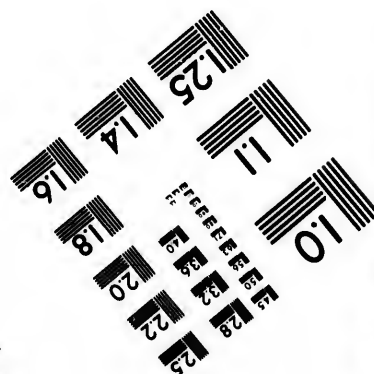
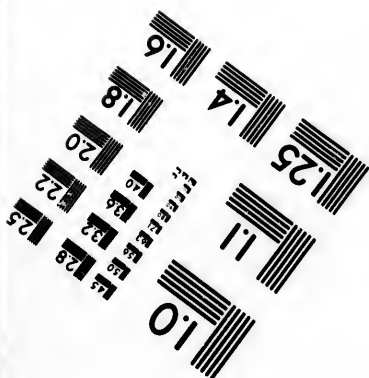
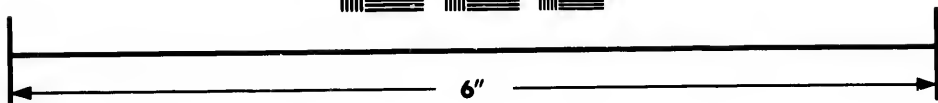
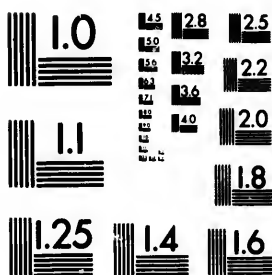


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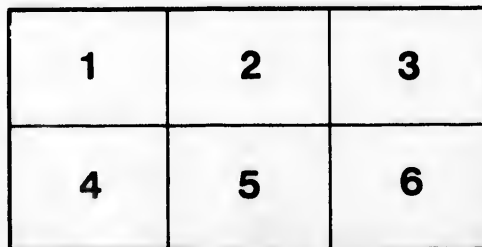
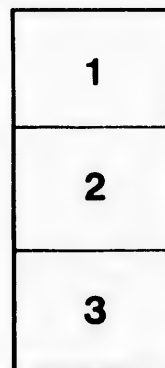
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INTERNAL PARASITES

OF

THE HORSE.

(ENTOZOA.)

BY

J. T. DUNCAN, M.D., C.M., V.S.,

LECTURER ON THE ENTOZOA OF THE DOMESTICATED ANIMALS IN THE
ONTARIO VETERINARY COLLEGE; HONORARY ASSOCIATE OF THE
R. C. V. S., LOND.; MEMBER OF THE ASSOCIATION OF
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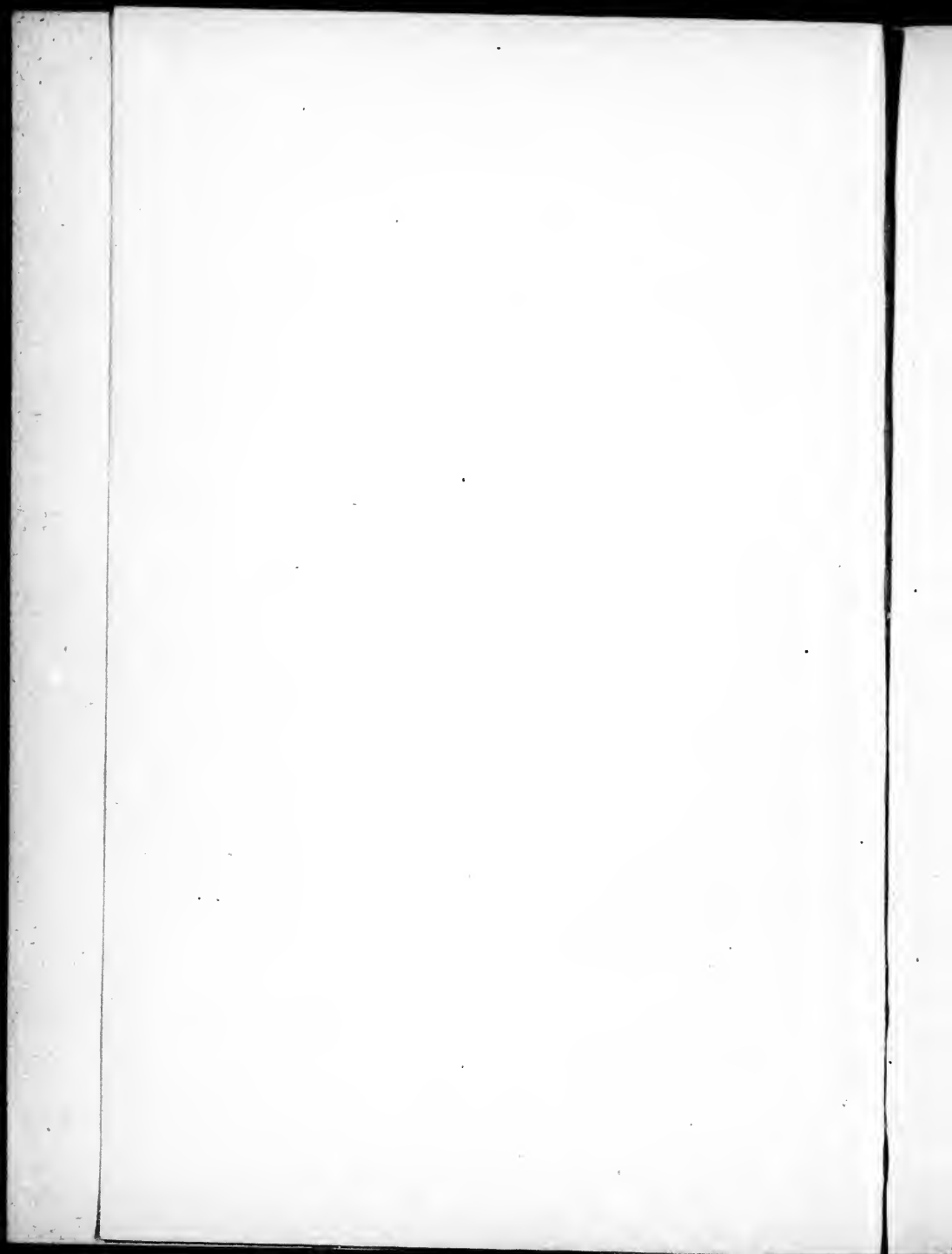
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PREFATORY NOTE.

In teaching this subject, the want of a suitable text book has often been felt. Cobbold's small volume has been difficult to obtain, [while the larger works are too voluminous. In attempting to supply the need spoken of, the labor of the writer has been principally that of a compiler. The works of Cobbold, Leuckart, Robertson, Fleming, Williams, Law, and others have been drawn upon. In addition, the experience of many Veterinarians has been availed of; the cases reported by them being exceedingly instructive. These materials having been arranged in such a manner as to facilitate reference, it is hoped that the result as presented in the following pages will be found useful to the Veterinarian and horse owner.

J. T. D.

Toronto, 1891.



CONTENTS.

SECTION I.—GENERAL CONSIDERATIONS.

	<i>Page.</i>
Older Countries more Infected	11
Losses Due to Parasitism	12
Ectozoa—Entozoa.....	13
Causation	13
Spontaneous Generation	14
Development of Round Worms.....	15
Laws Regarding Ova	15
Term "Host"	15
"Intermediary Bearer"	15
Life History of Round Worm.....	16
Development of Tape-Worm	18
Selection of Abode.....	18
Encysting	19
Further Life History	20
Nourishment—Growth.....	20
Maturity	20
Provision for Propagation	21
Provision for Checking Multiplication	22
Description of Round Worm.....	23
Description of Tape-Worm	24
Classification.....	25

SECTION II.—CLASSIFICATION.

How Many Species?	26
-------------------------	----

SECTION III.—TAPE-WORM OF THE HORSE.

<i>Teniz perfoliata</i>	28
Form of <i>T. perfoliata</i>	28

IV.

	<i>Page.</i>
Habitat	28
Development.	29
Difference between <i>T. perfoliata</i> and <i>T. plicata</i> . .	29
Symptoms	30
Epizooty in Wales	30
Post Mortem.	31
Diagnosis	32
Prognosis	32
Treatment	32

SECTION IV.—NEMATODES, OR ROUND WORMS.

Sub-Section 1.—Ascaris megalcephala.

Form	34
Length	34
Habitat	35
Numbers	35
Development	35
Symptoms	36
Burneson's Case	37
Cases in England	38
Diagnosis	39
Prognosis	39
Preventive Treatment	39
Medicinal Treatment	39
Oil of Turpentine	39
Santonin	40
Prof. Robertson's Treatment	40
Tonics—Diet	42

Sub-Section 2.—Oxyuris curvula.

Form	43
----------------	----

V.

	<i>Page.</i>
Length	43
Habitat	44
Numbers	44
Development	44
Symptoms	44
Diagnosis	45
Prognosis	45
Preventive Treatment	46
Medicinal Treatment	46
Enemata	47
Diet	47
<i>Sub-Section 3.—Filaria papillosa, or F. oculi.</i>	
Form	48
Habitat	48
Numbers	49
Development	50
Symptoms	50
Diagnosis	51
Prognosis	51
Preventive Treatment	51
Surgical Treatment	52
Mariott's Case	52
Danger of Delay in operating	53
Cocaine as Anæsthetic	53
<i>Filaria oculi</i> attached to Iris	53
<i>Sub-Section 4.—Strongylus armatus, or Sclerostomum equinum.</i>	
<i>Strongylus armatus</i> , Major and Minor	54
Most Important of Round Worms	54

VI.

	<i>Page.</i>
Form—Length	54
Habitat	55
Numbers	55
Development	55
In the Stomach	56
Immature in Coats of Vessels	56
Aneurisms	56
Symptoms if in the Intestines	57
Symptoms if Wandering	58
Symptoms if in the Coats of Vessels	58
Aneurism, Cause of	58
Aneurism, Pathology of	58
Rupture of Aneurisms	59
Colic Caused by Aneurisms	60
Lameness as a Symptom	63
Miller's Cases	63
Diagnosis	65
Embolism of the Iliac Artery	65
Prognosis	66
Preventive Treatment	67
Medicinal Treatment	67

Sub-Section 5.—Strongylus tetracanthus.

Mistaken for <i>St. armatus</i> Minor	68
Form—Length	68
Habitat	68
Results when in the Intestinal Wall.	69
Numbers	69
Development	69
Symptoms	70

VII.

	Page.
Paralysis Caused by <i>St. tetracanthus</i>	70
Taylor's Cases.....	70
Slocock's Case.....	73
<i>Post Mortem</i> Examination.....	74
Epizooty Caused by this Parasite.....	75
Rees Loyd's Cases.....	75
Diagnosis.....	76
Prognosis.....	76
Preventive Treatment.....	77
Medicinal Treatment.....	77
Professor Williams' Treatment.....	78

Sub-Section 6.—Spiroptera megastoma.

Form—Length.....	78
Habitat.....	79
Numbers.....	79
Development.....	79
Symptoms.....	79
<i>Sperioptera microstoma</i>	80
Size.....	80
Habitat.....	80

SECTION V.—TREMATODES, OR FLUKE WORMS.

<i>Fasciola hepatica</i>	80
Size.....	80
Form.....	80
Habitat.....	80
List of the common Entozoa.....	81
Numerous "Guests" in "Hosts".....	82
FULL LIST OF ENTOZOA.....	82

VIII.

SECTION VI.—BOTS.

	<i>Page.</i>
Form—Size.....	84
Numbers.....	85
Development.	85
Position in Stomach....	86
Position in the Intestines.....	86
Escape from the Bowels.....	86
Summary of Life History.....	87
Symptoms.....	87
Effects.....	87
T. Tegg's Case.....	88
Tetanus, Caused by.....	89
Bots in the Pharynx.....	89
Diagnosis.....	89
Prognosis.....	90
Preventive Treatment.....	90
Medicinal Treatment.....	90
General Symptoms of Parasitism.....	92

ILLUSTRATIONS.

Figs. I. to V., to face page.....	94
Figs. VI. to X., to face page.....	96

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SECTION I.

GENERAL CONSIDERATIONS.

It is a truth that the older countries are much more liable to parasitic diseases than are the newer. For instance, extensive outbreaks of these diseases are recorded in Europe, India and other eastern countries, while in America we are only beginning to notice such attacks. So noticeable is this difference that a general rule may be thus given, "the older the country the more numerous the parasites."

Fortunately for our stock owners, this continent is as yet only to a small extent infested with parasites, but year by year the trouble is becoming more extensive. New districts are infected, a greater number of animals are attacked. The reason for this mainly is that troubles of such a nature are overlooked or neglected. Means are seldom taken to prevent our valuable animals from becoming "hosts" to these unwelcome guests.

So long as this state of indifference continues, so long will loss from this cause gradually increase. This loss, in many cases, will not consist in the death of the animals. Comparatively few will succumb to the attacks of the parasites, but many will be weak, poor and unthrifty in spite of the best supply of food that can be given. The cause may be unsuspected, the owner may be adopting every means known to him to get his animals in condition, but without success. The loss on the fodder, the loss on the animals when sent to market out of condition, these are in many cases greater than if the animal had quickly succumbed to the infection.

If these losses are to be prevented, or reduced to the lowest point possible, and if this continent is not to become largely infested with these lower forms of animal life, it will be due to the well directed efforts of veterinarians, practical men, men of education and ability, who are now to be found in every part of the country.

The parasites attacking the domesticated

animals either infest the outer parts of the animal, or obtain access to the intestines or other internal parts. This gives good ground for separating them into two great classes, viz. : Ectozoa, so named from two Greek words meaning "without" and "animal," and Entozoa, which is similarly from the Greek "ento" within, and "zoa" animal. The ectozoa then are the external parasites, such as lice; the entozoa are those which are internal, such as tape worms. In this work there is no reference to the ectozoa, it is wholly devoted to consideration of the entozoa, and it is to this class of parasites that the previous remarks are more especially applicable.

CAUSATION AND DEVELOPMENT. — The study of parasites, first, in regard to their origin, and then in regard to their life history, has presented great difficulties. The total dissimilarity which so many of these present at different periods of their existence particularly has rendered the study most puzzling. Of late years, however, great progress has been made. Erroneous

theories have been swept away, and facts have been discovered and verified to such an extent as to place the study now on a sure basis, although much has yet to be accomplished before the life history of all parasites is understood.

Before proceeding to discuss particularly the entozoa of the horse, some of the more general truths in regard to parasitism may be set forth.

Some years ago the doctrine of "spontaneous generation" was held in regard to the entozoa by many scientific men. In other words, they held that the origin of these parasites was without cause;—did not require any pre-existing ova or seed.

But this theory is now entirely given up. Numerous observers and experimenters have proved beyond a doubt that these, as well as all other organisms, are always developed from ova. There is, indeed, no such thing as "spontaneous generation."

Speaking now of round worms, their ova, or eggs, being formed in the parent worm, and passed from it into the intestine of the

"host,"* will not form an embryo while located there. They must escape from that position before they can pursue their round of existence. It may indeed be given as a general law that the eggs must be passed away with the fæces from the animal before the embryos will develop.

Having escaped from the "host," and fallen upon damp earth or near a pool of stagnant water, embryos soon appear, and often these embryos swim about freely in the water near which they were dropped, growing and developing the while.

For the most part, these embryos need to enter the body of some other animal before they can continue their life history. Suitable creatures are found in the soft-bodied water snails, which are so often seen in stagnant water, and into these the embryos pass. Having found in them a suitable resting-place, they here encyst themselves, and, if the snail in which they

* The term "host" is applied to the animal which carries the mature form of the parasite. "Intermediary bearer" is used to indicate the animal bearing the immature form.

now reside be not swallowed by another animal, the embryos will die a natural death after a time.

On the other hand, a horse may, in drinking of the water in which they are, or eating the grass around the pools, swallow the snail containing the embryo parasite. The snail, having been thus swallowed, its soft body is soon dissolved by the active fluids of the stomach (gastric juice), and the embryo is set free. Not so easily destroyed as the soft-bodied snail, this embryo is generally carried into the intestine, where it finds a suitable resting-place. There development takes place with more or less rapidity, the worms attain maturity, and, male and female being present, fecundation takes place, thus completing the life history.*

In regard to the tape-worms,† the sexes

*While the above may be accepted as a fair statement of what is held by the majority of helmiologists, it is proper to say that excellent authorities differ widely from them. Thus, Davaine holds that nematodes do not need an intermediary bearer, although they certainly migrate from one host to another.

† Tape-worms—resembling a tape in appearance. See page 28

are not distinct. Each segment, indeed, possesses male and female organs. The male organ belongs to the dorsal surface, or back of the segment, the female opening (vagina) to the ventral. Sometimes both of these organs are close to the edge of the segment. Copulation takes place by the introduction of the male organ into the vagina of the same segment. The development of the ova proceeds rapidly, and the uterus becomes crowded with them, so much so as to show very prominently its outlines when a ripe segment is examined. These segments, when they become thus full of eggs, are being constantly passed off from the parent worm (which lies anchored to the mucous membrane of the intestine of the animal), and come away with the fæces. Dropped upon the pasture, or in the stable, they are broken up, and the ova scattered far and wide. These, in food or water, are conveyed to the intestine of another animal (intermediary bearer), where the eggs are hatched out, the embryos escape and wander free in the intestine. But not long do

they thus wander. In this intermediary bearer they are immature and must find some place in which they can rest before proceeding in their development. These embryos pierce the walls of the intestine, and wander through the tissues until they arrive at the proper place. What a curious instinct—if it may be called so—it is which leads these embryos to certain definite localities of the body. Thus, one species does not rest until it reaches the brain, another is not satisfied outside of the liver, while still another prefers the muscles of the host. Whatever locality it may be that the individuals of the species desire, they wander till they reach it, then form there a “limited settlement” or colony.

Having reached this resting-place development goes on, and soon a minute tapeworm head is formed. In addition to the head, a rudimentary neck appears, and these parts are both enclosed in a bladder, which really represents the caudal appendage, or tail. The head and neck are not properly “inclosed” in the bladder, but are

surrounded by it, and may be protruded from it.*

These little bladder worms, consisting, as has just been said, of a little sac filled with fluid (serum) with the head and neck of the future tape worm pressed down into it, are often spoken of as cysts. But they are not usually left without an additional covering, for the connective tissue† of the organ in which they lie forms around them a capsule, very thin at first, but gradually increasing in thickness until it is well marked. Here then we have the future tape worm as yet immature enclosed in a capsule, and supplied with nourishment from the small vessels which go to its capsule. But although thus enabled to develop slowly, it is only if some other animal should eat the infected part of this intermediary bearer, that the embryo can become mature. If, however, it is so taken, the gastric juice of the animal which has swallowed it dissolves off its cap-

*In this matter I follow Moniez, not Leuckart. See diagrams, Figs 12 and 13.

† *Vide* Leuckart, page 359.

sule, the caudal appendage disappears, and the now freed head passes to the intestines, where it anchors, and proceeds to throw out the segments of which we have previously spoken. In this position the parasite receives no nourishment from blood vessels, nor by devouring the mucous membrane on which he merely holds. The nourishment here is from the intestinal juices, which are often so abundant as to permit us to say that the tape-worm "swims" in them.*

The head holding its position, there is growth by "segmentation of the neck," (Leuckart), the earlier developed of these segments being constantly pushed further from the head by the development of new ones. The segments are at first without sexual organs, but gradually these appear, the male organ first, being dorsal in position, and then the female, which is ventral. Each segment having now both male and female organs, impregnation takes place,

* *Vide* Leuckart.—These remarks in regard to the nourishment of tape-worms in the intestines apply also to nematodes in the same position.

and the round of life history is complete.

Before proceeding with a notice of the separate parasites, one can not but be impressed with the provision which nature has made; on the one hand to ensure the propagation of every species, and on the other to guard against the excessive multiplication of parasites.

On the one hand we see provision for propagation by the enormous fecundity of nematodes, some females bringing forth sixty-four millions of eggs, or ova annually.*

Undue multiplication is guarded against in several ways. In the first place the ova must pass from the host in order to develop, and many millions of these ova perish by being dropped in a dry pasture

*We may give this instance of remarkable fruitfulness in addition to that of the nematodes (mentioned above). In *Tenia Solium*, the * * uterus of each segment holds some fifty-three thousand eggs. * * Seeing that a tape-worm produces yearly at least eight hundred and fifty segments, the total number of eggs will thus be some forty-two millions. * * * The extent of this fertility may be estimated by the following calculations. The sixty-four millions of eggs which a female thread-worm brings forth in the course of a year represents a fertility about thirteen times as great as that of a queen bee. A woman giving birth to a child is deprived of about seven per cent. of her weight, so that a thread-worm is as fertile as a woman would be if she brought forth seventy children every day.—*Vide* Leuckart, page 43.

or on the roadside, where there is no access to water or damp soil.

Then even when the embryos reach a moist locality, where they can develop, many of them will fail to enter the intermediary bearers, and even of those that do, thousands of them will yet perish with their bearers, for it is only comparatively few of these snails the horse will swallow, either on food or in water.

In regard to the tape-worms, the ova being scattered over fields or roadsides, the vast majority are not swallowed by any animal, therefore they must perish. A few are, however, taken in by some intermediary bearer, but if the species is not the right (or suitable) one, no development will take place. For instance, if a dog swallows ova (or segments containing ova) from the tape-worm of the horse, the ova perish—they will not grow in that soil—neither will the horse become infected if it should happen to receive ova from the tape-worms of the dog. But granting that they have escaped all those dangers, and suitable

ova have safely encysted themselves in some part of their intermediary bearer, they cannot yet reach their mature stage, unless the organ in which they are lying is devoured by some other animal. If not so devoured, little limey particles invade the capsule in which they lie, the blood supply is cut off, and the bladder worm is destroyed by this process of "calcareous degeneration." These many bars to the successful life of an embryo are so serious that it is reckoned that not one out of every fifty millions of embryo tape-worms succeed in reaching maturity.

Reference has been made in general terms to the "round" and "tape" worms. These terms are convenient, as they indicate with sufficient clearness the two orders under which may be placed the principal entozoa of the horse. By the term round worms is understood all worms of that shape, of whatever size—whether the immense whip worm, large enough to make the lash of a small whip—or the minute thread worms, so small as to need a magnifying

glass in order to see them properly. Round worms are classified as nematodes. (See classification, page 34). It is therefore proper to speak of any worm which is round as a nematode worm. These cylindrical worms always possess a well-developed alimentary canal, with a mouth and anus, and the sexes are distinct; that is, there are male and female worms, of which the female is decidedly the larger. In their mature condition, they inhabit the alimentary canal of the host.

In regard to the tape-worms, they, in their mature condition (like the nematodes), are always found inhabiting the alimentary canal of the animal carrying them.

They are characterized by the possession of elongated and flattened, or tape-like forms. "They are composed of head, neck and body, the latter made up of a variable number of segments (sometimes called proglottides). These segments are each of a quadrangular form, united by an intervening softer substance. As a whole, the structure of these may be said to be solid,

there being no cavity employed as a digestive tube.*" Each segment (proglottis) is, however, hollowed out to a considerable extent by the branching tubes forming the uterus. Each segment may be looked upon as a distinct organism, possessing, as each does, both male and female organs. The head, however, is the essential part, as from it is developed both neck and body. It is rounded, and possesses small hooks and suckers, but no mouth. And, strange to say, it possesses no generative organs (Leuckart).

SECTION II.

CLASSIFICATION.

The whole animal kingdom is divided into five sub-kingdoms, which are thus named :

(1) Protozoa.—This includes the lowest forms of animal life. Rising in the scale, there is next, (2) Cœlenterata; (3) Echinodermata; (4) Vermes; (5) Vertebrata.

Without pausing to discuss these various

*Professor Robertson.

sub-kingdoms, it is sufficient to state that under Vermes come the Entozoa of the Horse.

The following are the orders which are of interest in this connection :

ORDER I.—CESTODA—includes tape-worms.

Of these tape-worms we have to consider only *Tenia perfoliata*.

ORDER II.—NEMATODA—Round Worms.—

Belonging to this order are :

Ascaris megalocoplala,

Oxyuris curvula,

Filaria oculi, or *papillosa*,

Strongylus armatus,

Strongylus tetracanthus,

Spiroptera megastoma,

Spiroptera microstoma.

ORDER III.—TREMATODA—Flat Worms.—

Fasciola hepatica.

In addition to the above orders, we have the larval forms of certain insects, such as *Æstrus equi* and *Æ. hemorrhoidalis*.

PARASITES OF THE HORSE.

SECTION III.

TAPE-WORMS.

Speaking first of the tape-worms of the horse, these belong to the order Cestoda, therefore the term "cestode" is often used to indicate them.

This form of parasitism is rather rare in the horse, and the individual parasites are small, yet there are cases on record in which they have undoubtedly caused the death of the animal.

In one instance recorded by Rees Lloyd, V. S., of Wales, large numbers of ponies succumbed to the attacks of these parasites.

In regard to the species of tape-worms in the horse, Cobbold says five at least have been described, but he holds that they may all be reduced to two or three varieties.

These are *Tænia perfoliata* and *T. plicata*. As for Prof. Robertson's *T. mammilana* Cobbold says it is identical with *T. perfoliata*. This then leaves us but two species to consider, viz.: *T. perfoliata* and *T. plicata*. These two Cobbold holds to

be distinct. But Leuckart, writing at a later date (1886), proves that these two supposed species are really one, or in other words, one species at different periods of development.

Tænia perfoliata.

FORM.—Professor Robertson describes this as the commonest tape-worm of the horse. The head is small, square in outline, rounded at the corners, possessing two fleshy lobes at its base on each side. These are held to be distinctive of the worm. It presents four sucking discs, one at each angle.

The neck is not well marked, but otherwise the worm presents the ordinary tape-worm appearance. Length, one to four inches, "never more than five inches." (Cobbold).

HABITAT.—Found in both large and small intestines, but generally in larger numbers in the colon and cæcum.

NUMBERS.—Generally very few.

DEVELOPMENT.—*Tænia perfoliata* is, of

course, in the adult form in the intestines of the horse. Its location when in its immature form is not yet satisfactorily determined. There seems to be a good deal of confusion in regard to it.* The difficulties, however, no doubt will soon be cleared away. The point that demands particular attention is the strange fact that the young tape-worm is much longer than the mature worm. *T. perfoliata* measures when young as much as three feet. So different does it appear from an ordinary *T. perfoliata* that this young cestode is generally known by a different name, viz.: *Tænia plicata*. How can this remarkable difference be accounted for? The reason is this: On *T. plicata* are a number of sterile joints, which give to it its great length. And as *T. plicata* increases in age, it decreases in length, by the loss of those sterile joints (segments), until it becomes *T. perfoliata* of about four inches in length.

*Leuckart speaks of it (as *Tænia plicata*) as being in the intestine of the hare. It is possible that the horse nourishes at the same time both the strobila (mature form) and the scolex (immature form) of this tape-worm.—(Vide Cobbold, page 361).

SYMPTOMS.—It is usually stated that there are no symptoms which can be relied on as diagnostic, in fact the tape-worm of the horse is generally considered to be harmless to its host. Although, as a rule, this is the case, we must not overlook the fact of its possibly being the cause of great injury. Rees Loyd, V. S., quoted by Dr. Cobbold, gives an account of the epizooty caused by these parasites, with the symptoms and *post mortem* appearances.

Writing in 1874, he states that in one district one hundred animals perished from tape-worms. As a rule, he states, those affected with *Tænia* are in fair condition. The average time they are troubled with worms is two months, and the symptoms observed have been many. They are at first seen to be unable to keep up with other ponies; extending the head and turning the upper lip up, suddenly appearing distracted, seizing turf in mouthfuls when griped or pained, others running away as fast as they can go, rolling and kicking on the ground for five or ten minutes, then

walking away as if nothing had happened. If coming down a slope quickly they are almost sure to fall headlong. Not unfrequently they cough, and what is peculiar, in some of them lameness in one hind limb is seen, (mostly in the near hind) with slight knuckling over at the fetlock. The appetite is generally good, they are in fairly good condition;* they may be seen at one hour grazing and apparently well, and dead or dying the next.

Post mortem examination showed a healthy condition of the whole of the intestines, save congestion of the rectum. The colon showed no worms, but the cæcum was nearly full of faecal matter, and nearly half of this matter was made up of tapeworms. The corner of the tongue was bitten off in many cases.

*In confirmation of Mr. Loyd's statement regarding the condition of affected animals, may be quoted the following from the State of Illinois. Writing in October, 1891, J. L. Linxwiler, V.S., speaks in the following way of a mare from which fifty-eight of these parasites were removed, *post mortem*: "The subject gradually gained in flesh from the time she was brought from the city, but for the last month the men thought she was doing exceedingly well, and showing a very ravenous appetite."

DIAGNOSIS.—This is very seldom made, unless a large number of animals are affected. But symptoms of weakness without apparent cause would lead to examination of the fæces, when the segments or ova might be discovered. "It is a good general rule to follow, that where more than one or two animals, particularly if young, succumb with ill understood intestinal symptoms, every means must be taken to satisfy ourselves as to the presence or absence of parasites. To this end, nothing is more important than a careful *post mortem* examination of the dead subjects."

PROGNOSIS.—May generally be favorable.

TREATMENT.—*Preventive*.—The life history of this parasite not being fully known, only general means can be taken. The avoidance of low, damp pastures; the keeping of the stable clean; the use of clean fodder and water, and the keeping the animals in a high state of health, are the measures indicated.

TREATMENT.—*Medicinal*.—If the existence of the tape-worm be ascertained or

even suspected, the oil of male shield-fern (*Filix Mas*) should be administered, as being the best tæniacide we possess. It may be given in bolus or gruel, from half an ounce to one ounce, and it may or may not be combined with oil of savin. If the smaller amount be given, it is well to use an equal amount of the latter medicine. The bowels of the animal having been cleared by a cathartic, and no food given over night, the dose must be given in the morning, followed in a couple of hours by a bran-mash. The medicine may be repeated for two or three mornings, followed in twenty-four hours by a dose of aloes.

Some practitioners prefer to use oil of turpentine, which may be administered as for round worms. (Page 39).

Tænia plicata.—From what has been already stated we know that this is but the younger form of *T. perfoliata*. It is found in the small intestine, *T. perfoliata* in the larger.

SECTION IV.

NEMATODES, OR ROUND WORMS.

This order is very important, for to this belongs the great majority of those parasites requiring treatment in the horse.

SUB-SECTION I.—*Ascaris megalcephala* is so named on account of its supposedly large head. “ This is the largest, as well as the most common, of the round worms infesting the bowel.

FORM—Elongated and cylindrical, tapering toward both extremities. The oral opening is guarded by three papillæ, or swellings, probably analogous to teeth, and acting as tactile organs. The body is smooth, but marked by fine transverse striæ, or rings. Sexes are distinct. The males are from six to eight inches in length, with the reproductive orifice close to the tip of the tail, from which the spicules are sometimes seen protruding. The females are from seven to eighteen inches in length, and much stouter. Their reproductive ori-

fice is situated somewhat nearer the middle of the body than in the males."—(Robertson).

This ascaris of the horse, although resembling *A. lumbricoides* of man, and the *ascaris* of the pig, is not to be confounded with them, and can be distinguished from them by the greater number of papillæ on its caudal extremity.

HABITAT.—“The entire length of the canal, but chiefly the small intestines.

NUMBERS.—Usually several, occasionally very numerous.

DEVELOPMENT.—The eggs, having finely divided yolks, being passed along with the fæces from the horse, are conveyed by various agencies and find their way into ditches, ponds, or moist earth. Their vitality is not easily destroyed by cold or drought, and under favorable conditions of warmth and moisture, produce minute embryos in fourteen days. They appear in the water as free swimming larvæ, and are swallowed, probably with water or fresh fodder.*

*It is not likely that any intermediary bearer is necessary for the growth of the larvæ.—*Vide* Cobbold, p. 379.

On reaching the stomach or intestinal canal of their host, they grow rapidly and reach maturity in three weeks."—(Robertson).

SYMPTOMS AND RESULTS.—Generally speaking, this very common parasite exists in such small numbers as to occasion no inconvenience to the bearer. In this it resembles *A. lumbricoides* of man, in which the escape of one or more of the worms per anum is often the first intimation that they are present. This parasite, *A. lumbricoides* has considerable power of movement in either direction through the intestine, and may either pass upwards and escape from the mouth and nostril, or, as before remarked, pass downward. The *A. megalocephala*, which represents the lumbricoid worm of man, has similar powers of movement—consequently, it may be found in the stomach of the horse, having passed from the intestines to that viscus. But the conformation of the œsophagus proves an almost insuperable obstacle to its appearance at the anterior opening of the alimentary canal. Therefore, when noticed at all, it is when

they are passing per anum. If present in large numbers, symptoms of indigestion, intestinal obstruction, or even of occlusion, may be seen. Recurring and irregular attacks of abdominal pain, without apparent cause, depraved, irregular, generally voracious appetite, wasting of flesh in spite of a large consumption of food, a dry, unthrifty condition of the skin, pot belly, with an irregular character of the intestinal discharges, would be among the symptoms causing us to suspect the presence of this parasite.

A remarkable case was reported (1891) by Mr. J. C. Burneson, of the Ontario Veterinary College, as occurring in the practice of Ross Hale, V.S., of Sandusky, Ohio. A colt, aged four months, was noticed ailing in the evening, but on the following morning Mr. Hale being sent for, found the pulse very irregular, respirations labored and frequent, temperature 99° F., and the extremities cold. The owner stated that convulsions had taken place. The convulsions soon re-appeared, the colt plung-

ing; striking and pounding its head on the ground. The convulsions were tetanic in character. A diagnosis was made of some irritation of the bowels. Finding treatment unavailing, the colt was left, but in about two hours was seen again. It was then sinking, the action of the heart being almost imperceptible. Temperature 102° F. Death soon ensued.

Post mortem examination showed the duodenum considerably dilated, the walls thinned, and the bowel completely blocked with thousands of *A. megalocéphala*. A few were found in other parts of the small and large intestines. The other organs were healthy.

Speaking of the presence of these parasites in England and France it is stated that many of the cases resulted fatally. In one instance twelve hundred of these worms were counted, and in a similar fatal case Mr. Lewis reports that he found the small intestines literally crammed, some thousands of worms being huddled together in large masses.

DIAGNOSIS.—Usually this is easy, as the animal has generally passed several worms before being brought for treatment. Also, the symptoms are fairly well marked as a rule. Certainty, except in rare cases, can be attained by the administration of a cathartic and examination of the fæces.

PROGNOSIS.—Favorable.

TREATMENT.—*Preventive.*—Cobbold says, "So long as the water supply is good, and the fodder clean, there is no possibility of infection." Especially should horses be prevented drinking from foul road side pools.

TREATMENT.—*Medicinal.*—The diagnosis having been made, the bowels (if not already empty) must be cleared before administering a vermifuge. This may be done by a sufficient fast (over night) and an aloetic ball. The vermifuge must then be administered in the morning, before any food is given. If oil of turpentine is the vermifuge selected, a drench composed of that medicine; one to two ounces in a pint of gruel or raw linseed oil may be carefully given,

followed in the course of an hour by a bran-mash, on account of its laxative character. (Indeed, for the few days the animal is under treatment, hard food should be avoided; mash, boiled barley, carrots, etc., may be substituted.)

The turpentine and oil may be repeated on the second, or even on the third morning, if necessary, followed in twenty-four hours by a moderate purge of aloes and calomel.

Santonin in half, or one drachm doses, made into powders with linseed meal may be given for two or three mornings in succession, followed by a cathartic, using the precautions above stated as to diet, etc.

Professor Robertson speaks highly of the following combination :—

℞ Pulv. Antim. Tart., 1 ½ drachms.
 Hydrarg Submur, ½ drachm.
 Ol. Filix Mas.
 Ol. Sabinæ āā. 1 drachm.
 Pulv. Zingiber, 1 drachm.
 Terebinth Venet, q. s.
 Ft. bolus.

S.—One to be given for two or three mornings in succession, followed by a laxative if purging does not ensue.

In many cases it will be found that the second ball causes purging and nausea, in that case the third ball, or a laxative, should be withheld.

Many other vermicides and vermifuges might be mentioned, but there are few cases in which either of the above three methods of treatment will not be successful. The first is the most commonly used, and is exceedingly successful in the majority of instances.

The second method (by santonin) has this advantage, that it is more easily given than turpentine. Santonin is nearly tasteless, therefore the animal will often take the powders in his mash. It is very destructive to round worms.

Professor Robertson's method of treatment is backed by the weight of his authority.

In some cases it is necessary to repeat the treatment after a suitable interval.

In other cases a change, as from the turpentine to the second or third lines of treatment, is advisable. Another plan may be mentioned. It consists in using mechanical irritants for the purpose of clearing the bowel of parasites. The substances used are iron filings, tin filings, finely powdered glass, cowhage, etc. This line of treatment is happily out of date. It is not a safe method for the horse, and also uncertain as to the parasite. It should not be used.

In severe cases, a free use of tonics after the parasites have been expelled, is advisable. Iron is the best of such tonics, but it may be combined with others thus:—
“Sulphate of iron, gentian and quassia, of each two drachms, treacle (molasses) and linseed meal to make a ball. One to be given night and morning.”—(Finlay Dun).
Or drachm doses of the iron may be given in powders along with the food, three times a day.

In addition to the generous laxative diet spoken of, and the medicinal treatment, all

animals should have free access to rock salt, which they may lick at will.

SUB-SECTION II.

Oxyuris curvula,* or Pin Worm.—“This worm, of frequent occurrence in the horse, is often considered of trifling importance clinically, but it has power to induce irritation, indigestion, and lowering of the vital force, which ought not to be overlooked. Steady marasmus and impairment of health may, in many instances be directly traced to the presence of these worms.

FORM.—Very distinctly made up of two portions, body and tail. The body is smooth, the head cone-shaped, and the mouth armed with horny plates, or bars. The tail, which starts rather suddenly from a gradually attenuating body, is prolonged, in awl fashion, to a length equal to the body.”—(Robertson). The worms measure about one and three-quarter inches in length, that is, males—the longest of them; the female may measure as much as four

* These parasites are improperly spoken of by some veterinarians as *ascarides*.

inches. The species is easily recognized by its long, awl-like tail.

HABITAT.—“The large intestine, colon, cæcum and rectum. In the latter in particular they are often found, occasioning much irritation.”

NUMBERS.—Occasionally found in great numbers.

DEVELOPMENT.—“The ova, on extrusion from the parent worm, and from the bowel do not require an intermediary bearer in which to lodge previous to settling in the canal of the horse.” It seems probable “that they are conveyed to their host in a direct manner, by food or water. In the stomach, or small intestine, the embryos are set free. In this situation they seem to abide for two to four weeks, until they reach sexual maturity, when they proceed onwards to the large intestine, where they remain until discharged in the usual manner.”

SYMPTOMS.—With this parasite present in sufficient numbers to disturb the health of the animal, we have the general symptoms of worms, a depraved appetite, de-

vouring of strange materials, as lime, sand, manure, etc., very often in enormous quantities. There is a dry, rough coat and scurfy skin, alternate constipation and diarrhœa, with general wasting, and inability to do ordinary work. In addition there is an irritable condition of the skin at the external openings, viz., at the nostrils and anus, the latter causing rubbing of the tail. There is also a yellow colored incrustation around the anus, which is formed partly of mucus and partly of the eggs of the worms.

DIAGNOSIS.—The unthriftiness of the animal would cause suspicion of worms, and the great tendency to rub the tail, showing irritation of the parts, would lead to examination of the anus. The presence of the yellow incrustation spoken of above is presumptive evidence of the irritant being *oxyurides*; the diagnosis being confirmed if necessary by examination of the fæces, either with or without a purgative.

PROGNOSIS.—Generally treatment is successful, therefore the owner may be assured

of the recovery of the animal, so far as these parasites are concerned.

TREATMENT.—*Preventive.*—“No horse properly looked after can be infested with these worms. Local washings and stable cleanliness being secured by an attentive groom, the animals are safe. Prophylactic measures of this kind are all powerful against infection,” (Cobbold). But it is also necessary to see that the fodder and water are clean, and uncontaminated by ova. The method of infection spoken of by Professor Robertson, viz. : one horse receiving the ova by licking them off from around the anus of another may be almost completely prevented by attention to the local means spoken of above.

TREATMENT.—*Medicinal.*—In speaking of treatment it will only be necessary to refer to what is said under *Ascaris megalocephala* (page 39). Either of these agents may be employed with success, following the directions there given.*

In conjunction with these remedies, how-

*Dr. Cobbold says santonin is not successful for oxyurides.

ever, enemata of solution of common salt, tobacco, or turpentine may be given with the greatest benefit.

If the turpentine be used, two to three ounces may be dissolved in a pint of raw linseed oil.

An infusion of tobacco may be made for the same purpose (one drachm to one pint of hot water), or the old-fashioned tobacco-smoke clyster may be used. The latter "is most conveniently given by filling a common barrel syringe with smoke drawn from a tobacco pipe. Three or four syringe-fuls are sufficient at a time." Whichever enema is preferred, its use is to be persevered in for some weeks, two or three times weekly, so as to destroy those parasites which gradually pass back to the rectum. In all severe cases also, the use of sulphate of iron, as a tonic, is advisable.

In many cases it is useful to change the diet; giving soft, laxative food. Salt should be given freely in mashes, also placed within the reach of the animal.

SUB-SECTION III.

Filaria oculi, or *F. papillosa*. (Rudolphi).

FORM.—It is a round worm. “The head is broad, the mouth opens widely, surrounded by a ring of chitine, with two prominent denticles, one on either side, also two papillæ (Fig. 7). Males attain a length of three inches, females of seven. The tail of the male is spirally twisted, that of the female only slightly curved.” (Cobbold). The caudal extremity shows sixteen papillæ, eight on either side.

HABITAT.—This has usually been thought to be the eye—the anterior chamber. Certainly it is occasionally found in that situation, moving freely about in the aqueous humor, but from the specimens sent in from all parts of the country I am convinced it is much more commonly found in other parts of the body. Cobbold speaks of it as having been found in the thorax, abdomen, membranes of the brain, muscles and cellular tissues. It is not uncommonly found in the peritoneal cavity, as shown by specimens found in the dissecting room of the

Ontario Veterinary College. In fact these *Filaria papillosa* appear to be the most common parasite to be found in this position. But, although not unfrequent outside of the intestines they are never found in the lumen of the bowel. On the other hand, *Ascaris megalocoptala* and *Oxyuris curvula*, inhabitants of the intestines, are never seen outside of it.

Speaking again of *F. papillosa*, Dr. Manson, an authority on entozoa, considers that the eyeball is not really the proper habitat for this parasite, but it reaches there as an accidental result of its wanderings.

It is a fact that they are often found in nests, several being together. The same authority explains this curious circumstance by stating that, when one comes across the track of another in his wanderings, sexual instinct impels it to follow up the track. These tracks are of a yellow color, and sometimes may be readily seen by the naked eye.

NUMBERS.—If in the eye, usually single, although not necessarily so. One operator

removed three of the worms from an eye.

In other parts of the body, not numerous.

DEVELOPMENT.—Not yet fully understood.

SYMPTOMS.—(a) *Eye*.—The worm at first sets up no irritation, no symptoms therefore appear, but it may chance to be seen moving freely in the aqueous humor. Soon, however, "the symptoms seem to be conjunctivitis, the cornea obscured by nebulous effusion, the eyelids closed, and intolerance to light."*

(b) *In other parts*.—As the parasite has been found in many parts of the body, it is possible that it sets up irritation in any of these localities, thus causing the most diverse symptoms. So far, however, there is no record of it having been found in sufficient numbers to produce noticeable symptoms.

A case was reported from Owen Sound in which these worms were supposed to have caused the death of the colt. He had been unthrifty for some time, nervous

*Percival.

and irritable, coat staring, appetite irregular, a discharge from the nostrils, a staggering gait, showing nervous twitchings of the muscles of the head and neck. At last he went down and died. *Post mortem* examination revealed a few *Filaria papillosa* outside of the intestines, not sufficient to have been the cause of death. A diagnosis of irregular strangles had been made before death, which, no doubt, was correct.

DIAGNOSIS.—This can only be made positively by seeing the worm in the eye. If it (the parasite) be wandering in other parts of the body; the diagnosis is only a matter of conjecture.

PROGNOSIS.—If in the eye, it can with certainty be removed, but nothing can be done to dislodge the parasite in other parts of the body.

TREATMENT.—*Preventive*.—The life history not being fully known, only general directions as to cleanliness, good food, the avoidance of stagnant water, can be given. Also all animals should be kept up in the best condition of health.

TREATMENT.—(a) *In the Eye*.—The animal having been put under an anæsthetic and secured, a sharp-pointed scalpel is pushed flatwise through the cornea at its upper and inner margin. The aqueous humor escapes, and with it the worm, or this can be drawn out with a fine pair of forceps. The wound generally heals by first intention, and the aqueous humor is gradually re-secreted, filling the anterior chamber of the eyeball. Generally no bad effects result, although there may be a slight cicatrix at the point of puncture. The puncture having been made, however, in the position spoken of, the cicatrix (if any) does not interfere with vision.

In reference to treatment T. Marriott, A.V.D., India, writes:* During cavalry exercise on the 12th of January * * * a *Filaria oculi* was noticed springing gaily about in the aqueous humor of the near eye of a mare. “I delayed operating in order to procure some cocaine. On the following day * * * I punctured the cornea,

*Veterinary Journal, 1890.

* * * but no *Filaria* escaped. On careful examination through the now fairly opaque cornea, I detected the parasite near the inner and lower margin of the cornea, having attached itself to the iris. I then punctured immediately over the parasite. It escaped this time, but the amount of iritis set up by the *Filaria* having attached itself to the iris, considerably retarded recovery.

“To my surprise, this mare was admitted to hospital again on April 14th, with another *Filaria* in the near eye. * * * The cornea was punctured at once. * * * no iritis or ill effects followed; the cornea cleared in a short time, and the horse was discharged. I record this case * * * (partly) to show the folly of postponing the operation. Although a four per cent. solution of cocaine makes the operation painless, I shall never wait for that in future, for the parasite does not long continue to spring about as gaily as it does at first, but soon attaches itself to the iris; the tail then is the only portion moving, but this soon

winds itself around the body, describing a loop like the top of a driving whip, with the lash wound around the stock. When the worm assumes this form, puncturing the cornea is useless, at least it has been so in my practice."

There is no treatment for the parasites when they are wandering through other regions of the body.

SUB-SECTION IV.

Strongylus armatus (*Sclerostomum equinum*—Leuckart), or Palisade Worm.* This is considered by Cobbold to be the most important of the round worms of the horse. From its peculiar wandering habits, it is the cause of various and serious disturbances. Two varieties have been described, the smaller and the larger (*minor* and *major*) but these are simply the different stages of growth of the parasite.

FORM.—A round worm, measuring from one to one and a half inches in length (male) the females being about two inches.

*Named the Palisade Worm because it is so frequently found infesting the coats (or walls) of the blood vessels.

In both sexes the head is armed with numerous, closely set, upright denticles, surrounding the opening like the teeth of a trephine. It is indeed an armed strongle.

The tail of the male presents a well defined enlargement (bursa) while that of the female tapers, but is somewhat obtuse.

HABITAT.—The mature form (*Strongylus armatus major*) may be found in any part of the intestinal canal, but more commonly in the colon. The immature form (*St. armatus minor*) length, one inch and less, selects the coats of the arteries (especially the anterior mesenteric) in which to burrow. The parasite may also be found in almost any part of the body, as its wanderings from the vessels to the intestines carry it in every direction. Professor Williams states that sometimes it pierces the eyeball.

NUMBERS.—Generally few, but occasionally they are present in enormous numbers.

DEVELOPMENT.—The formation of embryos in the egg does not take place until the eggs have been dropped from the host. These embryos, having escaped from the

egg, speedily develop. The resulting larvæ have considerable power of motion, and bury themselves in the moist earth. Here they remain for two or three weeks, and emerge considerably shorter than before, from the loss of their long tails, (Robertson). Leuckart states that they then pass into the body of an intermediary bearer, such as a water snail. Having encysted themselves there, such bearer may be swallowed by the horse in food or water. In the stomach of the host the soft body of the snail is quickly dissolved by the gastric juice, and the embryos are set free. From the stomach and intestines they pass to the blood vessels; and among all the vessels they seem to prefer the anterior mesenteric. The myriad little worms lodge in its walls, each one inflicting a small wound in doing so. These wounds cause an inflammation of the coats of the vessel (endo-arteritis) and a consequent thickening of the coats; producing what is known as an aneurism. During this thickening of the coats, the parasite grows and becomes about one inch

in length. It is immature while here, but the mouth is gradually developing its armature, and sexual organs appear. The skin is then cast, and the parasite endeavors to find its way back to the intestines. In doing so it may bore (by means of the strong armature around the mouth) through almost every tissue of the body. Reaching the intestines, sexual organs are perfected, and it becomes fully mature.

Young animals are much more liable to succumb to the attacks of this parasite than are the aged, although the proportion of animals affected with aneurism is greater in the older ones.

SYMPTOMS.—In view of what has been said, it can be seen that the symptoms may be divided broadly into—

(a)—Those resulting from their presence in the intestines or other parts of the body, excepting the walls of the vessels, and

(b)—Those resulting from their presence in the walls of the vessels.

(a)—If in the intestines in considerable numbers there may be general unthriftiness,

together with indications of intestinal irritation, shown by diarrhœa alternating with constipation. If wandering in other parts of the body the marasmus may be so extreme as to eventuate fatally without other very noticeable symptoms. (*Vide* Miller's case, page 63). In addition, however, to the extreme weakness spoken of, so much irritation may be set up as to cause excessive nervous action, simulating convulsions; or, on the other hand, paralysis, generally temporary, may be the result.*

(*b*)—Their presence in the vessels is productive of the most serious consequences. We are already aware that aneurisms, some large, some small, are a result of their presence. Only one aneurism may exist, or several, and on different vessels. They vary in size from a pea to a man's head.

The pathology of these aneurisms has been worked out by Bollinger. His more important points may be thus summarized:

1st. The attacks of the *Strongyli* on the inner coat of the artery, causing endo

*See page 70.

arteritis, results, in the first place, in the thickening of the whole of the coats, consequently enlargements upon portions of the vessel; and secondly, in the formation of a clot (or more than one), partially blocking up the vessel. The thickening of the walls and the presence of the clot (thrombus) narrows the lumen of the vessel, consequently tends to increase the aneurism.

2nd. The clot may occlude the artery, but most generally only narrows its calibre. It may spread towards the smaller vessels, or towards the aorta. The thickening of the coats of the vessel, and the formation of a clot, are, then, the two results of the presence of *St. armatus*.

Now, what symptoms may we expect from these aneurisms? In man, the chief symptoms of an aneurism are due to pressure upon the surrounding organs. But in the horse, aneurisms increase so slowly in size that pressure symptoms are seldom or never recognizable. Again, the accident of rupture, so common in man, is very rare in the horse. This is due to the enormous thick-

ening of the walls of the vessel in that animal. Out of the innumerable cases of aneurism in the horse, but eighteen cases of rupture are on record.

Bollinger, who has given much attention to the matter, is of the following opinion : Large numbers of cases of colic, of gas in the intestines, etc., are the result of the thrombi. The cases are caused in the following manner :

A portion of the clot breaks off, is carried by the blood stream to a small vessel, which it fills, thus cutting off the blood supply to the part. This causes partial or complete paralysis of the bowel. Peristaltic action ceases, the fæces are not carried forward, and colics result.

Not only do colics result in the manner stated, but the palsy of the bowel tends much towards the production of enormous quantities of gas in the intestines, of ruptures of the intestines, &c.

It becomes a serious question, are those colics often caused in the manner spoken of, or, in other words, is verminous aneur-

ism frequently the cause of those dangerous conditions.

In endeavoring to answer this question, the number of horses thus affected must be taken into account. Professor Bruchmuller estimated the percentage of horses (in Europe) affected with aneurism at about ninety per cent. Bollinger says about ninety-four per cent. These figures have reference to horses over six years old, and the older the horse, the more liable he is to this form of aneurism.

Taking these figures, Bollinger says, "Among every forty horses affected with internal disease, forty are ill with colic. Among any hundred deceased horses, forty have perished from colic, and among one hundred colic patients, eighty-seven recover and thirteen die." These figures prove what a frequent affection this is, and how many victims it claims. Bollinger holds that blocking of the mesenteric arteries as spoken of above, is the cause of the vast majority of colics, "the causes hitherto accepted being for the most part insufficient."

“Considering the great losses * * * that are occasioned by the colic of horses to the horse breeder, to agriculture and to the general welfare, it is of the highest importance to discover means which should prevent the introduction to the animal of the embryos,* which are generally taken in with his food.

Granting that these careful observers are correct in stating that ninety horses out of every hundred are the subjects of verminous aneurism in Europe, the question arises, what proportion of horses are so affected on this continent? That is a question which can only be determined by a great number of independent observations carried on in different parts of the continent. It may be tentatively given as about one-third that of Europe.

If these data are correct, it follows that colics from the cause of which we are speaking cannot be more than one-third in number of those seen in Europe. But, while

*The foregoing remarks on aneurisms are mostly condensed from Bollinger. *Vide* Cobbold's *Parasites*, pp. 368 to 373.

admitting the likelihood that so skilled a clinician as was Bollinger is correct in his opinion so far as his observations go, it has yet to be proved that verminous aneurisms are in any case a cause of colic in this country. Close observations, extending over a considerable period, are necessary to settle this important point.

In view of what has just been stated, it must be admitted that there are no positive symptoms of the presence of *Strongylus armatus* in the walls of the vessels. It may yet be proved, however, that they produce colics and intestinal derangements in the manner spoken of.

Apparently causeless colics, especially occurring in an unthrifty animal, should be looked on with suspicion. Lameness in one or other of the limbs (produced in the manner spoken of under the head of Diagnoses) may also be a symptom.

The following interesting case was sent by J. H. Miller, V.S., Seville, Ohio:—"I was recently called to see a colt, two years old, which was very much run down. He

was so weak as to be unable to get up alone ; and had been failing for about two months before I was called in. After examining the animal, I informed the owner that treatment was useless. The death of the colt took place two days after my visit. I was notified, and visited the farm in order to make a *post mortem* examination. I found parasites in vast numbers in the abdominal muscles, most numerous, however, in the flanks. I examined the whole of the alimentary canal, but found no worms of any kind. A few bots were in the stomach. No other cause of death could be discovered than the parasites in the muscles.

* * * The colt was of the draft stock, and was raised on bottom lands, where he would have access to stagnant water. He was noticed to be out of health in the middle of the winter, but was turned out to grass in the spring with five other colts, these being apparently healthy. I did not look for parasites in the blood vessels, but cut into several of the large vessels and did not observe any."

Another case was reported from the same locality. This colt also was on a bottom farm and began to lose flesh two or three months before death. In this case a *post mortem* showed the parasites in the abdominal muscles very plentifully, and no other cause of death was discovered.

DIAGNOSIS.—Apart from the known frequency of abdominal aneurism, caused by *St. armatus*, which amounts, as has been said, to probably thirty per cent. in aged animals; general considerations would be the principal means of arriving at any conclusion. If an animal presents that general unthriftiness which is so marked in many cases of parasitism, and especially if he be liable to frequent attacks of colic without apparent cause, we may suspect the presence of this parasite. And a history pointing to embolism of an artery (perhaps most frequently seen in one of the iliacs) would tend to strengthen our suspicions. For there can be little doubt but that this condition, formerly ascribed to inflammation of the artery is generally

produced by a bit of fibrin blocking up the vessel. And such bit of fibrin, in the great majority of instances, comes from one of the thrombi spoken of, which exist in connection with these aneurisms.

If the bowel be now thoroughly cleared by cathartics, and the examination of the fæces shows no worms, or ova, their absence would exclude the idea of *Ascarides* or *Oxyurides*, but would not necessarily invalidate a diagnosis of *Strongyli*. The presence, however, of even a few of the latter parasites would tend to confirm it.

PROGNOSIS.—A favorable opinion may be given so far as those in the intestines are concerned. They may generally be got rid of. And even in regard to those in the vessels, it may be stated that they will ultimately pass into the intestine, whence they can be removed. It must be remembered, however, that in their wanderings to reach the intestine they may produce such injury as to cause death, as in the cases quoted. As to the results of their residence in the walls of the vessels,

viz., the aneurisms, the prognosis must be unfavorable ; these effects no treatment will remove.

TREATMENT.—*Preventive.*—Thorough stable cleanliness, care in the selection of fodder, avoiding such as comes from low-lying, swampy places, with the use of pure water (such as that from deep wells), will almost certainly prevent the ingress of this dangerous parasite.

So far as pasturage is concerned, low-lying lands must be avoided. Water from clear running streams, or wells, is not likely to contain the ova. Infected fields may be renovated by drainage and good thorough cultivation.

TREATMENT.—*Medicinal.*—Little need be added to what has already been said in regard to this (pages 39, 40). Oil of turpentine, or santonin, as there spoken of, may be used with success in so far as those in the intestines are concerned. Treatment for those in the vessels or tissues is useless. The animals must be kept in a state of vigorous health.

SUB-SECTION V.

Strongylus tetracanthus,* or Four-Spined Strongle.—This entozoon was formerly mistaken for an immature form of the worm spoken of in the last section, viz., *Strongylus armatus*. It is, however, essentially different. It is not so common as *St. armatus*.

FORM.—A very small round worm, the male measuring $\frac{1}{4}$ to $\frac{1}{2}$ inch in length, the largest females as much as $\frac{3}{4}$ of an inch. A number of denticles surround the aperture of the mouth, but they are not so easily seen as are the four large spines which are upon the outer protuberances. It also possesses two neck bristles. The body is smooth externally, and is of a well-defined red color, as it is a true blood sucker. The sexes are of nearly equal size, and are often seen united together. The tail of the male is furnished with a three-lobed hood; that of the female is pointed.

HABITAT.—In the immature state they

*Formerly known by the name *Trichonema arcuata*.

lie coiled up in the walls of the cæcum and colon, where they sometimes produce extensive changes, causing "ecchymoses, congestion, inflammation, and many small abscesses," the walls often being much thickened. When mature, they are found in the lumen of the bowel.*

NUMBERS.—Only occasionally numerous.

DEVELOPMENT.—The ova from the mature worms are expelled with the fæces, while the larvæ, which subsequently escape from the ova, are believed to enter some intermediary bearer. These bearers, on fodder or in water, are swallowed by the host, the larvæ set free in the stomach, and, reaching the cæcum and colon, bore their way into the walls of the tube. On looking at the mucous membrane, opaque spots are plainly seen of an oval shape, about one-tenth of an inch in diameter. These are capsules containing an immature worm coiled up. Here they remain for a time undergoing certain changes, and then pass back into the bowel, becoming fully mature.

*Professor Robertson.

SYMPTOMS.—In some cases symptoms are not observed until within a few hours of death. But generally speaking there is general unthriftiness and marked wasting, often with symptoms of severe intestinal irritation. The pain is frequently of an inflammatory type. The parasites may so wound the smaller vessels of the intestine as to cause fatal internal hemorrhage. Reflux disturbances are occasionally seen as shown by convulsive spasms, paralysis, etc.*

C. Taylor, V.S., of Upper Alton, Illinois,

*While it is not difficult to understand that the parasites, by irritating the nerves of the intestines (or other parts), may so stimulate the central portions of the cerebro-spinal system as to cause spasms, simulating true convulsions, it is more difficult to see how these same parasites can be the cause of paralyses. One theory is as follows: "That an irritation, operating upon certain sensory nerves, produces impressions which, after impinging upon the properly related grey matter in the spinal cord, are thence in part reflected along vaso-motor nerves regulating the calibre of certain blood vessels which supply either (*a*) the portion of the spinal cord in relation with the paralyzed parts, or else (*b*) the great nerves or the muscles themselves of the paralyzed parts. In either case, this reflection of impressions resulting from irritation of sensory nerves, upon such special groups of vaso-motor nerves is supposed to lead to a persistent spasm of the vessels, which they innervate, so as to cause a continuous anæmic condition, either of certain vascular territories in the spinal cord itself, or else of the related nerve trunks and muscles." (Brown-Sequard. *Vide* Quain's Dictionary, page 1496). The anæmia spoken of may be complete and result in permanent paralysis; or it may disappear rapidly, if the irritant be removed.

writes of four cases substantially as follows :—"The horse from which the parasites I send you were taken is the fourth I have met with in my practice, all having the same species of worm. These which I send were taken from about six inches of the mucous membrane of the colon. I am at a loss to know what name to give them. I showed them to Dr. — of this city, in his opinion they are a variety of *Trichina*. In each of the cases which I have seen, the symptoms occurred suddenly, and with great violence, the disease terminating fatally in a short time. The first case was in Manitoba in 1882. I did not see the horse till after death. *Post mortem* examination revealed millions of nematoid worms covering the mucous membrane of the cæcum and colon, also covering the contents of these bowels. The small intestines contained a few of these parasites, with a considerable amount of blood. There was no appearance of inflammation of the bowels nor any discernable cause of death, except the parasites spoken of.

"The second case was in the State of Iowa. The mare was apparently in good health that morning. About eleven a. m. she showed signs of weakness. I was sent for, and when I arrived about one o'clock, p. m., I found her down, the pulse running one hundred beats per minute, almost imperceptible at the jaw. The animal was gasping for breath, and showed a remarkable paleness of the mucous membrane. Death occurred about twenty minutes after my arrival. The *post mortem* examination revealed a condition similar to that in the first case described, considerable blood being found in the small intestines.

"The third and fourth cases were seen in this State (Illinois). A horse, five years old, was taken suddenly ill. When I saw him the same morning, the pulse was one hundred and ten, respiration seventy per minute. There was extreme weakness, but no perceptible paleness of the mucous membrane. Sensation was gone, sweats bedewed the body, the nose rested on the ground and dropped again if raised,

While looking at him, the owner came to say that a mule of his had suddenly shown the same symptoms as the horse. They both died in two hours from that time. *Post mortem* appearances in the mule were the same as in Nos. 1 and 2, excepting that there was no hemorrhage. The mucous membrane was so riddled by perforations that it could easily be scraped off. The examination of the horse showed a similar condition of the cæcum and colon."

S. H. Slocock, M.R.C.V.S., of Hounslow, writes as follows:* "Some months ago I was called to see two colts (two years old). They were said to be doing badly and scouring. I found both at grass; one was purging violently; was greatly emaciated, and showed every symptom of exhaustion from parasitic disease, the other was showing the same symptoms in a less degree. On examining the fæces, I found the blood-red strongle present in great numbers. * * * I had the colts removed to warm quarters, and they were allowed a

* *Veterinary Journal*, 1886.

most liberal diet ; a supply of rock salt and preparations of iron." The weaker colt died in a few days, as Mr. Slocock had expected, but the other gradually recovered, although for weeks he passed parasites at every motion.

He continues : " I was called to a colt on another farm. He was one of five, and had been housed at night all the winter and well cared for. He showed the same symptoms as the above colts, but for a fortnight I failed to find the parasites in the fæces. Suspecting the true origin of the purgation, I commenced the tonic treatment. The colt became gradually weaker until, seeing that the case was hopeless, I advised his destruction.

" *Post mortem* examination revealed the cæcum and the whole of the colon in a marked state of congestion and the parasites (*St. tetracanthus*) in great numbers in the canal. The larval forms could be distinctly seen arranged in a circular form under the mucous membrane of the intestines, also there were numerous punctures

of the membrane, showing the points at which the forms had made their exit on reaching maturity. *Strongylus armatus* was present with them in some numbers."

Occasionally these strongyli (*St. tetraacanthus*) cause many deaths in farm districts, as occurred in Wales some years ago. Rees Loyd, V.S., states that in one district alone, upwards of one hundred mountain ponies perished from this cause. He says that the ponies thus affected are noticed to be ailing "for three or four weeks, becoming rapidly emaciated and dying from exhaustion." Mr. Loyd thus describes one case:—"The case had suffered from colicky pains for about two months * * * I was sent for one evening about an hour before the animal's death. * * * I remained with it the whole of the time, of which about forty-five minutes of the most acute pain was borne by the trembling beast, which was leaping, rolling and tossing about. * * * Suddenly all was still, he quietly rose to his feet, and nipped grass as if nought had troubled him. I then trotted

him quietly to a corner of the field, where he got down to rise no more. The next day I examined him, and found thousands of four spined strongles."

DIAGNOSIS.—The general unthriftiness due to parasitism is more marked in connection with the presence of these parasites than with some others. Rapid wasting, with intermittent attacks of pain—which more resembles inflammation than colic—would lead to a suspicion of their presence. Persistent diarrhœa may be present; (pages 73, 74). These parasites have also a considerable tendency to produce nervous symptoms. Paleness of the mucous membrane would suggest internal hemorrhage, due to wounds inflicted by their armed mouths. But a positive diagnosis can only be made by finding the worms, or their ova, in the intestinal contents.

PROGNOSIS.—This depends upon the extent of the infection. If the animal does not succumb to the more direct attacks of the parasite, a cure may be expected, that is, if re-infection be guarded against.

TREATMENT.—*Preventive.*—The remarks made in connection with other entozoa apply here, viz., thorough cleanliness, the administration of food and water which can not convey the embryos in any form. The pastures must be such as are not likely to be infected, or, if infected, they must be cleansed by fire, salt, or ploughing and good cultivation, before being used for any horse.

TREATMENT.—*Medicinal.*—Dr. Cobbold says:—"The fatality of the disorder depends not upon the mature worms, but upon the wandering and sexually immature forms. All attempts to poison the entozoa, when once they have gained access to the tissues * * * are worse than useless. By all means let the animals have a dose of aloes in the first instance, followed by warm bran mashes, but thereafter let every care be taken to support the patient's strength. Especially should the administration of the oil of turpentine be avoided."*

*Cobbold here evidently has reference to large doses. See the following paragraph.

In Professor Williams' work there is given an account of Iceland ponies infected with this parasite. One died, the others were then treated with oil of turpentine in small doses (two drachms) night and morning, beaten up with eggs and milk, and all recovered.

The strength of the animal must be kept up to the highest point by liberal and suitable diet—nourishing, easily digested, and rather laxative—and the administration of suitable medicine, preferably iron and bitter tonics.

SUB-SECTION VI.

Spiroptera megastoma, or large mouthed maw worm.—This small parasite is not by any means so uncommon as it was thought to be formerly. But several points in its life history have yet to be worked out.

FORM.—It is a minute round worm, the male measuring one-third, the female one-half of an inch in length. "The mouth is round, very capacious, and provided with four lobes, two of which project over the

edge of the mouth, and each has two papillæ."

HABITAT.—"They are found between the mucous and muscular walls of the stomach. Their presence causes the appearance of tumors, measuring from an inch to one inch and a half in diameter. These tumors are divided into spaces by trabeculæ 'beams,' which give them a reticulated appearance. One or more of the parasites are usually found in a tumor, although in some there are none, the parasites" having passed from the tumor. (Robertson). Occasionally the contents of the tumors are found degenerated into pus, forming abscesses.

NUMBERS.—Not usually numerous.

DEVELOPMENT.—Not yet fully known.

SYMPTOMS.—The animal carrying these guests is not usually sufficiently disturbed by them to show any symptoms. *Sp. megastoma* is only recognized by finding the tumors in the stomach after death. In the present state of our knowledge, diagnosis and treatment are impossible.

Spiroptera microstoma, or small mouthed maw worm, is found free in the stomach. It is not known to produce symptoms. It is probably the same parasite as the one just mentioned, in a different stage of development, although some hold it to be a distinct species. It is larger than *Sp. megastoma*.

SECTION V.

TREMATODES OR FLUKE WORMS.

This order is mentioned only to complete the classification. One species, *Fasciola hepatica** may occasionally, but very rarely, be met with. This parasite produces the disease known as "Rot" in sheep, but has not been found in sufficient numbers in the horse to produce disease. In size, it varies somewhat, but is seldom larger than one inch in length by half an inch in breadth. It is a flat worm, resembling in outline a small leaf, and may be found in the gall duct, occasionally in the substance of the liver.

*In some works this is spoken of as *Distoma hepaticum*. Cobbold considers *F. hepatica* to be the more correct name.

The foregoing are the more important of the entozoa of the horse. *Ascaris megalcephala* and *Oxyuris curvula* are very common, every veterinarian and almost every owner of a horse has seen and knows these worms. After these, *Filaria papillosa* and *Strongylus armatus* are the commonest, although they are rarely seen by the practitioner. *Strongylus tetracanthus* is still more rarely seen, while *Spiroptera megastoma* and *S. microstoma* are very occasionally discovered in the stomach at a *post mortem* examination. But although these are all that are likely to be met with in practice, it will be well to give an even more complete list, which, by indicating the locality in which the entozoa are found, may prove to be an aid in identification of some of the rarer parasites.*

*As an example of how representatives of several different species may infest a single host, Van Beneden (*Animal Parasites*, p. 91) notes that Krause found in a two year old horse, over 500 *Ascaris megalcephala*, 100 *Oxyuris curvula*, 287 *Filaria papillosa*, 69 *Tenia perfoliata*, 214 *Strongylus armatus*, and several millions of *Strongylus tetracanthus*. Vide Leuckart, p. 11.

LIST OF ENTOZOA OF THE HORSE.

NAME.	USUAL LOCATION.
I. <i>Tenia perfoliata</i>	Large intestines.
II. <i>Ascaris megalcephala</i>	Small intestines.
III. <i>Oxyuris curvula</i>	Large intestines.
IV. <i>Filaria oculi</i> , or <i>F. papillosa</i> ..	Aqueous humor of eye-ball; also in peritoneal cavity and other parts of body.
V. <i>Strongylus armatus</i> , known also as <i>Sclerostomum equi-</i> <i>num</i> or <i>armatum</i> (mature)	Intestines.
" " (immature)	In the walls of the blood ves- sels, especially the anterior mesenteric; also in other parts of the body.
VI. <i>Strongylus tetracanthus</i> * (mature).	Intestines.
" " (immature).	Intestinal walls.
VII. <i>Spiroptera megastoma</i>	In small tumors in the stomach.
VIII. <i>Spiroptera microstoma</i> .	Free in the stomach.
IX. <i>Fasciola hepatica</i> , known also as <i>Distoma hepaticum</i> .	Gall ducts — Flat or Fluke Worms.
X. <i>Amphistoma collinsii</i>	Colon—Flat or Fluke Worms.
XI. <i>Echinococcus veterinorum</i> ..	Cysts in liver.
XII. <i>Cenurus cerebralis</i>	Brain (cystic form).

*This was formerly known as *Trichonema arcuata*.

NAME.	USUAL LOCATION.
XIII. <i>Filaria lachrymalis</i>	Between lids and eye-ball, and in the lachrymal ducts.
XIV. <i>Onchocerca reticulata</i>	Coiled in the muscles.
XV. <i>Strongylus micrurus</i>	Bronchial tubes.
XVI. <i>Strongylus</i> or <i>Eustrongy-</i> <i>lus gigas</i>	Kidneys.
XVII. <i>Filaria sanguinis equi</i> (microscopic).....	Floats in the blood.*

*Bots, treated of in Section vi., do not properly belong to the entozoa.

SECTION VI.

BOTS.

Bots are the larvæ of certain insects, known commonly as gad-flies. The common gad-fly (*Æstrus equi* or *Gastrophilus equi*) lays its eggs on many parts of the horse, principally on those parts which can be reached by the mouth of the animal. There are other varieties of gad-fly, however, one of which places the egg in the intermaxillary space, another attacks the nose, etc.

FORM.—As seen in the stomach, the bot (being the young of *Æstrus equi*) is of a light reddish color, about half an inch in length, tapering to both extremities. At the smaller extremity is the head, upon which may be seen the opening of the mouth. At each side of this opening there is a strong hook by which the parasite can hold to the mucous membrane. The skin is not smooth, but shows a number of transverse elevations and depressions, which give it a ringed appearance.

NUMBERS.—Generally few, but sometimes present in enormous numbers.

DEVELOPMENT.—The gad-fly attacks the horse late in summer, and deposits its eggs on some part of the animal which can be reach by its mouth, viz., on shoulder, knee, etc. The eggs having been firmly glued to the hairs, warmth and moisture are necessary for their development. These are supplied when the animal licks the part; then the growth of the embryo begins. In about three weeks they have assumed the maggot like form, and are transferred to the mouth, probably by the tongue or teeth of the animal, while licking or gnawing the part. A great many larvæ perish during this passive mode of migration, some being dropped from the mouth, others being crushed in the fodder during mastication. But some are carried down from the mouth to the stomach, either with food or water. Occasionally in their passage downwards, they lay hold of the mucous membrane of the pharynx, and remain in that situation. The majority reach the

stomach however, and by means of the two large hooks upon the head, anchor themselves so firmly there as almost to defy dislodgment. They may be found thus anchored on any portion, either of the cuticular or villous mucous membrane of the stomach, or even in the small intestines leading away from that viscus. Wherever they lay hold, they retain it until the following spring, gradually growing the meanwhile.*

Having attained their full growth by gradual development through the autumn, winter, and following spring, they, during early summer, voluntarily loosen their hooks from the mucous membrane, fall off among the contents of the stomach, and are carried with the fæces, away from the animal.

Having been dropped upon the ground, they bury themselves in the soft soil, remaining there for a period of six or seven weeks. They are gradually developing from the pupa state to that of the insect,

* *Vide* Cobbold on *Parasites*, p. 385.

and, at the end of that time, emerge as perfect gad-flies.

The history may be summarized as follows :

The eggs are laid in the autumn. The same autumn the maggots escape from the egg, are carried to the stomach, and gradually grow there during the following eight months.

They then loosen their hold and pass out with the fæces, bury themselves, and after a period of six or seven weeks* emerge as gad-flies.

This is the life history of *G. equi*. There are several other species (as *G. hemorrhoidalis*) which attack the horse, but it is unnecessary to speak particularly of them.

SYMPTOMS AND EFFECTS.—These are very indefinite. Bots undoubtedly may set up serious irritation, but “the irritation caused by them is not easily distinguished from ordinary indigestion,” nor from the condition produced by some of the entozoa.

*Cobbold says six or seven weeks. Gamgee says eighteen or nineteen days.

“ It (the indigestion) may be tympanitic or not, or accompanied or not with diarrhœa, and of the most variable intensity.”*

That they may mechanically interfere with digestion to a serious extent is admitted. If collected in large numbers around the cardiac orifice, they may prevent the proper ingestion of food, or, if at the pyloric opening, the food may not pass from the stomach properly.

The symptoms and results of a peculiar case are reported by T. Tegg, M.R.C.V.S.† “ The animal showed dull, continuous pain, was very weak, and would not eat. The second day, still weaker. The third day, debility was more marked, while it died on the fourth day. It died in great abdominal pain. The autopsy showed enormous distension of the stomach, it being largely occupied with food. Ninety-seven bots were picked off the villous coat, near the pylorus, and the irritation which had been set up by their hooks in the mucous mem-

* *Vide* Law's *Veterinary Adviser*, p 172.

† *Veterinary Journal*, 1882.

brane resulted in considerable tumefaction ; so much, indeed, as to close the pyloric orifice, and thus prevent food from passing into the intestines."

One case of tetanus is reported as having been due to bots, and it is possible that they may perforate the stomach, leading to symptoms of peritonitis, which may result in death. Bracy Clark held that bots actually aided digestion by stimulating the flow of gastric juice, but this idea is not now entertained. If the bots adhere to the mucous membrane of the pharynx they produce a soreness of the throat, with, usually, a discharge from the nostrils.

DIAGNOSIS. — A positive diagnosis is almost impossible. The history of the case may throw some light upon it. If the animal has been out at grass the previous season, he is almost sure to possess some bots. A history of marked indigestion (especially if recurring) without other adequate cause, the attacks coming on in the spring or early summer, the animal being weak and unthrifty, the bots passing away in the dung

and the animal turning up his lip as if nauseated, these would all tend to show that the indigestion was due to the presence of bots.

PROGNOSIS.—If an opinion be called for in spring or early summer a favorable one may be given. But at any other time medicinal treatment is highly unsatisfactory.

TREATMENT.—*Prevention.*—Preventive treatment is satisfactory. Horses exposed to attacks of gad-flies may be protected to a large extent by oiling freely the portions of the body where the eggs are usually deposited. The eggs will not adhere to the hair when oiled. The long hairs should be trimmed off before oiling.

The gad-flies belonging to one species always attack the intermaxillary space; they can be warded off in many cases by a piece of cloth stretched between the two sides of the bridle. If the horse be valuable enough, it is well to remove any adhering eggs every second day.

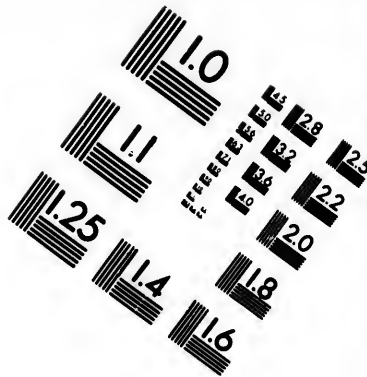
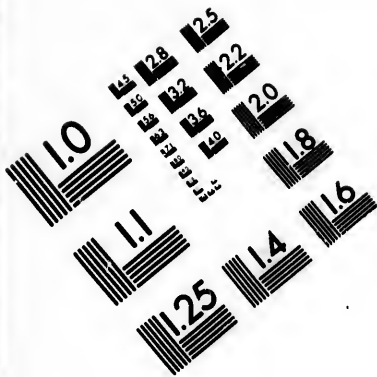
TREATMENT.—*Medicinal.*—The vermifuges previously mentioned may be given,

but with doubtful success. Finlay Dun recommends rubbing down two drachms each of aloes and assafœtida in hot water, adding when cool one ounce each of turpentine and ether. This may be repeated two or three times a week, leaving out the aloes if physicking takes place, but administering a cathartic dose if it does not. Large doses of carbolic acid, followed by purgatives, have also been well spoken of.* Professor Law thinks that vermifuges given as soon as the bot-fly season is over, and before the larvæ have attained their thick skin, may be successful in removing them. The most successful treatment, however, is free purgation at the time when they have relaxed their hold on the stomach. Their exit then may be hastened materially.

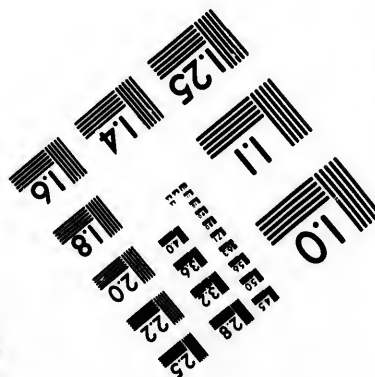
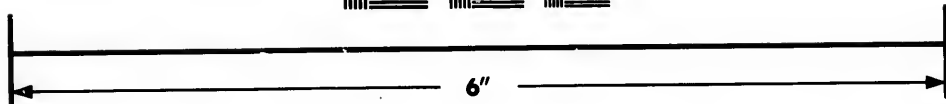
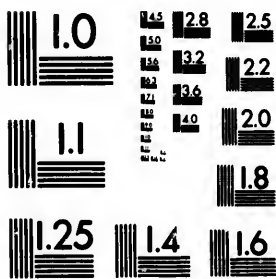
If the parasite is in the pharynx, it may often be removed by hand. Those that attach themselves to the anus, causing considerable irritation and annoyance (shown by switching of the tail, etc.) may easily be picked off by forceps.

*Dose for a horse, half a drachm to one drachm (Law).





**IMAGE EVALUATION
TEST TARGET (MT-3)**



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23 WEST MAIN STREET
WEBSTER, N.Y. 14580
(716) 872-4503

1.5 1.8
2.0 2.2
2.5 2.8
3.2 3.6
4.0 4.5

5.0 5.6
6.3 7.1
8.0 9.0

GENERAL SYMPTOMS OF PARASITISM.

While the effort has been made in this work towards a diagnosis of the separate species, it must not be forgotten that a host may harbor many species of entozoa at the same time (page 81, note). The symptoms, in such a case, would be the general ones of parasitism—the special indications being more or less masked. Those general symptoms are thus described: “There are general signs of ill-health, poor constitution, pot-belly, hide-bound, a scurfy, dry state of the skin, often with itching, irregular and often voracious appetite, fœtid breath, diarrhœa alternating with costiveness, the passage of mucus with the dung, slight colicky pains with tympany, especially in the morning before feeding, a puffy swelling and itchiness of the anus, which is often surrounded with a fur of dried mucus, and above all the passage of the worms or their eggs.” *

*Law's *Veterinary Adviser*, p. 179.

The figures here presented (Nos. 1 to 5) are diagrammatic, and intended to present the general outline of the parasite, but more especially to fix their relative sizes in the memory. They are life size, the smaller specimens having been selected for representation.

FIG. I.—ASCARIS MEGALOCEPHALA.

Length—Male, 6 to 8 inches.

Female, 7 to 18 inches.

FIG. II.—FILARIA OCULI, or F. PAPILOSA.

Length—Male, 3 inches.

Female, 7 inches.

(The figure is from a specimen found in the peritoneal cavity. Those located in the eyeball are, as a rule, smaller).

FIG. III.—OXYURIS CURVULA, (altered from Law).

Length—Male, $1\frac{3}{4}$ inches.

Female, 4 inches.

FIG. IV.—STRONGYLUS ARMATUS.

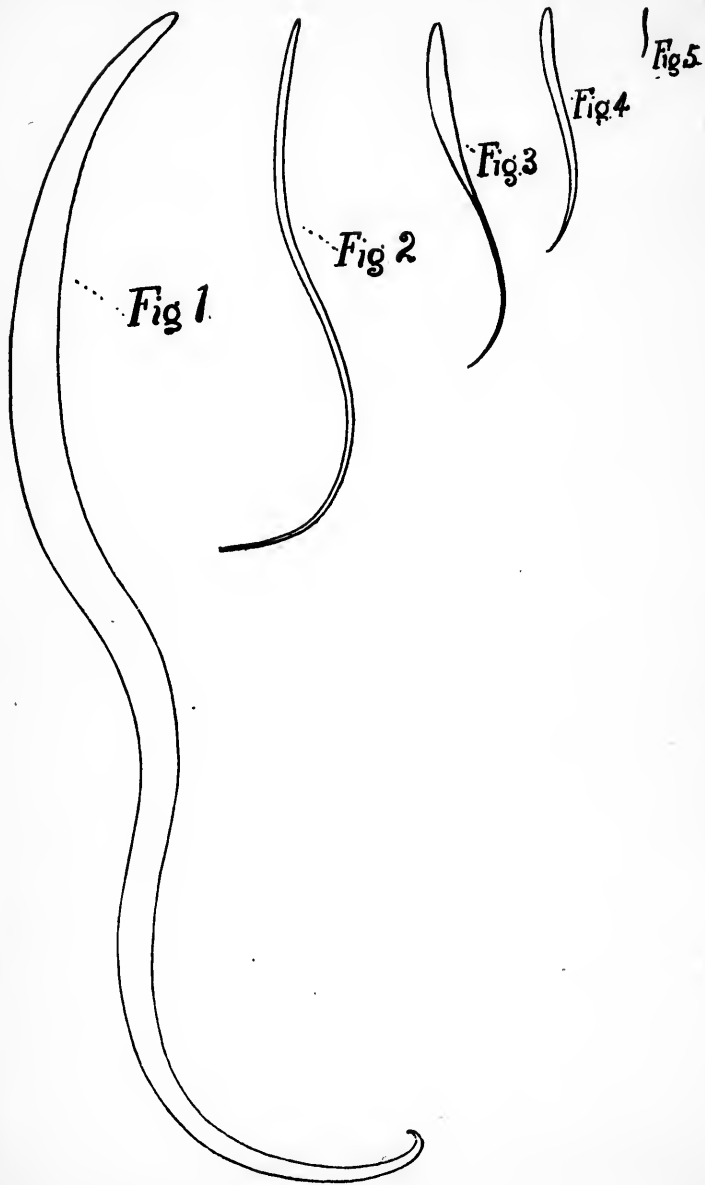
Length—Male, $1\frac{1}{2}$ inches.

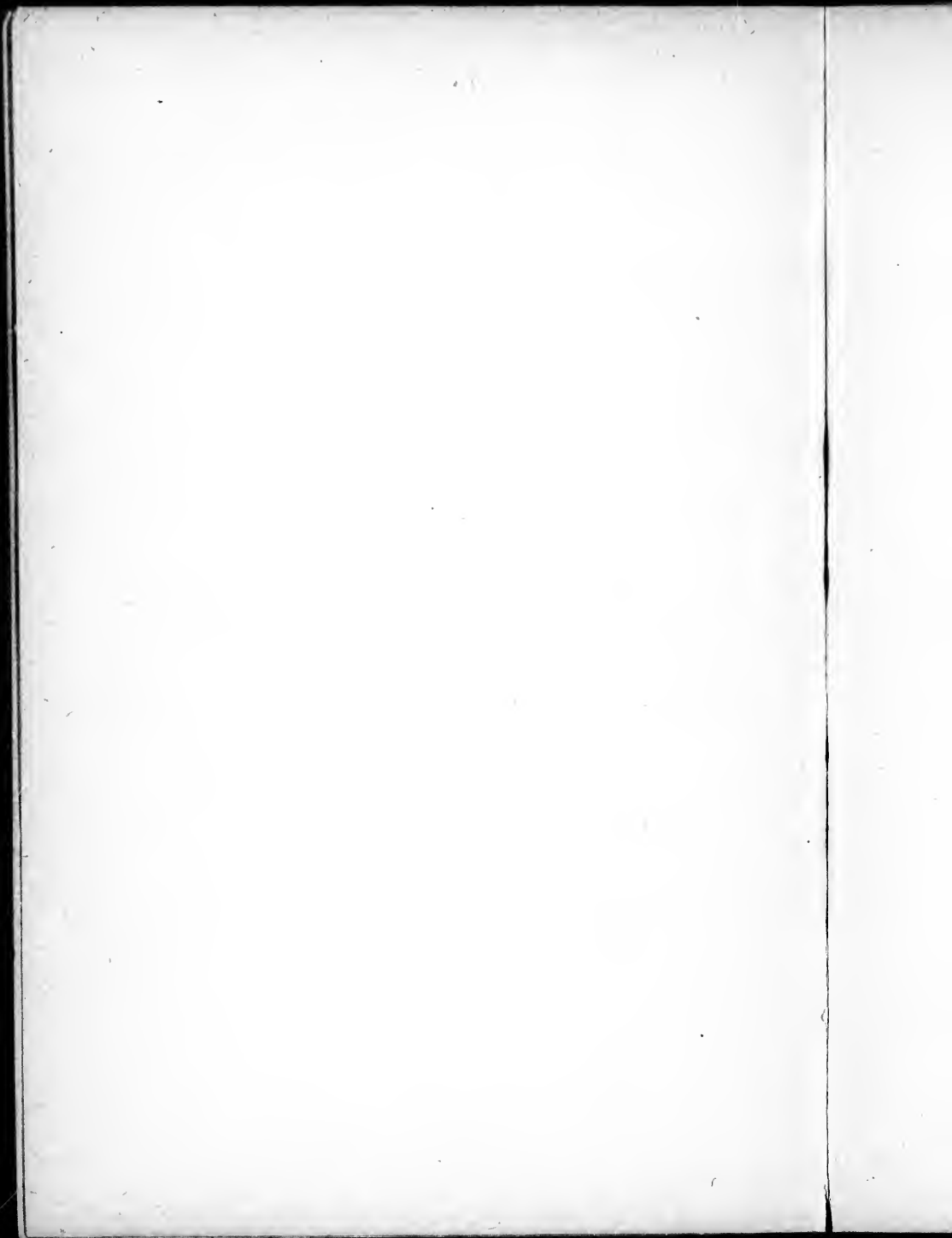
Female, 2 inches.

FIG. V.—STRONGYLUS TETRACANTHUS.

Length—Male, $\frac{1}{4}$ to $\frac{1}{2}$ inch.

Female, $\frac{3}{4}$ inch.





These figures (Nos. 6 to 10) are also diagrammatic. They are more or less magnified, but are not drawn to give any idea of the size, nor of the relation of one to another in this particular. They are outlines of the heads as they appear under slight pressure, and may be an aid to identification in doubtful cases.

FIG. VI.—Head of *ASCARIS MEGALOCEPHALA*.

FIG. VII.—Head of *FILARIA OCULI* or *F. PAPPILLOSA*.

FIG. VIII.—Head of *OXYURIS CURVULA*
(after Busk and Cobbold).

FIG. IX.—Head of *STRONGYLUS ARMATUS*.

FIG. X.—Head of *STRONGYLUS TETRACANTHUS*.

F


Fig. 6.



fig. 7



Fig. 8



Fig. 9



Fig. 10



