
	Creosoti	..	..	..	..	ʒj.
	Ol. lini	..	..	..	..	ad O.j.

M. Fiat haust.

Male-fern, areca-nut, kamala, and kousoo, are other remedies frequently employed by veterinarians.

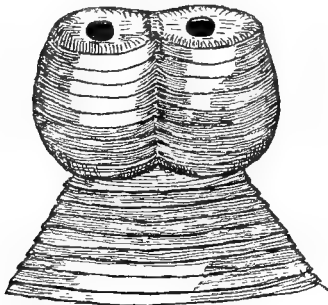


FIG. 14. —HEAD OF TÆNIA
PLICATA.



FIG. 15. —HEAD OF TÆNIA
MAMILLANA.

Ascaris Megalocephala.—This is a large round-worm, of a whitish or yellowish colour, often present in the intestines of the horse. The female ranges from 6 to 13 inches in length, and the males from 5 to 12 inches. The body is stiff and cylindrical, while the head is large, easily visible, and set upon a well-marked constriction, or neck. It carries three lips. The male possesses two wing-like outgrowths—one on each side of the tail.

The life-history has been the subject of much investigation.

According to Albrecht, ova which are kept in moisture

or in dung at ordinary room-temperatures require twenty-four to thirty days for the complete development of the embryos, but [if incubated at 37° C. three to four days is sufficient. He infers that transmission of the parasite takes place without an intermediate host by ingestion of ova in dung. He fixes the age at which the *Ascaris* gains sexual maturity as from ten to twelve weeks. Foals are particularly subject to *Ascarides*, but they occur in horses of all ages. Although no worms may have been passed in the dung, their existence may often be demonstrated by the presence of ova in the fæces. They are rounded, and easily visible when a portion of the fæces containing them is mixed with a small quantity of water on a glass slide and exposed to a magnification of 100 diameters.

Symptoms.—Usually the symptoms are *nil*, but when large numbers are present anæmia and marasmus may result. Intestinal catarrh is often associated with their presence, and is indicated by the discharge of a small quantity of watery fluid after defæcation.

More uncommon is peritonitis, produced by perforation of the intestinal wall. Jaundice has occasionally been seen, owing to the passage of an *Ascaris* up the bile-duct, but this is rare.

In foals particularly, large numbers of *Ascarides* not infrequently form a bundle and cause obstruction.



FIG. 16.—ASCARIS MEGALOCEPHALA.

Nervous symptoms are occasionally seen in the form of epileptiform spasms, vertigo, or even tetanic spasms.

Treatment.—Antimony potassium tartrate undoubtedly stands foremost among the agents employed to expel *Ascarides* from the horse. One drachm should be given three or four times daily for four days, and followed by a dose of physic.

Ol. tereb. is often efficacious, given with creosote and a full dose of ol. lini.

Male shield-fern is a well-known remedy, and is usually combined with ol. tereb. and ol. lini.

The following is a common prescription for the so-called "worm-powders":

℞	Ferri. sulph.	..	..	..	..	ʒj.
	Arsenic	..	..	..	..	grs. ij.
	Santonin	..	..	..	..	grs. xv.
	Pulv. gentianæ	..	..	..	..	ʒss.
	Pulv. anisi	..	..	..	..	ʒj.
	Pulv. locust	..	..	..	..	ʒj.

M. Fiat pulv. i. Sig.: To be given in first feed daily.

SCLEROSTOMES.

These worms are commonly known as "palisade worms." They have chitinous mouths, and are thereby capable of doing great damage.

Two *Sclerostomes* may inhabit the intestine of the horse, and both usually exist in the same animal. These are:

1. *Sclerostomum armatum* or *equinum*.
2. *Sclerostomum tetracanthum*.

Sclerostomum Armatum.—This is a short, straight, stiff worm, of a whitish or greyish-red colour. The female may be known by the straight-pointed tail, and measures about 30 millimetres in length, but this is subject to great variation. The male possesses a caudal pouch, and is about 20 millimetres in length. Occa-

sionally specimens are found which greatly exceed this length.

In its adult form *Sclerostomum armatum* inhabits the large intestine of the horse, particularly the cæcum, hanging on to the mucous membrane. It may even be found in the duodenum in some cases.

Life-History.—*Sclerostomum armatum* appears in three different positions :

1. Attached to the mucous membrane, or free in the lumen of the intestine.

2. Coiled up in nodules in the submucous tissue. These tumours range from the size of a millet-seed to that of a hazel-nut. They contain the worm, blood, and a quantity of soft, cheesy material.

3. In the arteries (anterior mesenteric or branches of aorta).

The eggs are laid either on or in the mucous membrane. In the former case the embryo burrows into the mucous membrane. After a while they bore their way out into the lumen of the gut. It is supposed that some, still in an agamous condition, again return and burrow into a vessel. They then work against the blood-stream to the root of the anterior mesenteric artery, and form an aneurism there, or else get into the aorta, and are transported by the blood-stream to other organs. Another theory, which makes the aneurism an essential part of the life-history of the worm, supposes that the ova are deposited in the bowel, and are passed out into damp ground or into water. Some consider that they develop into free Nematodes (rhabditidæ), and pass this stage of their existence in water or on damp ground. However this may be, the majority agree that after certain moults the embryo gets back into the intestine by ingestion of water or food. Those which bore into the vessels produce an aneurism in which it is believed further development takes place, and they reach their

full size, after which they again bore back into the intestinal wall, become encysted, and finally reach the lumen of the intestine as the perfect adult parasite. While in the aneurism, the parasite is spoken of as *Sclerostomum armatum minor*, while the adult is spoken of as *Sclerostomum armatum major*.

Sclerostomum Tetracanthum.—This is a much smaller worm, normally white in colour, but almost invariably bright red, from the blood contained within its body, previously sucked from its host. It ranges from 10 to 15 millimetres in length. The mouth is circular, and the rim carries a series of teeth, together with six papillæ, four large and two small. A little behind these is another pair of long papillæ, placed laterally. The tail of the male terminates in a caudal pouch, while that of the female is pointed.

This worm also inhabits the cæcum and colon of the horse, usually in company with *Sclerostomum armatum*. They are probably taken into the body with the water, and then encyst themselves in the mucous membrane, finally returning to the lumen of the bowel. They do not enter the vessels and set up aneurisms.

Symptoms.—Since both of these worms are usually found coexisting in the same horse, it is difficult to draw any marked distinction between the symptoms set up by either worm in particular. Since *Sclerostomum tetracanthum* confines itself to the bowel, and seldom bores, it is less frequently the cause of the so-called vermiform colic than is *Sclerostomum armatum*, which does further damage in the vessels. Nevertheless, *Sclerostomum tetracanthum*, when present in large numbers, is capable of causing marked anæmia, emaciation, and death.

The disease is commoner in the country, among horses that have been running at grass, than in town horses, except in those that have been recently introduced from the

country. Colts and young horses are more frequently affected, but it is not at all uncommon to find the worms present in large numbers, often causing grave symptoms, in aged horses. Colts running at grass at first show gradual emaciation, pitched coat, and general signs of unthriftiness. As the disease progresses, weakness sets in, and the colts acquire a stiff gait, particularly behind, and often the joints may be heard to crack, somewhat resembling the sound heard in some rheumatic affections. Ascites is not uncommon, but more frequently one sees œdema of the lips, with swelling of the legs from the hoof upwards. These symptoms arise from circulatory changes. At intervals attacks of colic occur, usually accompanied by diarrhœa and the passage of large numbers of worms. Death may occur during one of these attacks, but more often the colt gets on the ground, and shows inability or unwillingness to rise. In this case death soon supervenes.

The attacks of colic are due to cutting off of the blood-supply from portions of the bowel, owing to obstruction or embolism of small vessels.

During the attack the animal usually lies, with the head extended on the ground. The pain is continuous, and may pass off as suddenly as it has come. The colt then stands up, but may appear very dull and stupid for some while after.

In older animals *Sclerostomum tetracanthum* appears to be more commonly the cause of serious trouble than *Sclerostomum armatum*.

The animal shows signs of gradual emaciation, usually with increased appetite, but occasionally the appetite is diminished. The coat staves and the mucous membranes are anæmic. Ascites is comparatively rare in old horses. We have observed intussusception of the bowel as a result of their presence, though a number of *Sclerostomum armatum* were present at the same time.

In this case the ileum had entered the cæcum a distance of 2 feet.

The bowels are irregular, usually firm while in the stable, but becoming loose when on a journey. Occasionally diarrhœa is persistent. Sometimes micturition is performed more frequently than normal, from irritation.

Death may occur from anæmia, weakness, and exhaustion, especially in hard-worked horses.

Diagnosis is confirmed by the discovery of the worms in the fæces, especially during the attacks of diarrhœa or after a dose of ol. lini.

Prognosis.—This is at all times grave. If treated early the prognosis is much more favourable; but if the animal is on the ground, and unable to rise, then treatment is seldom of any avail. When diarrhœa has set in, the danger is much greater.

Treatment.—The first essential is rest. Vermicides are of little use, as their dilution is too great when mixed with the contents of the large intestine.

Thymol, in our experience, is valueless, although regarded by many as a specific.

The only treatment of use is the administration of hæmatinics over a prolonged period—at least one month—and if the animals are treated early, recovery takes place in 90 per cent. of cases by this means.

The following prescriptions we have found to have produced the best results :

℞	Ferri ammon. sulph. . . . .	..	..	..	ʒij.
	Quinia sulph. . . . .	..	..	..	grs. xv.
	Acid. carbol. . . . .	..	..	..	ʒxv.
	Pulv. nucis vom. . . . .	..	..	..	grs. xx.
	Pulv. quassiaë . . . . .	..	..	..	ʒij.
	Pulv. digitalis . . . . .	..	..	..	grs. x.
	Pulv. glycerrh. . . . .	..	..	..	ʒj.
	Theriacaë . . . . .	..	..	..	q.s.

M. Fiat bol. ʒ. Sig. : One ball to be given twice daily for one month.

℞	Ferri ammon. cit.	..	..	..	3j.
	Quin. sulph.	..	..	..	grs. xv.
	Acid. hydrochlor. dil.	..	..	..	℥xv.
	Tinct. nucis vom.	..	..	..	℥xv.
	Tinct. digitalis	..	..	..	℥xv.
	Tinct. quassiaë	..	..	..	ʒss.
	Aqua	..	..	..	ad O.j.

M. Fiat haust. To be repeated every night and morning.

℞	Liq. ferri. dialysat.	..	..	..	ʒiij.
	Thymol	..	..	..	grs. xx.
	Spt. vini rect.	..	..	..	ʒiv.
	Glycerin.	..	..	..	ʒij.
	Ol. tereb.	..	..	..	ʒiv.
	Acid. carbol.	..	..	..	℥xx.
	Liq. calcis	..	..	..	ʒj.
	Ol. lini	..	..	..	ad ʒv.

M. Fiat haust. Sig. : To be given in $\frac{1}{2}$ pint of milk, and repeated once daily.

Providing that the animal is not suffering from diarrhœa, it is advisable to give the following draught two days before commencing any of the prescriptions mentioned, in order to expel as many worms as possible :

℞	Ol. tereb.	..	..	..	ʒj.
	Acid. carbol.	..	..	..	ʒj.
	Ol. lini	..	..	..	ad O.j.

M. Fiat haust.

Ferri sulph. should be avoided, as it is too irritant, and brings on diarrhœa.

Milk, gruel, eggs, and concentrated, easily digested foods should be given when the disease is at all advanced, particularly if diarrhœa has set in.

In verminous or embolic colic the following draught is most useful :

℞	Spt. æther. nit.	..	..	..	ʒj.ss.
	Tinct. digitalis	..	..	..	ʒj.ss.
	Tinct. chloroformi et morph. acet.	..	..	..	ʒiij.
	Acid. carbol.	..	..	..	ʒj.
	Lactis	..	..	..	ad O.j.

M. Fiat haust.

Whenever prescribing balls in the treatment of intestinal parasites, it is well to paint the papers over with a strong solution of salol in æther. The salol is insoluble in the gastric secretion; solution of the contents is retarded, and hence the agents employed reach the intestine in a greater degree of concentration.

If the diarrhœa becomes acute, mild astringents may be given, combined with sodium sulphite, in doses of 1 to 2 ounces, as this agent appears to exert a very marked action in checking diarrhœa of verminous origin. Tinct. opii is also very useful.



FIG. 17.—*OXYURIS CURVULA*.

OXYURIDES.

The two members occurring in the horse are *Oxyuris curvula* and *Oxyuris mastigodes*. *Oxyuris curvula* is sometimes spoken of as the "maw-worm." The female ranges from 4 to 5 centimetres in length. The body is curved, and thickest in its anterior half, while the posterior end tapers away into a very thin tail.

The male is rarely seen. It is not curved, has only a short tail, and is only about 10 millimetres in length. It possesses a caudal pouch and a very fine, straight spicule.

Oxyuris mastigodes differs from *Oxyuris curvula* in the remarkable length of its tail. Whether it is but an abnormal form of the former worm has been disputed.

The Oxyuridæ inhabit the large intestine, more especially the floating colon, rectum, and diaphragmatic flexure of the double colon. The eggs are deposited in the neighbourhood of the anus in the form of a yellow

dust. Each egg is ovoid, about 90 μ long, and provided at one end with an operculum.

Symptoms.—These are often absent. When the worms are present in large numbers there is seen frequent rubbing of the anus and tail, with the presence of the characteristic yellow dust around the anus. Occasionally there is loss of condition from irritation and loss of rest. *Oxyuris mastigodes* appears to cause more disturbance than *Oxyuris curvula*.

Life-History.—This has not been fully worked out. Probably there is no intermediate host, but infection by ingestion of ova.

Treatment.—Turpentine and linseed-oil given once a week or once a fortnight, with early-morning clysters of infusion of quassia or common salt, given after the rectum has been emptied by hand, usually eradicate these parasites.

The "worm-powders," of which the prescription was given when referring to *Ascarides*, are very useful.

Trematodes occurring in the Horse.

These are two in number :

1. *Amphistomum Collinsii*.
2. *Gastrodiscus Ægyptiacus*.

Amphistomum Collinsii (Masuri).—This is a worm of a brick-red colour occurring in immense numbers in the large intestine of horses in India. They produce great irritation.

Gastrodiscus Ægyptiacus (*Gastrodiscus Sonsinoi*, *Gastrodiscus Polymastos*).—This parasite has a red, oval body, about 12 millimetres long, convex on the upper or dorsal and flat on the ventral surface. The buccal sucker is carried on a short proboscis, while the ventral surface carries about 200 papillary suckers.

It inhabits chiefly the small intestine of horses, asses, and mules in Egypt and Senegal, but may occur in

almost any portion of the alimentary tract. It produces anæmia and marasmus.

Treatment consists in giving vermicides and purgatives. All land should be limed or salted, and drinking-water filtered through fine sieves.

PARASITES INHABITING THE ALIMENTARY CANAL OF THE OX.

Ganglyonema scutatum is sometimes present in the œsophagus of the ox.

Stomach.

Amphistomum conicum, a Trematode, may inhabit the first stomach. It seldom produces noticeable symptoms, except in Australia, where the parasite appears to possess exceptional virulence. Various Strongyles may inhabit one or other of the stomachs. Hence *Strongylus contortus*, *Strongylus gracilis*, and *Strongylus convolutus* may be found in the abomasum. These will be discussed more fully later.

Ascaris Vitulorum is sometimes seen in the abomasum of the calf, but more frequently in the small intestine. It is a large worm, the female reaching the length of 25 centimetres (10 inches), and the male about 20 centimetres (8 inches). It is of a reddish-white colour, with a transparent skin. The head is small, and the mouth trilabiate. It is rare in animals over two years old, but is comparatively common in the small intestine and abomasum of calves, particularly in the South of France. The embryos are the more active in producing the disease. The commonest symptoms are those of colic and indigestion. A few worms may be passed with the fæces. Perforation or rupture of the abomasum has frequently been recorded.

Treatment.—Calomel, areca-nut, turpentine, and lysol are favourite remedies, and should be followed by linseed-oil or saline purgatives.

Small Intestine.

CESTODES OF THE OX.

The three tapeworms inhabiting the ox belong to the Anoplocephalinæ, or unarmed worms. These have the genital pore double in each segment, all of which are much broader than long.

The three tapeworms are :

1. *Tænia expansa*.
2. *Tænia alba*.
3. *Tænia planissima*.

Tænia Expansa.—This is the commonest and also the largest tapeworm of the ox. It ranges in length from

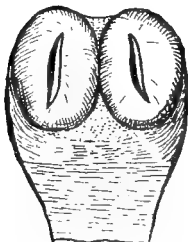


FIG. 18.—HEAD OF TÆNIA
EXPANSA.

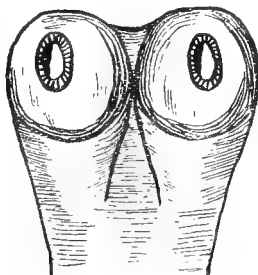


FIG. 19.—HEAD OF TÆNIA
ALBA.

25 to 100 feet. The anterior segments are narrow, but the ripe posterior segments are very short, and are usually an inch wide. The head is small and slightly flattened, and the suckers are arranged in the form of four oval slits.

Tænia Alba.—Next to *Tænia expansa*, this is most commonly found. It averages about 6 feet in length, and the widest segments reach from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch. The segments are proportionately longer than those of *Tænia expansa*, and are of a dense whiteness. On holding the

worm between the eyes and the light an opaque line may be seen running the whole length of each segment, about $\frac{1}{8}$ inch from the edge. The head is large, and extends beyond the adjoining segments, while the suckers, unlike those of *Tænia expansa*, are round.

Tænia Planissima, or Denticulata.—This worm ranges from 3 to 6 feet in length only, and is characterized by a serrated edge, which is due to the overlapping of each anterior segment. The head is by no means large, and the suckers are slightly elongated.

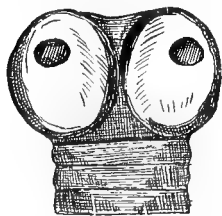


FIG. 20.—HEAD OF
TÆNIA DENTICULATA.

Symptoms.—The presence of tapeworms in the ox is seldom suspected until some have been passed with the fæces. If in large numbers, they may cause anæmia, loss of condition, depraved appetite, and diarrhœa. By coiling themselves together into a ball, they may cause intestinal obstruction.

Treatment.—As these worms are unarmed, vermicides and purgatives will remove them with little difficulty.

Lysol, turpentine, male-fern, areca-nut, given in linseed-oil, are quite efficient.

Arsenic, in doses of 10 grains daily, may be given to oxen for three or four consecutive days.

Strongylus Ventricosus.—This worm is the inhabitant of the small intestines of cattle and deer. It is a comparatively small worm, the female reaching only 12 millimetres in length, and the male 6 to 8 millimetres.

In the male there is a broad caudal pouch, which is not distinctly trilabiate.

In the female the vulva is situated just behind the middle of the body, and is surrounded by a pouch. Professor Penberthy has associated this worm with cases of parasitic gastro-enteritis in cattle and sheep, while other observers regard it as producing no ill-effects.

ŒSOPHAGOSTOMES.

Œsophagostomum Columbianum.—This parasite is the cause of the so-called “pimply gut,” which is more common in America. It is occasionally seen in this country, infection taking place through the spreading of manure brought from other countries.

The male is $\frac{1}{2}$ inch and the female $\frac{3}{4}$ inch long. The whole of the life-history is unknown.

The eggs are laid in the intestine, and pass out with the fæces.

The embryos are found in small tumours, from the size of a pin’s head to a pea, under the mucous membrane. They possess no boring apparatus, so that some doubt exists as to the precise manner in which they gain their position. In these nodules the embryo moults, and develops until it reaches about $\frac{1}{8}$ inch in length, when the nodules burst, and the worm is set free.

The intestines must not be used for preparing sausage-skins.

Œsophagostomum Inflatum is not so common.

STRONGYLES INHABITING THE ALIMENTARY CANAL OF CATTLE, SHEEP, AND DEER.

These are of especial importance, as they cause very serious wasting disease, accompanied by great mortality. The Strongyles inhabiting the stomach and intestine of ruminants are :

1. *Strongylus cervicornis*.
2. *Strongylus contortus*.
3. *Strongylus filicollis*.
4. *Strongylus vicarius*.
5. *Strongylus MacFadyensis*.
6. *Strongylus convolutus*.
7. *Strongylus gracilis*.

To detect the presence of these worms after death, the abomasum or a piece of intestine should be opened and emptied of its contents. A scraping of the mucous membrane should then be taken and mixed in a watch-glass with water, placed while in this receptacle on the stage of a microscope, and examined with a low-power objective. A magnification of $\times 50$ is ample. If the watch-glass is placed on a piece of black paper, in a good light, the parasites may be more readily discovered. In addition to the adult worms, ova and embryos may be discovered.

A brief description of the more important of the above-mentioned parasites will suffice.

Strongylus Cervicornis inhabits the abomasum of cattle and the intestine of sheep and lambs.

It causes great mortality—even as high as 20 per cent. Its colour is a greyish-white. The male is 7 millimetres long. It has a caudal bursa, supported by dichotomously branched chitinous rays. The female is 10 millimetres long.

Strongylus Contortus inhabits the abomasum of cattle and sheep. It is of a reddish colour, owing to the blood of its host contained within it.

The male is 10 to 20 millimetres in length, and the female 10 to 30 millimetres.

The male has a bilobed caudal bursa, with a small unilateral accessory lobe.

The oviducts of the female are contorted, and wound around the intestine.

Strongylus Filicollis inhabits the abomasum of cattle and sheep, and commonly the small intestine. The anterior portion is tapered into a neck.

It is smaller than *Strongylus contortus*.

Strongylus MacFadyensis is similar, but smaller.

Strongylus Convolutus inhabits the abomasum of cattle and sheep. The male has a bilobed caudal bursa, with four rays in each.

This worm lives coiled up in nodules in the mucous membrane.

Strongylus Gracilis affects cattle, sheep, horses, and pigs. It is dull white in colour. It possesses a tapered anterior extremity, like *Strongylus filicollis*, but is smaller.

The female is only 3 to 4 millimetres in length.

Symptoms.—Parasitic gastro-enteritis is more often seen in young animals, such as yearling cattle and lambs, especially when a wet winter follows a dry summer. It is characterized by progressive emaciation, diarrhoea, and anæmia.

Young cattle affected show all the symptoms of catarrhal gastritis and enteritis. Diarrhoea is a marked symptom, and wasting is very rapid. The fæces are watery, black, and fœtid. The animals refuse food, but exhibit great thirst, and show signs of stomach irritation, such as licking sand or soil. The temperature is elevated, and 105° or even 108° F. is by no means uncommon. The cattle appear tucked up and hidebound, and the mucous membranes are pale and anæmic. Finally, the temperature becomes subnormal, and death takes place from exhaustion.

The course of the disease is usually from one to three weeks, but may be only from one to three days.

In sheep the disease presents similar symptoms, but the mortality is even greater.

It is extremely common to find husk present at the same time.

Lesions.—On post-mortem examination, the mucous membranes of the abomasum and small intestine are found in a condition of catarrhal inflammation. Ulceration may be present, or the mucous membrane may be easily removed by slight friction. A submucous gelatinous exudate is commonly present.

The external mucous membranes are anæmic. Ascites is occasionally seen.

On making a microscopical examination, hundreds of Strongyles may be discovered.

Prognosis.—Animals badly affected with parasitic gastro-enteritis seldom recover unless treated, and even then with difficulty.

Prophylaxis.—The parasites which cause these symptoms must necessarily pass a certain period of their existence amid damp surroundings, and they undergo certain modifications outside the host.

All affected pastures should be drained, salted, limed, or ploughed. If possible, they should be kept free from cattle. Overcrowding must be avoided, and lambs and yearlings should be well fed and kept in good condition, in order that they may withstand the attacks of Strongyles. As preventives, salt and general tonics may be given in the food. Lambs must never be placed on affected ground after adult sheep, as the latter may act as a host and yet be unaffected, and may pass the disease on to younger animals, with disastrous results.

Treatment.—Affected animals should be isolated, and the whole herd or flock dosed, as a preventive measure, three times, at intervals of three days.

The following drench is suitable for lambs :

℞	Ol. tereb.	..	..	..	..	ʒj.
	Chloroformi	}	..	..	..	āā ℥x.
	Lysol					

M. Fiat haust. Sig. : To be given in milk.

Picrate of potash, up to 5 grains per lamb, is also very successful.

In cattle lysol has proved most useful. As a preliminary 4 drachms may be given, either by bottle or probang.

Professor Penberthy recommends the following :

℞	Lysol	..	..	..	..	ʒij.
	Chloroformi	..	..	..	..	ʒij.
	Ol. tereb.	..	..	..	..	ʒj.ss.

M. Fiat haust.

This should be followed by tonics and anthelmintics, such as iron, salt, bitters, as gentian or asafoetida.

Trichocephalus Affinis.—This worm inhabits the cæcum of the sheep, goat, and ox. It belongs to the Trichotrachelidæ, and is characterized by the cephalic extremity being drawn out into a thread. It is thus exactly opposite to *Oxyuris curvula*, in which the caudal extremity is filiform. The anus is terminal. The worm attaches itself by its head, and rolls the remainder of its body spirally into a ball. The male has a genital spicule, and the length ranges from 6 to 8 millimetres.

There is no intermediate host required in the life-history of this parasite. The whole cycle is completed in a little over a fortnight.

Symptoms.—These worms are seldom the cause of serious trouble in cattle, unless present in very large numbers. In sheep they often set up muco-enteritis. Occasionally they are seen in emaciated, anæmic cattle, which are also probably the host of numerous other varieties of parasites.

Treatment.—If detected in the fæces, purgatives or a course of astringent tonics, such as ferri sulph., will be sufficient.

The only other parasite worthy of note as being found in the large intestine is *Amphistomum tuberculatum*. This is, however, very unimportant.

Protozoa inhabiting the Intestine.

As this volume is intended only to give a description of the macro-parasites, it is only necessary to give a brief account of the Coccidia and the disease (psoro-

spermosis) which they produce. *Coccidium Zurni* is responsible for outbreaks of dysentery in young cattle and lambs, while *Coccidium oviforme* produces similar symptoms in rabbits. Sir John MacFadyean found Coccidia in cattle indistinguishable from *Coccidium oviforme*. The Coccidia are ovoid in shape, and possess an outer envelope, which gives the parasite a double contour when examined microscopically.

The contents of the capsule or envelope are granular, and may assume various forms and positions, according to the stage of development.

The length is 18 to 25 μ , and width about 13 μ . Desiccation destroys the Coccidia, and they are therefore prevalent on low-lying, marshy ground.

Symptoms.—At first the animals void greenish-black, foetid, liquid fæces, and there is no straining and little constitutional disturbance. In a few days this gives way to dysentery, with a large proportion of blood mixed with the fæces. The animals now appear distressed, strain forcibly for some minutes after defæcation, arch the back, and may show colic. There is loss of appetite and absence of thirst, and emaciation sets in very rapidly. The course of the disease lasts about a week. Mortality may be anywhere from 10 to 25 per cent.

Lesions.—These are present in the whole length of the large intestine. The bowel is empty, the mucous membrane inflamed and discoloured, thickened and ridged, and shows areas coated with a thick tenacious layer of mucus. On removing this, the mucous membrane beneath appears whitish and shows depressed ulcers.

On microscopical examination of a section the parasites are seen to have invaded the crypts of Lieberkühn, and to be present both in the lumen of the ducts and in the cells themselves. The interglandular connective tissue is infiltrated and thickened.

Treatment.—Prophylaxis consists in draining the land. All fæces from affected animals should be disinfected and destroyed. Fields in which the disease exists should be avoided during the hottest months of the year.

Therapeutic treatment consists in giving internal antiseptics, as lysol, creolin, salol, etc., together with alkalis and mild astringents, given in mucilaginous drinks.

An ample supply of concentrated, easily digestible nourishment is essential.

Tapeworms in Sheep.

These are very common, and the sheep, next to the dog, is the most frequently infested of the domesticated animals.

As in the ox, there may be present :

1. *Tænia expansa*.
2. *Tænia alba*.
3. *Tænia denticulata* ; sometimes spoken of as *Tænia ovilla*.
4. *Tænia fimbriata*, or *Thysanosomum actinioides*.

Thysanosomum Actinioides. — This parasite is also spoken of as the fringed tapeworm, as the posterior edge of each segment is quite visibly serrated. The genital pore is double in each segment.

The head is quite distinctive. It carries four slit-like suckers, placed exactly at the four corners.

Symptoms.—This disease in sheep is very prevalent and of great importance in North America. In September and November the lambs fail to make the progress they should do. Catarrhal enteritis sets in, as a result of irritation, and the worms invade the bile-ducts. Jaundice results, and the infected lambs are small, dropsical, and badly nourished.

Treatment.—Arsenic, 3 grains, with areca-nut, 15 grains, should be given once daily for a week, and followed by a purgative. Potassium picrate, 10 to 20 grains, once daily, or naphthalin, 20 grains, may be used. Other agents used are kamala, 1 drachm, twice

daily, male-fern, and lysol.

Lambs should be kept off infected pastures, and these should be drained and dressed with sulphate of iron, lime, or salt.

Ascaris Ovis.—One or two cases have been recorded, but the parasite is rare.

Sclerostomum Hypostomum.—This parasite is an inhabitant of the large intestine of the sheep and goat.

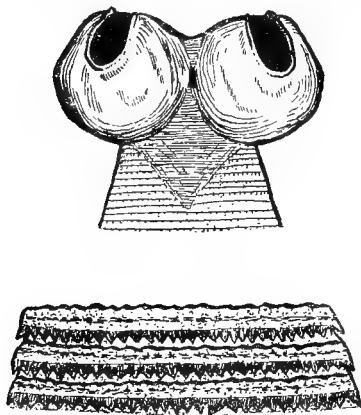


FIG. 21.—HEAD AND SEGMENTS OF TÆNIA FIMBRIATA.

It lives in small nodules in the mucous membrane. Its length is 1 inch (female); the male is smaller. The body is stiff and white, and the head is rounded, but is obliquely cut off on one side. The mouth is armed with teeth.

Symptoms.—Anæmia, gastro-enteritis, and dysentery. On the whole, the symptoms resemble almost precisely those produced by Sclerostomes in the horse.

The mucous membrane of the intestine is chocolate-coloured, and shows nodules. Many cases prove fatal.

Treatment.—Thymol, turpentine, and linseed-oil; lysol, salol, etc., may be used.

PARASITES INHABITING THE ALIMENTARY CANAL OF THE PIG.

In the œsophagus *Ganglyonema scutatum* may be found.

Small Intestine.

Echinorhyncus Gigas.—This worm belongs to the Acanthocephala, or thorn-headed worms. It is cylindrical in shape, and of comparatively large size. The male reaches 10 centimetres in length, while the female ranges from 30 to 40 centimetres.

The head carries a retractile proboscis, armed with a large number of hooks, arranged in transverse rows. The body is greyish in colour and of variable diameter throughout its length.

The male possesses a bell-shaped caudal pouch, while in the female the caudal extremity is blunt and rounded. The life-history has not been clearly demonstrated, but it appears that after the ova, which are elliptical in shape, have left the pig, the immature embryos are ingested, while contained in the larvæ of insects; as in the May-bug, cockchafer, or even in the bodies of certain snails.

The worms may be free in the intestine, but usually are attached by the head, which is buried in the mucous membranes. Sometimes the worm bores deeply into the mucous membrane, and on being removed leaves a scar. Perforation, with subsequent traumatic peritonitis, is not rare.

These worms are not common in the United Kingdom, but are of very frequent occurrence in France, Germany, and the United States.

Symptoms.—These vary according to the number of

worms present. If they are but few in number, the symptoms may be nil. If present in large numbers, there is anorexia and constipation, with a varying degree of colic, signs of irritation, such as rubbing on the ground or biting at the hind-quarters, together with epileptiform convulsions, spasms, and twitching. These symptoms are accompanied by progressive emaciation.

Post-mortem Appearances.—When badly infested, the piece of intestine, when grasped in the hand, feels as though it were filled with a number of large shot, while small centres of suppuration may frequently be seen on looking through the serous surface. These have the head of the worm in the centre. The remainder of the mucous membrane may present the usual appearance of catarrhal inflammation. Ulcers are common, and they may reach, or even perforate, the serous coat.

Treatment.—Ordinary vermicial treatment may be employed when the number of parasites present is small. When complications ensue special treatment must be resorted to.

As a vermicide, ol. tereb. is useful in 2-drachm doses, given in milk. Aperients should also be given. Aloes, 1 drachm, is probably the best.

Ascaris Suis.—This large worm inhabits the intestine of the pig. In appearance it much resembles the *Ascaris lumbricoides* of man, and often reaches a length of 10 inches.

It is not very common, and may produce no very marked symptoms. If present in large numbers, the worms may cause intestinal obstruction, with colic. Epileptiform spasms and convulsions have also been noted.

Treatment.—Santonin or areca-nut is usually efficacious, and should be followed by a purgative.

The *Tænia* are not represented in the intestine of the pig.

A whip-worm, *Trichocephalus crenatus*, is occasionally present.

INTESTINAL PARASITES OF THE DOG AND CAT.

Ollulanus Tricuspis is sometimes found in the œsophagus of the cat.

Stomach.

Spiroptera Sanguinolenta.—These worms may occur in the pharynx, œsophagus, and stomach of the dog, where they form clusters of nodules. They are more common in Italy than in any other country, and there they cause in the host a form of gastritis. They frequently penetrate to the bronchial glands, causing hypertrophy, with suppuration. They have been seen in the walls of the aorta.

Spiroptera sanguinolenta is a blood-red worm. The female measures 6 to 8 centimetres, and the male about half that length. The so-called "blackbeetle" is believed to act as an intermediate host in the life-cycle of this parasite.

Ollulanus Tricuspis is found in the œsophagus of the cat.

Intestine.

Protozoa, as *Coccidium bigeminum*, may exist between the villi, but the symptoms they set up are usually slight.

CESTODA OF THE DOG.

Next to the sheep, the dog is, of all the domesticated animals, the most frequently infested with tapeworms.

The *Tæniæ* found in the dog are eight in number,

and there may also be present three *Bothriocephalidæ*.

Six <i>Cystotæniæ</i>	..	<i>Tænia serrata</i> . <i>Tænia marginata</i> . <i>Tænia echinococcus</i> . <i>Tænia serialis</i> . <i>Tænia cœnurus</i> . <i>Tænia Krabbei</i> .
One <i>Dipylidium</i>	..	<i>Dipylidium caninum</i> , or <i>Tænia cucumerina</i> .
One <i>Mesocestoides</i>	..	<i>Mesocestoides lineatus</i> .
Three <i>Bothriocephalidæ</i>	{	<i>Bothriocephalus latus</i> (Europe). <i>Bothriocephalus cordatus</i> (Greenland). <i>Bothriocephalus fuscus</i> (Iceland).

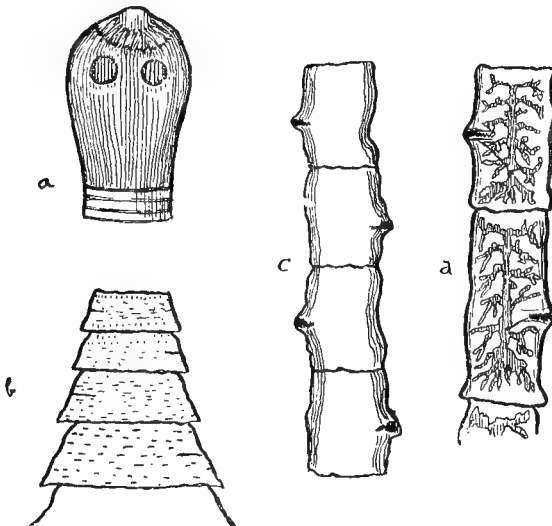


FIG. 22.—*TÆNIA SERRATA*.

a, Head ; *b*, *c*, *d*, segments.

Life-History.—All the Cestoda are hermaphrodite, but fertilization nevertheless takes place. Either by rupture of the proglottis or by extrusion through the genital pores, the ova are liberated, and hatch into

embryos, all of which are armed with three pairs of hooks.

The embryo of each variety of tapeworm requires a special host, and in the event of being unable to find this it dies. When ingested, it is carried by the blood-stream to some organ, such as the liver, or even to the brain in some cases, and becomes encysted. The *Dipylidium* found in the dog is interesting, as the intermediate host is an invertebrate, as a louse or flea.

The cysts just mentioned are not all alike. There are three varieties: *Cysticercus*, *Cœnurus*, and *Echinococcus*.

In *Cysticercus* the cyst has only one cavity, and contains only one head, or scolex, attached to its inner wall—*i.e.*, it is monosomatic and monocephalic.

In *Cœnurus* the cyst is multilocular, and each loculus contains one scolex—*i.e.*, it is polysomatic and monocephalic.

In *Echinococcus* the cyst is multilocular, and each loculus contains several scolices—*i.e.*, it is polysomatic and polycephalic.

The whole cycle may take from two to eight months.

Tænia Serrata.—This is one of the commonest tapeworms found in the dog. The length varies from 1 inch to 6 feet. The head is a little wider than the neck, and is armed with from thirty to forty hooks, which are of two classes, large and small. The latter possess a bifid guard. The segments are much longer than wide, and the posterior edges are widest, making a serrated edge. The genital pores are characteristic. They are arranged on alternate sides, and each is very

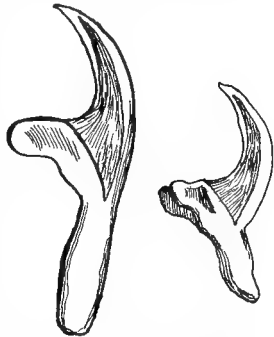


FIG. 23.—TÆNIA SERRATA:
HOOKS.

prominent and forms a marked convexity. The uterus is a long median tube, and has a number of lateral branches, which are given off after the manner of an umbel.

The cystic stage takes the form of a *Cysticercus*, the *Cysticercus pisiformis*, which is found attached to the mesentery of rabbits or situated in some other portion of the peritoneal cavity.

The *Cysticercus pisiformis* is of the size and shape of a pea, and shows on inspection the invaginated head, which exactly corresponds in structure with that of *Tænia serrata*. Occasionally a *Cysticercus pisiformis* is found elongated in shape, and even a few segments may be present behind the head.

A dog may become infected by ingestion of the cysts, eight to ten days after desiccation. The cycle is complete in eight weeks, when the dog will be voiding ripe segments and ova.

Tænia Marginata.—This is also a fairly common parasite of the dog's intestine. It is a large worm, and is only with difficulty to be distinguished from *Tænia serrata*. Its length is from 4 to 6 feet.

The head is not wider than the neck, and so does not project on either side. It carries from thirty to forty-four hooks. In *Tænia marginata* the guards of the hooks are not bifid, as in *Tænia serrata*, but S-shaped. The segments of the anterior portion are much broader than long, but in the terminal half the reverse is the case, though even then they are broader and shorter than those of *Tænia serrata*, and the posterior border of each segment shows a somewhat wavy outline. The genital pore is much less prominent, and the outline is therefore more regular.

The cystic form is a *Cysticercus*, the *Cysticercus tenuicollis*, which is found in the peritoneal cavity, and occasionally in the thorax of sheep, oxen, and some-

times in pigs. The *Cysticercus* may be the size of a pigeon's or hen's egg, and is pedunculated, possessing a long, narrow neck or stalk, by which it is attached. This parasite has been responsible for fatal outbreaks of hæmorrhagic hepatitis in lambs, owing to migration from the intestine, through the bloodvessels and liver, into the peritoneal cavity. The occasional presence of

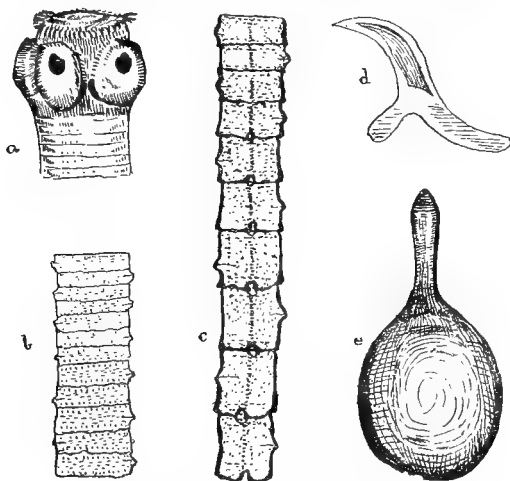


FIG. 24.—*TÆNIA MARGINATA*.

a, Head; *b*, unripe segments; *c*, ripe segments; *d*, hook; *e*, *Cysticercus tenuicollis*.

small cysts in the muscles of the sheep has given rise to the term "pseudo-measles of the sheep."

In pigs a similar condition is seen, particularly affecting the muscular pillars of the diaphragm.

***Tænia Echinococcus*.**—This is the smallest tapeworm of the dog, and never exceeds four segments. The head is armed with a double row of hooks, by means of which the parasite attaches itself to the mucous membrane

of the intestine. In other cases the worms lie free in the bowel lumen. In length it ranges from $\frac{1}{4}$ to 1 inch. The terminal segment is by far the largest, and contains the mature ova.

The cystic form is the *Echinococcus veterinorum*, which may be found in various organs of the body—liver, lungs, ovaries, etc.—in cattle, pigs, and other animals.

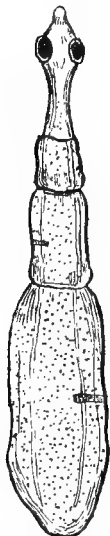


FIG. 25.—TÆNIA
ECHINOCOCCUS.

The cysts may be single or multilocular, and may be few in number or present in sufficient quantity to completely deform the organ in which they are contained. Their contents consist of clear, limpid fluid.

A cyst-infested liver in the ox may weigh 100 pounds.

Tænia Serialis.—This worm seldom exceeds 2 feet in length, and is not very commonly found.

The head carries twenty-five to thirty hooks, the smaller ones having bifid guards. The segments are long and narrow. The intermediate host is a rodent, such as a rabbit or hare, and the *Cœnurus* is found attached to connective tissue, often between the muscles, or occasionally in the brain.

Unlike *Cœnurus cerebralis*, this cyst frequently buds off internal or external daughter cysts, containing numerous scolices. This cyst does not produce gid in sheep, even when attempted experimentally.

Tænia Cœnurus.—In length this worm seldom exceeds 1 yard. It is not common. The head bears twenty to thirty hooks. The segments are very much wider than long, and much resemble those of *Tænia serialis*. The uterus gives off about twenty ramifying branches.

The cystic form is *Cœnurus cerebralis*, which develops under the dura mater of the sheep's brain, and occasionally of cattle, and in rare instances that of the horse, producing the so-called sturdy, or gid.

The *Cœnurus cerebralis* sometimes attains a comparatively large size : cysts of the volume of a hen's egg are not uncommonly met with. The contents are limpid and colourless. The surface shows scattered clusters of dense white spots, representing invaginated scolices.

The ova or terminal segments of *Tænia cœnurus* are ingested by a lamb, and the outer coverings become dissolved in the stomach. The embryos are set free, and bore into a small vessel, whence they are carried to various organs of the body. Those which reach the brain gradually develop into *Cœnurus* cysts.

They have also been described as occurring in other organs and tissues.

Tænia Krabbei.—Not found in this country. Segments wider than long. Genital pore occupies the whole of the lateral edge of each segment.

The cystic form is a *Cysticercus*, and has been seen in the muscular tissues of reindeer.

Tænia Cucumerina, or Dipylidium Caninum.—This worm, as its less common name indicates, is a *Dipylidium*, having its genital pores situated on each side of each segment. It is about 16 inches in length, and is a very common inhabitant of the dog's intestine. The head is larger than the neck, rounder in shape, and bears a protractile rostellum, armed with several rows of hooks.

The segments are elliptical in shape, and resemble cucumber-seeds joined end to end. The cystic stage is passed in one of the external parasites of the dog, such as the flea or louse.

Bothriocephalus Latus is unarmed, having no hooks. The genital pores are central in each segment.

The length varies from 10 to 20 yards. The head is lanceolate in shape, and in place of suckers carries two long canals, or bothria. The segments are much wider than long. When ripe, the terminal segments shrivel and remain attached for a while. They are practically empty of ova. In this worm actual ovulation takes place, the eggs being extruded from the central opening.

The intermediate host is a perch or pike. This worm

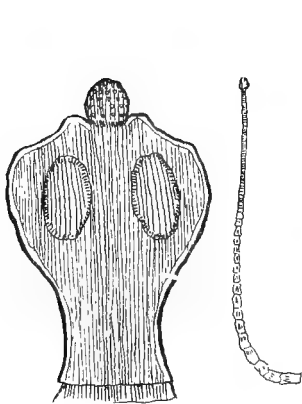


FIG. 26.—*TÆNIA CUCUMERINA*.

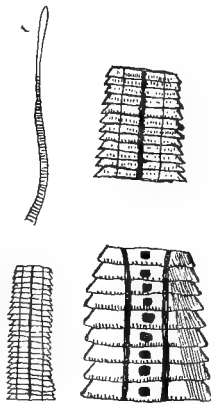


FIG. 27.—*BOTHRIO-
CEPHALUS LATUS*.

may inhabit the intestine of man or the dog in countries where sanitation is neglected and sewage drains into lakes or rivers.

Mesocestoides Lineatus also has the suckers centrally placed in each segment. It is much shorter, only averaging 18 inches in length. The segments resemble those of *Tænia cucumerina*. Instead of bothridia, *Mesocestoides lineatus* has four ordinary suckers, opening by slits.

Life-history not fully worked out.

Tapeworms in the Cat.

There are four tapeworms which may be found in the cat.

These are :

1. *Dipylidium*, *Tænia elliptica*.
2. *Tænia crassicollis*.
3. *Mesocestoides lineatus*.
4. *Bothriocephalus felis* (very rare).

Tænia Elliptica.—This worm is practically identical with *Tænia cucumerina* of the dog.

Tænia Crassicollis.—This worm is peculiar to the cat. It is a comparatively short worm, seldom exceeding 2 feet in length, and more commonly only reaching 5 or 6 inches. The head is rounded and of the same diameter as the neck. It possesses four suckers, and a rostellum carrying thirty to fifty hooks, arranged in a double row. The terminal segments are longer than wide. The cystic form is the *Cysticercus fasciolaris*, which occurs in rats, mice, and other rodents, more commonly situated in the liver. This *Cysticercus* possesses several interesting characters. In length it may reach 6 inches, and may thus be mistaken for the mature form of some parasite. The head is invaginated, and is succeeded by a number of segments, and at the other extremity there is a small bladder, with the diameter of a pea.

Mesocestoides Lineatus.—Probably is identical with the *Mesocestoides* found in the dog.

Signs of Tapeworms.—These are often absent, except when the worms are present in considerable numbers. The signs then noticeable are capricious appetite, at times ravenous, with loss of weight, staring coat, signs of irritation, such as drawing the anus along the ground and barking or yelling during sleep. In some in-

stances the dog will betray signs of excitement, and even mania, and act as though hunting imaginary mice, and scraping at floors and boarding. Epileptiform fits and convulsions are common.

Occasionally the symptoms are such as to cause one to suspect rabies. These are excitement, epileptic fits, and paralysis of the lower jaw, followed by periods of depression. Continual snapping together of the jaws is not uncommon.

On post-mortem examination in badly infested intestines the lesions discernible are those of chronic catarrh of the bowels, together with the presence of tapeworms, chiefly in the ileum and jejunum.

Treatment.—The agents now in general use in canine practice are various preparations of areca-nut. The dry extract, dissolved in glycerin, is most efficacious. All remedies must be given fasting, and preferably in a small quantity of milk.

Extract of male-fern ranks next, in doses of 10 to 80 grains.

Grated areca-nut, 2 grains per pound body-weight up to 2 drachms, is a favourite remedy.

Calomel, kamala, kousso, creolin, ol. tereb., and various other agents, each have their supporters.

Ascarides.

In the dog: *Ascaris marginata*.

In the cat: *Ascaris mystax*.

Ascaris Marginata is a frequent inhabitant of the small intestine of dogs, and particularly of puppies. Length, 1 to 5 inches.

The body is cylindrical, stiff, and curved. The head bears two membranous wings. In the male the tail curves sharply upwards and carries two smaller wings.

Ingestion of ova is the means of infection. Pups

are frequently born with *Ascarides*, though no satisfactory explanation is forthcoming. Pups, when affected, show a harsh, staring coat, pot-belly, capricious appetite, and often intermittent diarrhoea and vomiting. The vomit occasionally contains one or more *Ascarides*. Nervous symptoms are usually in evidence when the number of *Ascarides* present is large. These are represented by twitching of groups of muscles and epileptiform convulsions. Death in pups from these parasites is quite common. Incontinence of urine is another frequent symptom.

We have seen several cases of intestinal intussusception due to *Ascarides*.

In older dogs the symptoms are less pronounced, though nervous symptoms are not uncommon.

Treatment.—Santonin is considered a specific, but must be used with caution. Pups should receive $\frac{1}{2}$ to 2 grains, with 2 to 5 grains calomel.

Syrup. ferri iod., given daily for a week, is much safer and quite as efficacious.

Older dogs may receive santonin, 2 to 5 grains, according to weight and breed.

Ext. filix mas and grated areca-nut are also used.

Ascaris Mystax resembles *Ascaris marginata*, but is smaller, and the wings on either side of the head are quite easily visible to the naked eye.

Symptoms and Treatment.—As in the dog.

Ankylostomum Trigocephalum.—This worm is sometimes found in the small intestine of the dog and cat.

It ranges from $\frac{1}{2}$ to $\frac{4}{5}$ inch in length, and is usually reddish in colour, from ingested blood. The caudal pouch of the male consists of two large lateral lobes and a small median lobe. The mouth is chitinous, with three hooked teeth at either side of the ventral border and one straight tooth at either side of the dorsal border.

In both sexes there is a right-angled bend close behind the head.

Symptoms.—Debility, weakness, and general signs of pernicious anæmia are present.

The skin becomes scurfy, and ulcers arise on the skin of the limbs, which is often œdematous. The nose becomes excoriated, cracked, and sore.

Epistaxis sets in in the later stage, and several ounces of blood may be lost at one time.

Diarrhœa becomes persistent, and leads to dysentery. Finally the animals grow very weak, constantly lie about, and finally become comatose and die.

A whole kennel may be affected at one time, and the disease is common in packs of hounds in some countries.

On post-mortem examination, after careful search the worms may be discovered. The mucous membrane is thickened, raised, and red in patches, and shows petechiæ.

There is usually marked enlargement of the mesenteric lymphatic glands.

Treatment.—This form of helminthiasis spreads rapidly, so that isolation of affected animals is essential. Sanitation must be improved, and great care taken in the cleansing of all feeding utensils.

The usual anthelmintics may be employed.

Filix mas or kamala, with calomel, are useful.

After expulsion of the worms, a course of syrup. ferri iod. or ferri arsenas should be given. Syr. Eastonii might be useful.

Above all, nourishing, easily digestible food is essential.

CHAPTER III

PARASITES WHICH INVADE THE LIVER

THERE are two channels by which parasites, in some stage of their life-history, may reach the liver. The easiest way is by passing from the duodenum up the bile-ducts, while the other is by boring through the intestinal wall into one of the branches of the portal system, and so being carried thither in the blood-stream. By the first route blocking of the bile-ducts is common, and this is accompanied by symptoms of jaundice and in chronic cases ascites.

The parasites which may invade the liver are :

1. *Linguatula denticulatum*.
2. Coccidia.
3. Cystic forms of tapeworms.
4. Trematodes.

1. **Linguatula Denticulata.**—This is the larval form of *Linguatula tænoides* of the dog, encysted in the liver of one of the Herbivora. It possesses four pairs of rudimentary legs, and after going through a moult becomes annulated, the rings possessing series of spines, resembling those on a bot. They remain in the liver several months.

They may also be found in the mesenteric glands or even in the lung.

2. **Coccidia in the Liver.**—*Coccidium oviforme* may affect calves, lambs, young pigs, etc.

The *Coccidium cuniculi* of the rabbit is identical, and these rodents act as harbourers and carriers of the parasite.

3. **Tænia Cysts in the Liver.**—Tænia may be present in the liver, as embryos passing through on the way to the peritoneum or encysted therein. Of the former *Cysticercus pisiformis* may be taken as an example. These cysts invade the liver of rabbits in the form of miliary nodules, greyish in colour, with thick envelopes, quite distinct from the thin walls of the *Coccidium* cysts.

They remain in the liver from three to four weeks before escaping into the peritoneal cavity.

Echinococcus Veterinorum.—This is the cystic stage of *Tænia echinococcus* of the dog, and is common in the liver of the ox, sheep, pig, and many wild animals. It may also occur in the lungs, heart, kidneys, and brain, in the intermuscular connective tissue, or in almost any organ or tissue.

The cyst takes six months to fully develop, and may range in size from a pea to a pumpkin. It possesses two layers—an outer thick envelope, known as the ectocyst, and an inner thin layer, the endocyst. The fluid contained is clear and serous, but free from albumin. Many are sterile, and contain no scolices.

Echinococcus cysts may be single or multiple, from external or internal budding. The latter method is commoner in man than in the Herbivora.

A liver thus infested is more or less enlarged, according to the number of cysts present. A hundredweight is not an uncommon weight for a badly affected ox-liver, and in this there may be present several thousand cysts. A pig's liver may reach half this weight. The liver in these advanced cases is usually found firmly adherent to the neighbouring organs, such as the intestines, or to the diaphragm or omentum. On section the tissues may appear to be one mass of cells, resembling a honey-

comb, or may contain only a few cavities of varying size. The portions of liver between the cysts become atrophied from pressure. Old cysts may show signs of calcification, with pus in the centre.

These must not be mistaken for lesions of tuberculosis, and may be distinguished by the discovery of scolices on microscopical examination, by the existence of vestiges of the envelopes in the calcified cysts, and by the absence of tubercle bacilli.

Symptoms.—Often there are no apparent symptoms. When in sufficient numbers to cause marked enlargement of the liver, percussion in the neighbourhood of the last two ribs on the right side will often assist diagnosis. On palpation pain may be evinced. Digestion is disturbed and emaciation becomes marked. Jaundice is seldom exhibited. Diarrhoea is not uncommon. On rectal examination the liver may be found enlarged and lumpy.

Treatment.—Useless. Slaughter when the diagnosis is confirmed is the most economical course if the number of cysts in any one organ is great.

DISTOMIASIS (FLUKE DISEASE, FASCIOLIASIS, LIVER ROT, ETC.).

Distomiasis is the name given to the condition arising from the existence of Distomata, or flukes, in the bile-ducts of the liver. It affects oxen, sheep, and goats. There are two species which may set up the condition—viz., *Distomum hepaticum* and *Distomum lanceolatum*.

Distomum Hepaticum.—The parasite is leaf-shaped and of a dirty white colour. In length it varies from 20 to 30 millimetres, and in width from 10 to 15 millimetres. The anterior extremity is more or less rounded, except at the extreme tip, which is drawn out into a short

projection, on which is situated the oval sucker. The posterior extremity tapers almost to a point. The suckers are two in number—an oval sucker, rounded in outline, and a ventral sucker, situated about 3 millimetres behind it, which is larger and triangular. The alimentary organs, which are visible when the parasite is held between the eye and the light, consist of two main lateral branches, from which arises on either side a much-branched system. The parasite is hermaphrodite.

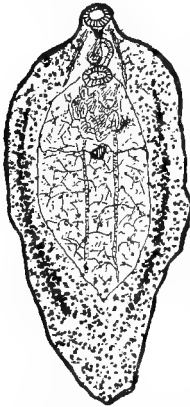


FIG. 28.—*DISTOMUM HEPATICUM*: LIVER FLUKE.

The testicles are profusely branched, and occupy the middle third of the body. The uterus is situated immediately behind the ventral sucker, and opens by a short vagina on the ventral surface of the body, between the oval and the ventral suckers.

Distomum Lanceolatum is not found in this country. It is narrower than *Distomum hepaticum*, and the two lateral alimentary canals are unbranched. Its life-history has not yet been worked out. Probably it is similar in most respects to that of *Distomum hepaticum*.

Life-History of Distomum Hepaticum.—*Distomum hepaticum* is subject

to an alteration of generations, involving a change of hosts.

In the bile-ducts the adult parasite fertilizes itself, or a cross-fertilization is brought about by the union of two individuals. As a result, in spring or early summer the worm migrates towards the intestine, and deposits its eggs either in the bile-ducts themselves or in the intestine. In size these vary from 20 to 80 μ . They are oval in shape, and provided with an operculum,

or lid. They consist of a germ cell and a number of vitelline or yolk cells of granular consistence, destined to provide food for the developing germ cell. These pass out with the bile, and are expelled from the animal's body with the fæces. For their further development it is essential that they should fall upon or be carried to damp or marshy ground, otherwise they undergo desiccation and die.

Incubation takes place in from one to three months, according to the weather and other conditions. Each ovum hatches out into what is known as a Miracidium, or ciliated embryo, from the cilia which surround it. This organism is somewhat pear-shaped, and is provided at its anterior extremity with a prominence—really a boring apparatus.

It now swims freely in water till it finds a small fresh-water snail known as *Limnæa trunculata*. This snail has a spiral grey shell, and is from $\frac{1}{4}$ inch to $\frac{1}{2}$ inch in diameter, and about the same from base to apex. It is not found in Australia, although fluke disease abounds in that country. Probably another intermediate host is present there.

The ciliated embryo now attaches itself to the soft parts of the body of the snail, and finally reaches the lung. The organism then loses its cilia, becomes shortened, and finally becomes encysted in the snail as the sporocyst.

The sporocyst contains masses of germ cells, each clump of which develops into an organism known as the Redia. This, too, contains a number of germ cells, and possesses a mouth and a blind tube representing the intestine. It wanders to the liver of the snail, where its germ cells develop into about twenty Cercariæ, which are nearest in structure to the adult parasite. The body is made up of an egg-shaped, flat anterior portion, and a tail posteriorly situated. The two suckers are

present as in the adult, and there is a simple alimentary tract. The *Cercaria* passes out of the *Redia*, and after a short period leaves the snail and swims about in moisture. It next attaches itself to a blade of grass or some other object, loses its tail, and secretes a covering round itself, thus becoming encysted. It is swallowed by an animal, and providing that this be one suitable for its further development, it loses its leathery coat, passes up the bile-ducts (or, according to some authorities, the portal veins), and reaches the liver, where it becomes adult.

Occasionally they may reach the lungs, where they form cysts containing flukes floating in a brownish fluid. Other parts of the body may be similarly invaded.

Occurrence and Symptoms.—Fluke disease occurs in sheep and cattle kept on marshes or in damp surroundings suitable for the development of the snail which acts as intermediate host. The embryos reach the liver during the last few months of the year, and at first cause few or no symptoms. The appetite remains unchanged, but there may be a little falling off in condition and slight dulness. In other cases death may occur from hepatitis, or from embryos, carried by the bloodstream, being deposited in organs such as the heart or brain. After a few weeks the sheep again regain condition, and for a short while appear to be putting on flesh. In many parts of the country it is the practice to run the sheep on fluky ground in order to fatten them more quickly for the butcher. This flesh-forming period is only of short duration, and the symptoms now become more marked. The wool becomes dry and loose in parts, emaciation sets in, and the appetite is capricious, while great thirst is a constant feature. Ascites, with œdema of the dewlap and submaxillary space, now appears, and the affected sheep show dyspnoea and inability to travel fast. The subcu-

taneous tissue over the lumbar region and over the rump becomes œdematous and flabby to the touch. The eyes have a peculiar watery appearance, with œdema of the lids. Symptoms of jaundice may be apparent, arising from blocking of the bile-ducts. Ova may be found in the fæces. Death is by no means uncommon at this period.

About the end of January the symptoms become even more apparent, and appetite practically disappears. Œdema may now be almost entirely localized to the submaxillary space, and this is marked when the animal is grazing, but almost entirely disappears after a journey.

Diarrhœa now sets in. Anæmia is extremely marked, and the number of red corpuscles present in the blood is enormously reduced. Ewes in lamb often abort about this time.

Death may now greatly reduce the flock, but a number of the strongest and best-conditioned animals survive, and in these, about March or April, the parasites leave the liver and pass out with the fæces.

In oxen the symptoms are similar, but are not usually so severe. In these animals the disease may last for years.

Post-mortem Lesions.—The chief changes are seen in the liver itself, particularly in the bile-ducts. These show chronic inflammatory changes in the form of thickening of the walls, owing to the deposition of fresh connective tissue. It is not uncommon to find bile-ducts so distended as to reach $\frac{1}{2}$ inch in thickness. Those nearer the surface cause projection of the capsule of the liver in the form of grey ridges, easily discernible before the liver is cut. As a result the liver tissue atrophies and becomes fatty. The bile-ducts contain a quantity of dark-coloured bile, often gritty, and, on squeezing, flukes may emerge. Adhesion of the visceral and serous layers of the peritoneum is common, while

in the liver it is probable that the flukes live principally on blood.

Ascites and emaciation may be visible on post-mortem examination, and there may be submaxillary œdema or œdema of the dewlap.

Treatment.—There is no treatment of much use, as no anthelmintic has been discovered that will destroy parasites within the bile-ducts.

The best course is to fatten sheep that are kept on infected land as quickly as possible. Volatile oils have been recommended.

The following is a favourite prescription :

R̄	Ferri sulph.	..	..	..	..	ʒj.
	Sodii chlorid.	..	..	..	..	ʒij.
	Bacc. junip.	..	..	..	..	ʒx.
	Pulv. gentian	..	..	..	..	lb. i.
	Oatmeal	..	..	..	..	ad lb. xxv.

Half a pound of this mixture should be fed to each sheep once daily.

Prophylaxis.—This is of the greatest importance on those lands in which the disease is prevalent.

The most effectual means of prevention consists in draining all low, marshy fields, and afterwards dressing with sulphate of iron, salt, or lime. From about 2 to 3 hundredweight per acre is necessary. From May to September is the best time of the year in which to dress the land.

Rock-salt should be provided for the sheep to lick. In many parts of the country aromatic shrubs are added to the food during autumn and winter. The commonest are broom, willow, birch, and juniper.

Raised drinking-troughs are sometimes of assistance.

Care must be taken not to infect land not already fluky. Dogs, hares, rabbits, and other animals, may carry infection. In the dog, eggs may pass uninjured from a piece of ingested liver out on to fresh pastures.

As previously stated, if it is impossible to keep sheep on any other land than that infested with flukes, it is the best course to fatten them off as quickly as possible.

Distomiasis in Other Animals.

The liver of the horse may occasionally be affected.

Distomum truncatum and *Distomum albidum* affect the liver of the dog, and *Distomum felineum* affects the liver of the cat in some countries, notably in Holland and India. *Distomum heterophyes* affects dogs in Japan.

Monostomum hepaticum affects swine.

CHAPTER IV

PARASITES OF THE RESPIRATORY TRACT

NOSE.

COCCIDIA sometimes set up nasal catarrh in rabbits.

Linguatula Tænioides.—This is a degenerate member of the Arachnida. As the name indicates, the body is elongated, ringed, and worm-like. The anterior extremity is broad and rounded in shape, and scarcely distinguishable from the thorax and abdomen. Legs are absent, with the exception of vestiges in the form of two hooks, which curve backwards at each side of the mouth, and which can be protruded or retracted at will through slit-like openings. The mouth is surrounded by a ring of chitin.

The male is small, being usually under 1 inch in length, and white in colour.

The female may measure 5 inches in length, and is greyish or sometimes almost yellow. It is quite common to find the parasite rolled up.

LIFE-HISTORY.—The female deposits eggs in the nasal cavities, from which they escape by the nasal discharge. If they happen to fall on grass or fodder, they may be ingested by another animal, and providing that animal be one suitable for their further development (ox, sheep, rabbit, sometimes a horse), on reaching the stomach or intestine they hatch out into larvæ. They bore through the intestinal wall into the liver or mesenteric glands, and become encysted there. They

then moult and develop rings, each ring bearing a number of short spines. At this stage the parasite is spoken of as *Linguatula denticulatum*.

They remain encysted for about six months, and then migrate into the peritoneal cavity, pleura, or intestine, and escape into the open. Occasionally they bore into a bronchus and are coughed up.

Dogs may be infected by sniffing up larvæ thus deposited on the ground, or by ingesting rabbits, or portions of viscera containing larvæ.

SYMPTOMS, ETC.—The adult parasite is found between the turbinated bones or in the frontal sinus of dogs, or occasionally of goats, sheep, or even man.

The symptoms consist of unilateral nasal discharge, sneezing, epistaxis, dyspnoea, and coughing.

TREATMENT.—Injections of weak creolin, lysol, or iodine solutions.

Inhalations of chloroform, carbolic acid, turpentine, sulphur, iodine, formalin, etc.

Larvæ of *Æstrus Ovis*.—The fly which represents the adult form of this larva is from 10 to 12 millimetres in length, with a yellow head, a brownish-grey thorax, and an abdomen mottled with white, yellow, and black. The wings are transparent, and show a terminal streak and three spots. The fly is active from May to October. The female lays her eggs in, or close to, the nostrils of a sheep. Sheep, when attacked by the fly, rush wildly about, and rub their noses against trees and fences until they bleed.

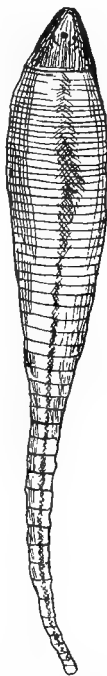


FIG. 29.—LINGUATULA TÆNIOIDES.

Instead of being oval, as in the case of the ova of *Æstrus equi*, the ova of *Æstrus ovis* are kidney-shaped. The larvæ have the body white, 1 inch in length, and divided by dark transverse streaks. The dorsal surface is rounded and convex from side to side, while the ventral surface is flat, and on this surface each segment after the third carries red pointed spines, laterally situated, leaving a plain middle portion.

The larva spends about ten months within the nasal cavities, after which it escapes and becomes a chrysalis.

This stage lasts six months, and the adult stage is then attained.

SYMPTOMS.—When a number are present in the nose, frontal sinuses, or horn-cores, there may be unilateral nasal discharge, purulent or blood-stained in many cases, with repeated rubbing of the nose against other objects. The head is carried a little to one side and frequently shaken. Occasionally the symptoms resemble those of gid. Epileptiform convulsions may occur, and death may follow. Ova may also be present in the larynx, trachea, or may reach the brain by passing through the ethmoid bone.

TREATMENT.—Fumigation. Trephining the horn-cores in some cases.

PREVENTION.—Where the fly is common it is best to use special feeding-boxes, with apertures of sufficient size to admit only the nose. Tar mixed with fish-oil is smeared around the apertures, so that the nose is constantly dressed with the mixture. This usually suffices to keep the fly at a distance.

BRONCHIAL STRONGYLES.

These parasites inhabit the trachea and bronchi of various animals. They have the caudal pouch supported by chitinous rings, but the mouth is non-chitinous.

There are eight species :

1. **Strongylus Filaria**.—Sheep, goat, deer, and camel. Male, 3 to 8 centimetres ; female, 5 to 10 centimetres. White, thread-like, ovoviviparous.
2. **Strongylus Rufescens**.—Sheep and goat. Male, 2 to 3 centimetres ; female, 3 to 4 centimetres. Reddish-brown, ovoviviparous.
3. **Strongylus Micrurus**.—Calf. Male, 4 to 5 centimetres ; female, 6 to 8 centimetres. White and tapering, ovoviviparous.
4. **Strongylus Pulmonalis**.—Calf. Less common.
5. **Strongylus Armfieldi**.—Male, 2 to 3 centimetres ; female, 4 to 5 centimetres. Thread-like, ovoviviparous.
6. **Strongylus Paradoxus**.—Pig. Male, 1.5 centimetres ; female, 3 to 4 centimetres. White or brown, ovoviviparous.
7. **Strongylus Pucillus**.—Cat. Male, 5 millimetres ; female, 10 millimetres.
8. **Strongylus Commutatus**.—Wild rabbits and hares.

OCCURRENCE.—Verminous bronchitis, or, as it is more popularly termed, "husk," or "hoose," occurs chiefly in sheep, lambs, and calves, though it is by no means uncommon to find adult bovine animals affected. It is of more frequent occurrence on low-lying damp ground, and seldom attacks animals pastured on high ground. A large number, usually an entire flock, are attacked at one time. Autumn is particularly the time of the year at which the disease is rampant, and in wet seasons it attains its greatest prevalency.

Stall-fed calves are seldom affected, and then probably through hay and fodder grown on infected land. It is not certain by what means infection is brought about, but it has been suggested that the parasites at some period of their existence reach the stomach with the food, and are then carried into the pharynx during

rumination, and so pass down the trachea. Other observers state that the embryos are carried to the bronchi or lungs in the blood-stream.

SYMPTOMS.—These vary considerably according to the site and variety of the parasite present. For instance, in sheep *Strongylus filaria* mainly produces symptoms of bronchitis, while *Strongylus rufescens* produces those of pneumonia.

In Bovines.—*Strongylus micrurus* of the calf produces either bronchitis or pneumonia, according to whether the worms are seated in the large bronchi or in the smaller divisions deeper in the lung.

In simple cases, where the symptoms are those of bronchitis, there is gradual wasting and emaciation, with pitched coat and general signs of unthriftiness.

Cough is always present. In character it is frequent, short, and harsh; the head is held down, and a quantity of thick ropy saliva issues from the mouth. The discharge from the nose may contain worms, eggs, or embryos. The appetite is usually at first undisturbed. As the disease progresses the cough becomes weak and faint, and the animal gasps for breath.

In those cases in which the worms are situated in the smaller divisions of the bronchi there are present symptoms of pneumonia, more or less acute, with rapid breathing, elevated temperature, and anorexia. In some cases the symptoms are indistinguishable to the naked eye from those of tuberculosis. In the former type of the disease the degree of mortality is low, providing the animals are well nourished, but in the latter type death is a very common sequel, and the degree of mortality may be anywhere from 20 to 80 per cent.

Intestinal strongylosis often accompanies husk, as the conditions necessary for the development of all these parasites are identical.

Adult cattle usually show less serious symptoms.

Cough is present, but few of the signs observable in young animals are noticeable.

In Sheep the symptoms are similar, but are more serious than in calves. Lambs and yearlings are attacked more often than older sheep.

In bad cases lambs feed on their knees, and death takes place at a period varying from a week to two months.

In Pigs.—Young pigs are chiefly affected, but the symptoms are not usually serious, and disappear as adult age is reached.

POST-MORTEM LESIONS.—The appearances produced by *Strongyli* are very varied.

1. *Simple Verminous Bronchitis*.—In this type the bronchial mucous membranes are infiltrated and swollen, and often show extravasations of blood. The bronchi contain viscous, often bloody, mucus, containing worms, eggs, and embryos.

The lungs are usually emphysematous in parts and œdematous in others. Bronchiectasis may often be observed.

2. *Verminous Broncho-Pneumonia*.—This type of lesion is the result of the passage of groups of worms into the finer bronchioles. Hepatization takes place around these areas. Localized pleurisy is not uncommon.

3. *Pseudo-Tuberculous Verminous Bronchitis*.—This takes the form of nodules much resembling tubercles. They produce an uneven surface, and are composed of clusters of worms surrounded by connective tissue.

THERAPEUTICS.—Preventive treatment consists in avoiding damp, low-lying ground, and in keeping young cattle and sheep as far as possible on high ground. Therapeutics may be classed under the following headings:

1. *Fumigations*.—The agents usually employed are chlorine gas (generated in an overhead receptacle), sulphur fumes, carbolic acid, creosote, tar, etc.

Some practitioners use iodine. The process is as follows: Two sacks are obtained; one is placed inside the other, and both are immersed in a bucket of water, thoroughly wetted, and wrung out. A brick made hot in the fire is then dropped into the bottom of the sack, and as much iodine as can be held on a threepenny-piece is dropped on to it. The head of the calf is enveloped in the sack, and held there till the animal has coughed twice.

This method is highly recommended by those who practise it, but, like all fumigation methods, it is open to the objection that the worms, especially in the later stages of the disease, often possess greater vitality than do the calves themselves.

2. *Tonics*.—Preparations of iron, sodii chlorid., quassia, or gentian, and aromatics, are useful to maintain strength and condition in the early stages.

The following is useful :

℞	Ol. tereb.	..	..	..	..	ʒiij.
	Asafoetidæ	..	..	..	..	ʒvj.
	Chloroformi	..	..	..	..	ʒvj.
	Acid. carbol.	..	..	..	..	ʒij.
	Aqua calcis	..	..	..	..	ʒvj.
	Ol. lini.	..	..	..	..	O.j.ss.

M. Fiat mist. Sig. : One to two wineglassfuls to be given twice daily in gruel to each calf, according to age.

This method is only applicable when the number of animals affected is comparatively small.

3. *Intratracheal Injection*.—This is one of the best methods of treatment. A very useful injection is as follows :

℞	Ol. tereb.	..	..	..	..	ʒj.ss.
	Chloroformi	}	..	..	..	āā ʒss.
	Glycerini					
	Acid. carbol.					

M. Fiat inj.

Dose.—Lambs, ʒj. ; calves, ʒj. to ʒiij.

Many practitioners prefer olive-oil to glycerin. The injection should be repeated in a week.

A modification is to trickle 1 drachm of the following mixture down the nostrils :

Turpentine	..	..	..	..	1 part
Ether	..	..	..	..	30 parts.

This method is not to be recommended.

PARASITES INHABITING SEROUS MEMBRANES.

Among these must be included the cystic forms of several tapeworms already mentioned. Especially we may mention :

1. **Cysticercus Baillei**.—This is the cystic form of a *Bothriocephalus*, and is found in the peritoneum, in the pleura, or other serous membranes of the dog, cat, and some other small animals. The cyst is formed of an invaginated head without hooks, but having four suckers, with an elongated body tapering at the posterior end. The body is full of calcareous particles.

The whole length is from 1 centimetre to 2 centimetres. The parasite is contained in the interior of a cyst, and it is probable that it reaches the serous membranes from the alimentary tract by means of the blood-stream, as it is usually found in close proximity to bloodvessels.

2. **Filaria Papillosa (Filaria Equina)**.—A white, thread-like worm, tapering at each end. Male, 6 centimetres to 8 centimetres; female, 10 centimetres to 15 centimetres. Mouth bears eight papillæ. Tail spirally twisted. Ovoviviparous.

This worm may be found within the scrotum of horses during castration, especially in cases of hydrocele and adhesions between the testis and scrotum, which symptoms may be set up as a result of its presence. It is commonest in India, but has been observed in Great Britain.

It has also been found in the diaphragm, under the dura mater, around the spinal cord, and in several other situations, particularly as the embryo form in the eye of Indian cattle.

3. **Sclerostomum pinguicola** occurs in Australia and America, in the fatty tissue surrounding the viscera, more especially the kidneys.

The symptoms produced have been confused with those of other diseases and greatly exaggerated.

4. **Linguatula Denticulatum**.—In the cat.

5. **Filaria Cervina**.—Peritoneum and eye of cattle.

6. **Sclerostomum Armatum** has been found within the scrotum of horses and asses during castration.

HÆMATOZOA.

Sclerostomum Armatum Minor causes aneurisms in the aorta or branches of the mesenteric arteries of the horse. These may vary from the size of a pea to a cocoanut. The aneurism usually has thickened walls, and contains a thrombus, with a small passage through which the blood still flows, together with a variable number of worms, usually partially buried in the walls.

Bilharzia Crassa.—This parasite belongs to the Distomidæ. It affects cattle in Egypt, Arabia, India, Mauritius, and the Cape.

The male and female are constantly joined together, the female being contained in a gynæcophorous canal running the whole length of the male, and formed by the turning in of the edges of the latter.

The male is $\frac{1}{2}$ inch in length, and possesses an oral and a buccal sucker. It is much thicker than the female, which is $\frac{3}{4}$ inch long and much more slender.

It chiefly inhabits the portal vein and the mesenteric vessels, and is carried to the intestines. It is also sometimes found in the bladder, being carried there by the

blood-stream. The symptoms may hence be those of enteritis or hæmaturia. Man may be affected with the parasite obtained from cattle.

The means of infection in cattle is the drinking of impure water.

Cystic forms of various tapeworms are sometimes seen in the heart tissue (*cf. Cysticercus cellulosa*, *Cysticercus bovis*, *Cysticercus tenuicollis*, *Echinococci*).

The dog may be infested with several Hæmatozoa.

Hæmatozoon Lewisi.—This is the embryonic stage of a *Filaria*, about $\frac{1}{100}$ inch in length. They may be found in drops of blood taken from the capillaries of dogs in India, China, and the East. They have a fine body, drawn out into a very thin tail. According to some observers (Grassi, Lewis), when observed microscopically, they have the power of attaching themselves by the buccal end to the cover-glass, and freely moving the body. This is not evident in the next-mentioned parasite.

Filaria Immitis.—This is a white filiform worm, with the anterior end only slightly larger than the posterior, both being somewhat blunt. The tail is spiral and carries two wings. The average length is about 8 inches, the females being the larger.

The parasites inhabit the right ventricle of the heart (often twined round the chordæ tendineæ) and the pulmonary artery of dogs in Denmark, Italy, China, etc.

The embryos inhabit the peripheral vessels, particularly at night, and the large vessels of the body by day. They much resemble *Hæmatozoa Lewisi*.

SYMPTOMS.—Often these are absent.

Usually the symptoms are those of chronic valvular disease, with dyspnœa, cough, and dropsy. Embolism of various vessels, such as those of one limb, is not uncommon. Symptoms resembling those of rabies

have been recorded by several observers. The embryos can usually be discovered in the blood.

In time the heart hypertrophies. Syncope, epistaxis, and hæmaturia follow on.

LIFE-HISTORY.—This is doubtful, and the intermediate host has been supposed to be a Mollusc or Crustacean.

Probably the embryos undergo development in the bodies of mosquitoes, migrate back to the mouth, and are thus transmitted; or else the pools at which the dogs drink are contaminated by mosquitoes alighting at the edges.

The parasite may be present in pups born to an infested bitch.

Strongylus Vasorum.—This is a smaller worm, a light pink in colour. The male is $\frac{1}{2}$ inch in length, with a bilobed caudal pouch.

The female is about $\frac{3}{4}$ inch in length. Their habitat is the right heart and pulmonary artery.

They set up endocarditis and thrombosis of the pulmonary artery.

Lafosse obtained good results by treating affected dogs with turpentine.

Arsenic might be useful.

Spiroptera Sanguinolenta.—Although this worm is usually an inhabitant of the first portion of the alimentary tract, it is found in Italy and China encysted in the wall of the aorta. The bronchial glands have been found to contain Spiroptera in one or two instances.

PARASITES OF MUSCLE AND CONNECTIVE TISSUE.

Spiroptera Reticulata.—This worm causes subcutaneous tumours of a fibrous nature in muscular and tendinous structures.

It is a filiform, spirally twisted worm, about 16 to 18 inches in length.

The tumours are from 1 inch to 2 inches in length, and somewhat egg-shaped. They occur principally in the neck and flexor tendons, particularly in the suspensory ligaments of the fore-limbs, in which case they set up chronic lameness.

Treatment is excision.

Sarcosporidiæ.—These are Sporozoa, inhabiting muscular tissue or connective tissue.

Balbiania Gigantea.—These Psorosperms may inhabit the connective tissue of the sheep, and also of the pig, ox, goat, and other animals. Their presence is manifested by the appearance of small nodules, varying from 2 millimetres up to 1 centimetre in diameter. The commonest positions in which the nodules may be met with are the œsophagus, bulb of the tongue and pharynx, neck, abdominal muscles and connective tissue, and the muscles of the thighs, especially the adductors. Each nodule consists of a thin envelope, containing a large number of sickle-shaped corpuscles or rounded bodies.

Balbiania gigantea may produce epileptiform fits or asphyxia from spasm of the larynx or œdema of the pharynx.

They are of chief importance to the meat-inspector.

Sarcocystis Miescheri.—These parasites produce the so-called "Miescher's tubes" in the muscles of the pig.

In the flesh the parasites may be seen dotted about in various parts, and they may be just visible to the naked eye as small whitish, drawn-out specks, with the dark-coloured flesh as a background.

When examined microscopically, the Sarcocyst is seen to be composed of a somewhat thick striated envelope, provided on the outside with numerous cilia, and containing a number of fusiform, comma-shaped or rounded

spores, each of which shows one or two nuclei. These spores are contained in cells formed by the crossing of membranes, thus giving the interior of the Sarcocyst, when magnified, the appearance of a honeycomb.

The symptoms produced in the pig are usually not noticeable, but paraplegia, rash, and fever have been observed.

It is doubtful whether man is infected by ingestion.

Sarcocystis Tenella.—In this the envelope is thinner, but otherwise it is similar to *Sarcocystis Miescheri*. It is especially found in the adductors of the thigh of the sheep, and next frequently in the heart muscle, but any portion of the muscular system may be affected.

MEASLES.

“Measles” is a term denoting the condition of the flesh of various animals produced by the presence therein of Cysticeri.

Cysticercus cellulosæ, for instance, is the cystic form of *Tænia solium* of man, and inhabits the muscles of the pig, dog, and cat.

Cysticercus bovis is the cystic form of *Tænia saginata*. It inhabits the muscles of the ox.

Measles of Pork.

This condition arises from the presence of *Cysticercus cellulosæ*. This is a small ovoid cyst, about 15 millimetres long and $7\frac{1}{2}$ millimetres wide. It shows, when magnified, a white spot, corresponding to the invaginated head. If the head is extruded by pressure, it may be seen to be four-sided, and to carry four suckers and a rostellum, bearing a double row of hooks, twenty-four to thirty-two in number.

The Cysticeri may be found in any or all the striped muscles, but the muscles chiefly affected are, in order :

the tongue, cervical muscles, muscles of the shoulder, pillars of the diaphragm, intercostal muscles, psoas muscles, muscles of the thigh. The myocardium is also frequently affected, as are also various organs of the body.

The muscles containing the *Cysticerci* are flabby and pale in colour, and contain small cavities, which lodge the parasites. On section, the flesh is wet, and, if badly affected, a yellowish clear fluid may exude. In pork that has been measly for a considerable length of time the *Cysticerci* become calcified.

SYMPTOMS.—Usually symptoms are not recognizable during life. When very advanced, there may be difficulty in muzzling, loss of energy, anorexia, diarrhoea, stomatitis, and death.

The *Cysticercus cellulosæ* of the pig, when ingested by man, develops in the intestine into *Tænia solium*. The worm becomes mature about two months later.

The flesh, when eaten, is gritty and sweet to the taste. Roasting at 120° F. for one minute kills the parasite, but this temperature is not usually reached in the centre of pork while being cooked for the table, though the external temperature may be 212° F.

In smoked hams and pickled pork the vitality of the *Cysticerci* is usually weakened.

Measles of Beef.

This condition is produced by the presence of *Cysticercus bovis* in the muscles of the ox.

This is an ovoid cyst, measuring from 3 to 15 millimetres in length. It shows a small, dense, yellowish area at one point, corresponding to the invaginated head. When extruded, the head presents the characters of that of *Tænia saginata* of man, tetragonal in shape, devoid of hooks, and possessing four large rounded suckers.

These *Cysticerci* may be found in any organ, but voluntary muscles are usually affected.

The most common site is in the muscles of mastication—the masseter, pterygoids, and in the tongue. Then, in order, follow the heart, gluteal, intercostal, cervical, psoas, and pectoral muscles.

The *Cysticerci bovis* are never present in such numbers as are the *Cysticerci cellulosa*, and, moreover, they quickly become calcified.

SYMPTOMS.—Usually nil.

When ingested by man, the *Cysticercus* develops into *Tænia saginata* in the intestine.

TRICHINOSIS.

This is the name applied to the condition arising from the presence of *Trichina spiralis* in the body of the pig or man.

Trichina spiralis is a member of the family Trichotrachelidæ.

The adult male worm is about 1 to 5 millimetres in length, and the female 3 to 4 millimetres. They possess very slender bodies, tapering at each end, with no transverse striation. The female is ovoviviparous.

LIFE-HISTORY.—The adult stage is passed in the intestine and the larval stage in the muscles.

When flesh infested with encysted larvæ has been ingested by a suitable animal, more especially the pig, or even man, the cysts become partially digested and the larvæ are set free. After an interval of a few days, they develop into sexually mature *Trichinæ*, copulate, and the females soon deposit embryos. The number produced by a single female at one ovulation may exceed 10,000. The embryos then proceed to migrate to the muscles, either by boring through the intestinal wall or by the aid of the blood or lymph streams. The average

interval between ingestion of trichinous meat and muscle infestation is ten days. On arriving at its destination, each larva coils itself into a spiral, and by its presence irritates the tissues, so that eventually fresh connective tissue is thrown out from that already between the bundles of muscle fibres, and a cyst wall is formed around the parasite.

Each cyst is somewhat ovoid and pointed at the extremities, and in its length lies parallel with the direction of the muscle fibres. The length of the cyst is from 0.3 to 0.8 millimetre.

The commonest seats of infestation are :

1. Pillars of diaphragm.
2. Muscles of tongue and larynx.
3. Shoulder.
4. Intercostals.
5. Psoas muscles.
6. Adductors of thigh.

The muscles are infested to a greater extent close to their insertions.

In order to discover *Trichina* cysts in pork, thin strips are cut from the pillars of the diaphragm, tongue, etc., in the direction of the muscle fibres. These should be macerated in a mixture composed of pot. chlor., 1 part, and acid. nitric. dil., 4 parts. The strips are then shaken in water, placed between two slides, and examined microscopically. The coiled-up larva is then easily visible.

When trichinosis has been present for a long time calcareous or fatty degeneration sets in, and in the former case the cyst becomes hard, and gives a gritty feel to the meat. Pigment may also be deposited in the cyst. Calcareous and fatty deposits usually render the parasite harmless.

SYMPTOMS.—In the pig symptoms are usually absent. If the number of invading *Trichinæ* is large, the first

symptoms noticeable are those of enteritis. There may be anorexia, fever, thirst, grinding of the teeth, with tucked-up flanks and arching of the back. Chronic diarrhoea then sets in. About the tenth day these symptoms diminish and give way to muscular symptoms. The animal is stiff and has difficulty in walking. The muscles are sore to touch, and the pig usually remains in the recumbent position. The animal may now recover or become dropsical and eventually die.

INFECTION, ETC.—Infection takes place in the pig from ingestion of trichinosed flesh, such as that of rats, which are frequently affected, or from devouring the excreta of animals containing *Trichina* in some stage of their life-history. Probably the pigs infect the rats, and *vice versa*, and so the existence of the disease is maintained. In Germany, America, Holland, Denmark, and Sweden, and particularly in Russia, trichinosis in man is not rare, owing to the practice of eating only partially cooked pork.

VITALITY.—Boiling affected pork for fifteen minutes per pound weight is considered safe, and experiment has shown the *Trichina* to be destroyed by this means.

Roasting, if complete, is sufficient to destroy the parasites.

Salting and smoking are not reliable.

Putrefaction has little influence on their vitality, and after four months some *Trichinæ* may yet be alive.

PARASITES AFFECTING THE EYE.

Numerous parasites may affect the eyelids. Among these are Acari, Demodectes, and the Pediculidæ.

Besides these, various Diptera attack the exterior of the eye, especially the nasal canthus.

Filaria Pellucida.—There is some doubt as to whether this worm may not be an undeveloped stage of *Filaria*

papillosa. It is commonest in the horse, and is met with in India, Burma, and Ceylon.

It is a fine thread-like, reddish-white worm, somewhat thicker in front. The male is about 30 millimetres in length, and the female is slightly smaller.

The habitat of this parasite is the anterior chamber of the eye. Both eyes are seldom affected simultaneously, and there is usually only one worm present, but three is not an uncommon number.

SYMPTOMS.—Conjunctivitis and swelling of the eyelids are present, arising from irritation. Photophobia is very marked. In the early stages the worm may sometimes be seen through the cornea. Later opacity sets in. "Loin-weakness" has been associated in India with the presence of the *Filaria* in the eye.

TREATMENT.—Cocaine is applied, and the cornea punctured with a cataract needle. The worm is thus brought into the wound by the rush of aqueous humour, and is withdrawn. A larval form of *Filaria cervina* infests the eye of the ox in a similar manner.

Similar parasites have been observed in sheep, dogs, and poultry.

Filaria Palpebralis.—A white filiform worm, from 8 to 16 millimetres in length.

It has been found in the lachrymal sac and in the conjunctiva beneath the eyelid.

Filaria Lachrymalis.—This is a longer worm, 10 to 24 millimetres in length. It affects the eyelids of cattle in the South of France in a similar manner.

TREATMENT.—This consists in removing the parasites, and applying mild astringents and sedatives to lessen the conjunctivitis.

APPENDIX I

IN advanced cases of the pustular type we have lately obtained almost remarkable results from the following treatment :

The largest pustules are first squeezed out and the affected areas dressed once or twice, at intervals of a day, with the following mixture :

℞	Formalin	..	..	..	..	ḡiij.
	Glycerin	..	..	..	..	ḡij.
	Spts. vini rect.	..	..	..	..	ḡij.
	Ol. caryoph.	..	..	..	..	ḡiij.
	Ol. rapii	..	..	..	..	ad ḡvj.
	M. Fiat. lin.					

This application at first produces marked hyperæmia and swelling of the skin.

After one or two dressings the pustules appear flattened, dry, and scaly, and the majority soon disappear, leaving the skin smooth and apparently healthy. The parts are then dressed with Ung. sulph. co. until they are thoroughly softened, and then treated daily with the following :

℞	Formalin	..	..	..	..	ḡss.
	Glycerin	..	..	..	..	ḡi.
	Tinct. cantharid.	..	..	..	..	ḡi.ss.
	Acid. salicylic.	..	..	..	..	ḡss.
	Spts. vini rect.	..	..	..	..	ḡi.
	Ol. ricini	..	..	..	..	ḡij.
	Ol. rapii	..	..	..	..	ad ḡvj.
	M. Fiat. mist.					

The hair soon commences to grow, and in the great majority of cases thus treated by us a perfect cure has resulted, although many have at first appeared hopeless.

APPENDIX II

By the Sheep Scab Order of 1910, recently issued, Article 5 of the Sheep Scab Order of 1905 is revoked, and an article substituted which enacts that for the prevention of scab an inspector of the Local Authority shall serve an Isolation Notice on the owner or person in charge of sheep recently affected or in any way suspected of scab or exposed to infection, and that such sheep shall not be permitted to stray or come into contact with other sheep until a further notice has been issued. It further enacts that if, on veterinary inquiry, the above suspicions are found to be correct, the sheep shall be efficiently dipped by the owner, and, if required, in the presence of the inspector.

By an amendment of Article 9, a Local Authority may make regulations requiring the dipping of sheep moved from another district into their district (providing they remain there over seven days), and may also issue notices regulating their movements, and requiring an owner to notify the arrival of sheep.

Paragraph 4 of Article 30 is omitted, and a notice substituted forbidding the straying of sheep, in contravention to the order, under penalty.

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