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STUDIES ON THE TREATMENT
OF HABRONEMA
INFESTATIONS OF HORSES

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THESIS

STUDIES ON THE TREATMENT OF
HABRONEMA INFESTATIONS OF HORSES

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HABRONEMA INFESTATIONS OF HORSES

by

Francis Hugh Wilson

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TABLE OF CONTENTS

Title

Acknowledgment

I. Introduction

II. Life History

III. Review of Literature

IV. Colloidal Iodine (Chandler)

V. Experimental

VI. Discussion

VII. Summary

VIII. Conclusion

IX. Plate

X. References

STUDIES ON THE TREATMENT OF HABRONEMA INFESTATIONS OF HORSES

INTRODUCTION

The prevalence, and methods, of treatment for stomach parasites of the horse has long been a problem of economic importance to the veterinarian and horseman. It is common knowledge that at least annual treatment for certain species of stomach parasites should be employed as a routine measure. There are, however, two helminth parasites (Nematode), which have received less attention and undoubtedly have been overlooked by the veterinary profession and the horse industry. These nematodes, of the genera Habronema and Trichostrongylus, are commonly known as the large and small "stomach worms", respectively. There are three species of the genus Habronema that are parasites of the horse stomach: H. megastoma, H. microstoma, and H. muscae, and it is only with these Habronema that the following work deals.

These large stomach worms are long, finely filiform, white in color, varying from one-third to one inch in length. The H. muscae and H. microstoma are of similar size, while H. megastoma is the smaller, ranging from one-third to one-half inch.

According to my observations, and those of others,

Habronema species may occur free in the stomach or attached to the mucous membranes, and often imbedded in the wall, usually near the intestinal opening. These nematode parasites are frequent and of wide distribution. They have been observed in various parts of the world.

The wide distribution, the damage caused by the worms, and because it is practically impossible to diagnose their presence, is certainly reason for not taking Habronema infestations too lightly. Approach to control may be had by two methods:

1. The elimination of favorable breeding conditions for the intermediate host and general stable sanitation.
2. The removal of the worms from the host by internal treatment with a favorable and efficient vermicide.

Many drugs have been used for treatment of stomach parasites of the horse (19). The most widely used is carbon disulphide, administered for a general vermifuge of all the stomach parasites. Carbon disulphide, like most drugs used as vermifuges, has normally a marked irritating action on the parts exposed, and, in many cases, is counter-indicated. Because of the toxic effects that the common drugs have in cases of advanced pregnancy, gastro-enteritis, and aged and generally run down subjects, Colloidal iodine (Chandler), which is comparatively non-

irritating, was used in this work to determine its efficiency in the removal of Habronema sp.

LIFE HISTORY

According to Schwartz, Imes, and Wright (15), and various other workers, the evolution of the Habronema sp. has been reported to be as follows:

Habronema eggs, containing fully developed embryos, are deposited by the female while in the horse's stomach. The shells of the eggs are very thin, flexible, and transparent, enabling it to change shape as the embryo develops and increases in length. They are discharged from the horse with the feces, and swallowed by fly maggots. The worm larvae develop in the maggot and pupae of the fly, and are infective when the fly emerges from the puparium. H. muscae and H. megastoma develop in the fat bodies and malpighian tubules of the house fly (Musca domestica), respectively. H. microstoma develop in the fat bodies of the stable fly (Stomoxys calcitrans). They may also develop in other flies. The infective larvae gain entrance to the digestive tract by way of the nose and mouth. Under favorable conditions of warmth and humidity, the larvae leave the proboscis of the fly when it comes in contact with the lips and mouth and open skin lesions of the horse. Once deposited on the lips, the larvae are swallowed and enter the stomach, where they develop into mature worms.

Another possible, probably less common, means of in-

gestion by the horse is by swallowing dead flies which still are harboring living larvae of Habronema sp.

According to Price (14) there is no available data as to whether the eggs or larvae are seasonal in occurrence. Climatic conditions are, however, favorable during the summer months for the development of the larvae outside of the animal's body. Embryos are seldom seen in the fecal material.

REVIEW OF LITERATURE

Hutyra and Marek (10) describe gastric swellings caused by H. megastoma in New South Wales. Neumann, as translated by Fleming (12), described two species of Spiroptera; they are S. megastoma and S. microstoma. Schwartz, Ines, and Wright (15) make note of work done in Europe, Africa, and elsewhere, on the disease of summer sores caused by the larvae of the large stomach worm. According to Hegner, Root, and Augustine (9), H. megastoma appears to be of wide distribution, and, in this country, is especially prevalent in the southern United States. Giltner (8), reports stomach worm infestations in Kentucky, and, according to Price (14), 20.31 percent of sixty-four horses slaughtered near Washington, D. C., under supervision of Allen McIntosh, of the Zoological division of the Bureau of Animal Industry, United States Department of Agriculture, harbored tumors of Habronema megastoma. In recent reported work by Britton (2) 31 of 35 California horses were infected with Habronema

microstoma. This species and Habronema muscae were present in horses examined from Oregon and Nevada. The writer has observed Habronema sp. in stomachs of a large number of slaughtered horses in Michigan, Illinois, and Missouri.

Investigations by Thorpe and Graham (17) show that these parasites attach themselves to, and partially penetrate, the wall of the stomach, allowing bacteria to invade the tissues. H. megastoma may be found in nodules or tumors in the stomach; and Hegner, Root, and Augustine (9) have seen parts of the bodies projecting from the summit of the tumors. Schwartz, Imes, and Wright (15) found that large tumors located near the pyloric sphincter interfere, mechanically, with the passage of food.

H. microstoma appears to be the most harmful. It sometimes lives in large groups or colonies of individuals free, or often found imbedded in the mucous membranes by its anterior end, and, according to Hutyra and Marek (10), leads to ulceration in these cases.

For some time, it has been thought that skin lesions, or "summer sores", have been caused by the larvae of Habronema, the larvae being deposited on the skin by the fly, the intermediate host of the parasite. Schwartz, Imes, and Wright (15) reported, definitely, the occurrence of the larval forms of Habronema sp. in summer sores in horses in the United States.

Wright (19), and others, have used carbon disulphide in the treatment of Habronema sp., and, according to their

reports, find it effective to reduce the number an appreciable amount. Lumb (11), states that carbon disulphide will remove the stomach worms that are accessible. Despite the effectiveness of this drug, there are times when, for some reason, the desired results are not obtained.

COLLOIDAL IODINE (CHANDLER)

Chandler (3) reported the discovery of the vermicial action of iodine and, in 1925 (4), stated that weak solutions of iodine (18 parts per million) killed fully exposed encapsulated hookworm larvae, and reported his discovery of a colloidal form of iodine. Colloidal Iodine (Chandler)* is a colloidal suspensoid. The suspending fluid is a saturated water solution of iodine, the suspended material held in dispersion by the action of a protective colloid, gum arabic. The suspensoid carries a supply of readily available iodine, in dilute solutions, and is comparatively non-toxic, non-irritating, and will not injure skin or mucous membranes of parts exposed, unless unduly prolonged or excessively applied.

*Colloidal Iodine (Chandler), according to the formula developed by W. L. Chandler, is manufactured by Merck & Co. in several forms; two of which are, and hereafter, will be referred to as, Iodine Suspensoid and Iodine Vermicide.

In the annual reports of the Division of Veterinary Science, Michigan State College, for the years 1924 to 1934, Chandler (5) gives the progress made and the results obtained in experimental work with the vermicidal use of iodine. He found that a tepid active aqueous solution of "hyperactive" iodine, containing .05 percent iodine, may be successfully employed as an entero-gastric for dogs and silver foxes. When the solution is administered per rectum under pressure, until the vomit contains a large percentage of free iodine in solution, both hookworms and roundworms appear to be completely destroyed; and, following this lavage, much improvement has been observed in gastro-enteritis cases.

Experimental work (7), done with silver foxes, showed that pills containing, .5 grams of iodine absorbed by powdered skim milk, were efficient against both hookworms and roundworms.

In working with sheep, it was found that a protein-iodine compound, containing two percent absorbed iodine, was wholly efficient in three ounce doses, when it entered the fourth stomach of the sheep; and a four ounce dose of a suspension of colloidal iodine, containing one percent iodine, and any sulphate in solution, administered by the drench method, readily entered the fourth stomach, and was effective in killing the stomach worms in ninety-seven out of ninety-eight infested lambs thus treated.

Data of work by Alderman (1), shows that thirty cubic centimeters of a 1.8 percent iodine suspensoid is one-hundred percent efficient against both round and tapeworms of poultry. Stafseth (16), after working on the treatment of tapeworm infestations of poultry, concluded that Iodine Vermicide, a colloidal iodine containing 2 percent iodine, plus 4 percent gum arabic, should be recommended as a valuable aid in the control of tapeworms in chickens.

Iodine Suspensoid has been definitely proven, Weisner (18), to be of great value in controlling coccidiosis in chickens. Feeding of this product in excess of the normal iodine requirements of chickens may be of value in aiding the chickens to overcome the action of the toxins arising as the results of intestinal parasitism.

Foxes recently given Iodine Suspensoid, show a marked improvement in general condition and fineness of fur coat. Dog owners, fitting their dogs for shows, have given capsules of iodine powders (colloidal), with results in obtaining fineness of hair coat.

The careful administration of Iodine Suspensoid has comparatively no toxic or harmful effects on the subject treated. Stafseth (16) found that Iodine Vermicide was harmless when given to birds suffering from disease, and Nyiri and Dubois (13), in comparing the corrosive action of Tincture of Iodine and Iodine Suspensoid on the mucous membranes of the rabbit, found that the colloidal product

had one-fourth to one-sixth the corrosive action of the Tincture. Chandler (7) demonstrated that there was no blistering of the skin when Free Iodine (Colloidal Suspensoid state) was carefully employed in the treatment of certain types of Dermatomycoses in humans.

EXPERIMENTAL

Horse No. 1

Horse had been fed four hours prior to treatment.

Received 450 cc. of a 1 percent solution of Iodine Suspensoid administered by the stomach tube method while the horse was anesthetized and on its right side.*

Destroyed in $\frac{1}{2}$ hour, and the stomach and upper 18 inches of duodenum examined.

There was heavy infestation of *Gastrophilus* sp. larvae in the cardia, pylorus, and upper intestine. Many of the large, more mature, larvae were displaced, but the immature forms were apparently not disturbed.

A ~~//~~ infestation** of immature filarioids was found dead in the pylorus and upper intestine.

The pylorus was well stained by the iodine.

*Several horses used in this work were also used as surgery subjects in the Surgery and Clinic department, and so were cast and anesthetized with chloral hydrate, and, following the surgery class procedure, were destroyed and posted.

**~~-~~ less than 100; ~~//~~ number few, difficult to detect;
~~///~~ many; ~~////~~ very many, numbers undeterminable.

Horse No. 2

Received feed four hours prior to treatment.

Received 450 cc. of a 1.2 percent solution of Iodine Suspensoid administered by the stomach tube method, while the horse was anesthetized and on its right side.

Destroyed in $\frac{1}{2}$ hour and the stomach and upper 18 inches of duodenum examined.

Larvae of *Gastrophilus* sp. were present, of which the mature forms were mostly detached, while the immature larvae were not disturbed.

Habronema sp. (//) were found dead and stained in the pylorus and duodenum.

The pylorus was well stained.

Horse No. 3.

Horse received no feed for 12 hours prior to treatment.

Received 500 cc. of a 2 percent solution of Iodine Suspensoid administered by the stomach tube method, while the horse was anesthetized and on its right side.

Destroyed in $\frac{1}{2}$ hour and the stomach and upper 18 inches of duodenum examined.

Immature larvae of *Gastrophilus* sp. were undisturbed. *Habronema* sp. (//) were dead and heavily stained.

The mucous membranes of the stomach and duodenum were well stained. There was an inflammation at the pyloric sphincter.

Horse No. 4

Horse had been fasted for at least 12 hours before treatment.

Received 500 cc. of a 2 percent solution of Iodine Suspensoid administered by the stomach tube method while the horse was anesthetized and on its right side.

Destroyed in $\frac{1}{2}$ hour and the entire digestive tract opened and examined.

The stomach distended very little, but contained most of the solution administered. The mucous membranes of the entire stomach were well stained.

Immature larvae of *Gastrophilus* sp. were undisturbed.

Habronema sp. (✓✓) dead and well stained.

Horse No. 5

Horse had been fasted for at least 12 hours before treatment.

Received 6 drams of liquid carbon disulphide administered by the stomach tube method while the horse was anesthetized and on its right side.

Destroyed in 1 hour and the entire digestive tract opened and examined.

Very few larvae of *Gastrophilus* sp. were disturbed. Strongyles in the lower tract showed no affects.

/ infestation of *Habronema* sp. present and alive.

A portion of duodenum, to which bots were attached, was submerged in a 2 percent solution of Colloidal Iodine. The first larvae detached in three minutes, in thirty minutes 50 percent had let go, and the remaining number did not detach.

Horse No. 6 (Four months old colt)*

Received 570 cc. of a 2 percent solution of Iodine Suspensoid administered by the stomach tube method.

Destroyed in $\frac{1}{2}$ hour and the stomach and upper 18 inches of the duodenum opened and examined.

Larvae of *Gastrophilus* sp. detached in the lumen.
✓ infestation of *Habronema* sp. dead and well stained.

The mucous membrane of the stomach was very heavily stained and there was evidence of iodine in most of the duodenum which was later opened.

*The digestive tract was free from any material because the subject was unable to swallow, due to paralysis of the throat.

Horse No. 7

Horse had been fasted for at least 12 hours before treatment.

Received 6 drams of liquid carbon disulphide administered by the stomach tube method while the horse was anesthetized and on its right side.

Destroyed in 1 hour and the stomach and upper 18 inches of duodenum opened and examined.

Larvae of *Gastrophilus* sp. below the pylorus alive.
Habronema sp. (✓✓) present and alive in pylorus and duodenum.

Horse No. 8

Horse had been fasted for at least 12 hours before treatment.

Received 500 cc of a 1.2 percent solution of Iodine Suspensoid, and 200 cc of a sodium bicarbonate solution administered by the stomach tube method while the horse was anesthetized and on its right side.

Destroyed in 2 hours and the stomach and upper 18 inches of the duodenum opened and examined.

40 percent of *Gastrophilus* sp. larvae detached.
Habronema sp. (✓✓) destroyed, not visibly stained.
Little evidence of iodine present at time of slaughter.

Horse No. 9

Horse had been fasted for at least 12 hours before treatment.

Received 300 cc. of a 2.4 percent Iodine Suspensoid solution and 300 cc. of a 4 percent sodium bicarbonate solution; totally a 1.2 percent Iodine solution administered by the stomach tube method while the horse was anesthetized and on its right side.

Destroyed in $2\frac{1}{2}$ hours, and the stomach and upper 18 inches of duodenum opened and examined.

Small percentage of bot larvae detached. There was a flaking of bile between the Ampulla of Vater and the pylorus.

~~///~~ Habronema sp. infestation dead and stained. The iodine was all destroyed by the ingesta.

Horse No. 10

Horse had been fasted for at least 24 hours before treatment. Received 500 cc. of a 1 percent solution of Iodine Suspensoid administered by the stomach tube.

Destroyed in 10 days, and the entire digestive tract opened and examined.

There were no parasites of any kind present; however, there were lesions showing recent infestation by Bots, Strongyles, and Ascaris.

Horse No. 11

Horse had been fasted for at least 24 hours before treatment.

Received 500 cc. of a 1 percent solution of Iodine Suspensoid administered by the stomach tube method. Allowed to eat $\frac{1}{2}$ hour after treatment.

Destroyed in 10 days, and the entire digestive tract was opened and examined.

The stomach contained attached bot larvae. There was, however, evidence of recent detachment of about 40 percent of the larvae. A few Strongyles were present in the caecum.

/ Habronema sp. larvae present and alive.

Horse No. 12

Horse had been fasted for at least 24 hours before treatment.

Received 1000 cc. of a 1 percent solution of Iodine Suspensoid, administered by the stomach tube method.

Destroyed in 10 days, and the entire digestive tract was opened and examined.

The stomach contained a very heavy infestation of *Gastrophilus* sp. larvae.

~~///~~ *Habronema* sp. present, 50 percent of which were living.

Horse No. 13

This horse received no medication. There was a very heavy infestation of larvae of *Gastrophilus* sp. *Habronema* sp. were present (~~////~~) and there was a great deal of congestion of the pylorus where most of the *Habronema* were found.

Horse No. 14

Horse had been fasted for at least 24 hours before treatment.

Received 500 cc. of a 2 percent solution of Iodine Suspensoid administered by the stomach tube method.

Destroyed $\frac{1}{2}$ hour after medication.

No bot larvae present.

~~///~~ *Habronema* sp. infestation. All worms appeared to be living.

The stomach lining was very heavily coated with mucous.

There were, along the cardia-pylorus margin, four or five nodular appearing pathological structures. There were no larvae or encysted parasitic forms present. Whether these growths had any parasitic significance was not determined.

Horse No. 15

Horse had been fasted at least 30 hours before treatment.

Received 500 cc. of a .2 percent solution of Iodine S uspensoid administered by the stomach tube method.

Destroyed in 8 days after the medication, and the stomach and upper 18 inches of duodenum were opened and examined.

A ~~///~~ infestation of live Habronema sp. was present. There were apparently no effects from the Iodine given.

The stomach lining was very heavily coated with mucous.

Horse No. 16

Horse had been fasted for at least 24 hours before treatment.

Received 1000 cc. of a .3 percent solution of Iodine Suspensoid, administered by the stomach tube method.

Destroyed in 10 days, and the stomach and upper 18 inches of the duodenum were opened and examined.

A ~~///~~ infestation of live Habronema sp. was present. The stomach lining was heavily coated with mucus.

Horse No. 17

This horse received no medication. The stomach and upper 18 inches of the duodenum were opened and examined to determine whether there were any parasites present.

There was a small number of larvae of Gastrophilus sp.

No Habronema or lesions were found, and there were no indications that the subject had been infested.

DISCUSSION

Fecal examinations, of both the flotation and the centrifuged sugar solution methods, were run prior to each treatment, but, in no case, were there any Habronema eggs seen. However, practically all of the Habronema encountered on post-mortem were immature. There were, in several cases, strongyle and ascaris eggs.

Of the seventeen horses slaughtered, fifteen were infested with one or more of the three species of Habronema. No attempt was made to identify the species in this work, because the main point of interest was the effect of Iodine Suspensoid on the large stomach worms in general. The subjects used varied in age from a four months old colt to aged horses, and from those of average condition to those in a weakened and poor state of health. Age had little affect on the degree of infestation, as horses of comparatively younger age were found to be the host of as many worms as those of older ages.

One of the two horses that were free from Habronema, horse N_o. 10, was a clinical case, and, in reviewing the clinical history, it was found that this horse had received, previously, two worm treatments. It had been treated with carbon disulphide for bots, and received a month's feeding of a conditioning powder containing nux, quassia, and arsenic, ending six weeks before administration of the iodine.

In cases of heavy infestations of *Habronema*, there repeatedly appears a very tenacious covering of mucus over the lining of the stomach, in which the worms imbed themselves. This condition was found to be true in horse No. 14, 15, and 16. The tenacious film makes the worms more or less inaccessible, and may explain why occasionally usual effective treatments fail. To overcome this and aid in removing this mucus coat, it has been suggested, by various workers, that the stomach be rinsed with a warm, weak solution of sodium bicarbonate before the administration of the vermifuge. It was observed that the administration of sodium bicarbonate with iodine obtained the desired results in this condition.

The administration of Iodine Suspensoid was used in varying doses, and amounts, and it was shown that solutions of 2 percent iodine were most effective in the killing of Habronema sp. Solutions of .2 and .3 percent iodine did not kill any of the parasites, and while a 1 percent solution did destroy all Habronema in horse No. 1, it was less efficient in the case of No. 11, and was only about 50 percent efficient in killing the large stomach worms in horse No. 12. In light infestations, solutions of 1.2 percent were fairly effective, and when given to horse No. 8 and No. 9, with four percent solutions of sodium bicarbonate, success was obtained in the destruction of the worms.

Iodine Suspensoid, because of its activity, is relatively quickly destroyed by the action of secretions of materials within the digestive tract, but solutions of 2 percent iodine were apparently of a sufficient strength to destroy the stomach worms and stain the mucous membranes before losing its vermifugal power even with small amounts of ingesta present.

Quantities of 500 cubic centimeters of solution are of great enough volume to expose the dispersed iodine to the stomach wall, providing the animal has been starved so that there was little or no ingesta present. Grain in the stomach has a slower action in destroying the germicidal action of the iodine than does hay and straw.

Iodine Suspensoid did dislodge large bot larvae, but did not remove all small bot larvae, nor other parasites of the lower digestive tract in general. It was, however, effective in destroying Habronema in the upper 18 inches of the duodenum.

SUMMARY

Habronema sp. were found in 15 out of 17 horses slaughtered, all of varying ages and condition.

Heavy infestations of Habronema sp. cause a heavy tenacious mucus covering on the stomach mucous membranes, in which the worms are imbedded.

500 cubic centimeters of a 2 percent Iodine Suspensoid

is effective in the destruction of stomach worms of horses.

Solutions of sodium bicarbonate, administered before, or with, Iodine Suspensoid, do aid in cutting a mucus film in which Habronema may be imbedded.

Iodine Suspensoid had little value in the removal of young larvae of Gastrophilus sp., but did dislodge enlarged larvae.

CONCLUSIONS

Large stomach worms are very prevalent in horses of this region, and because they are parasitic, should be removed from the host by medication. These parasites, besides being an expense to the host generally, cause a general congestion of the stomach wall (Fig. 1), and may lead to the formation of ulcers and nodules in the pylorus of the stomach and upper duodenum.

Their presence and the pathology of the tissue caused by them may be responsible for impaired digestion, colic, and proper emptying of the stomach.

If the horse is carefully prepared for treatment, Iodine Suspensoid will destroy Habronema worms in the stomach and upper intestine.

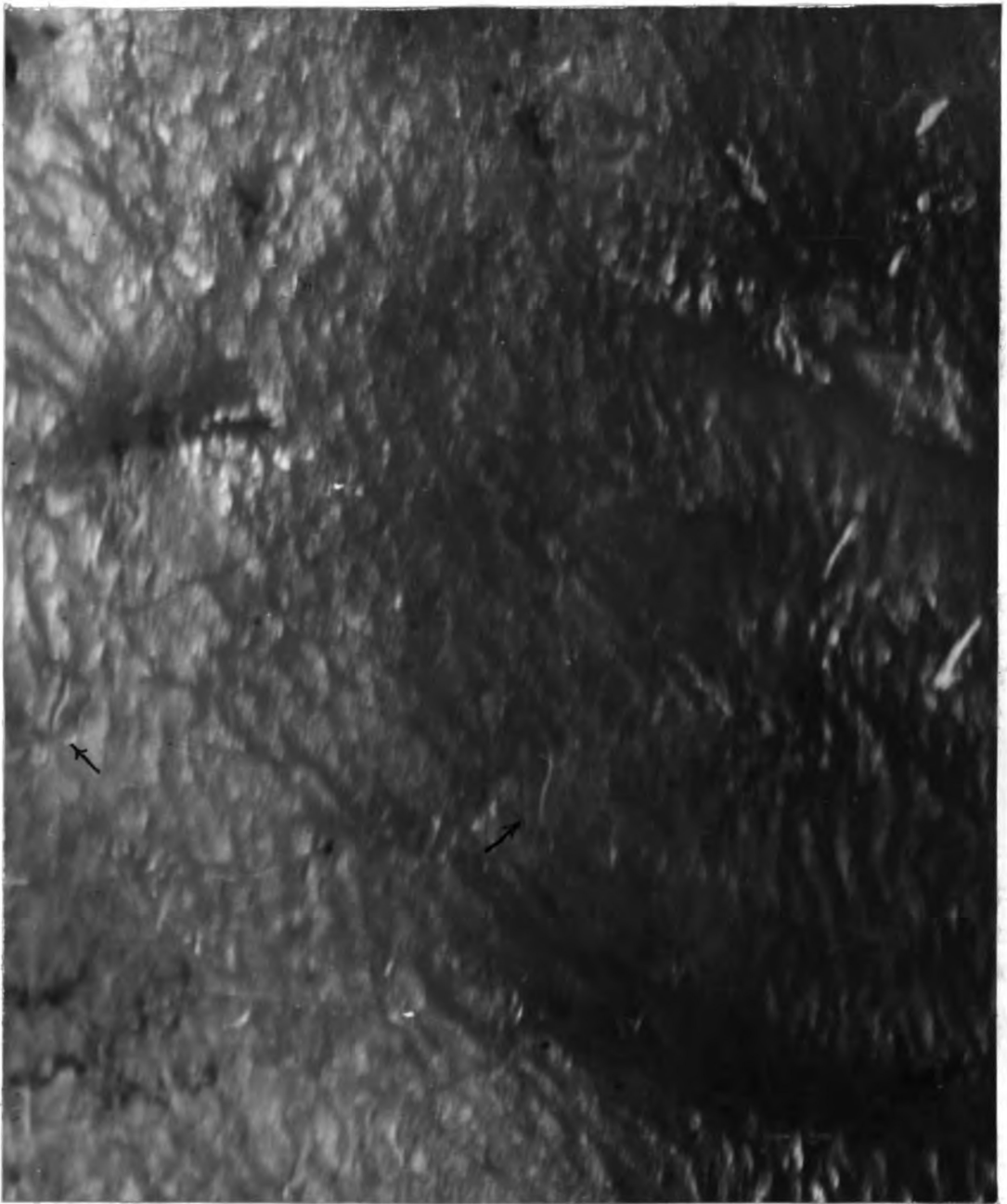


Fig. 1

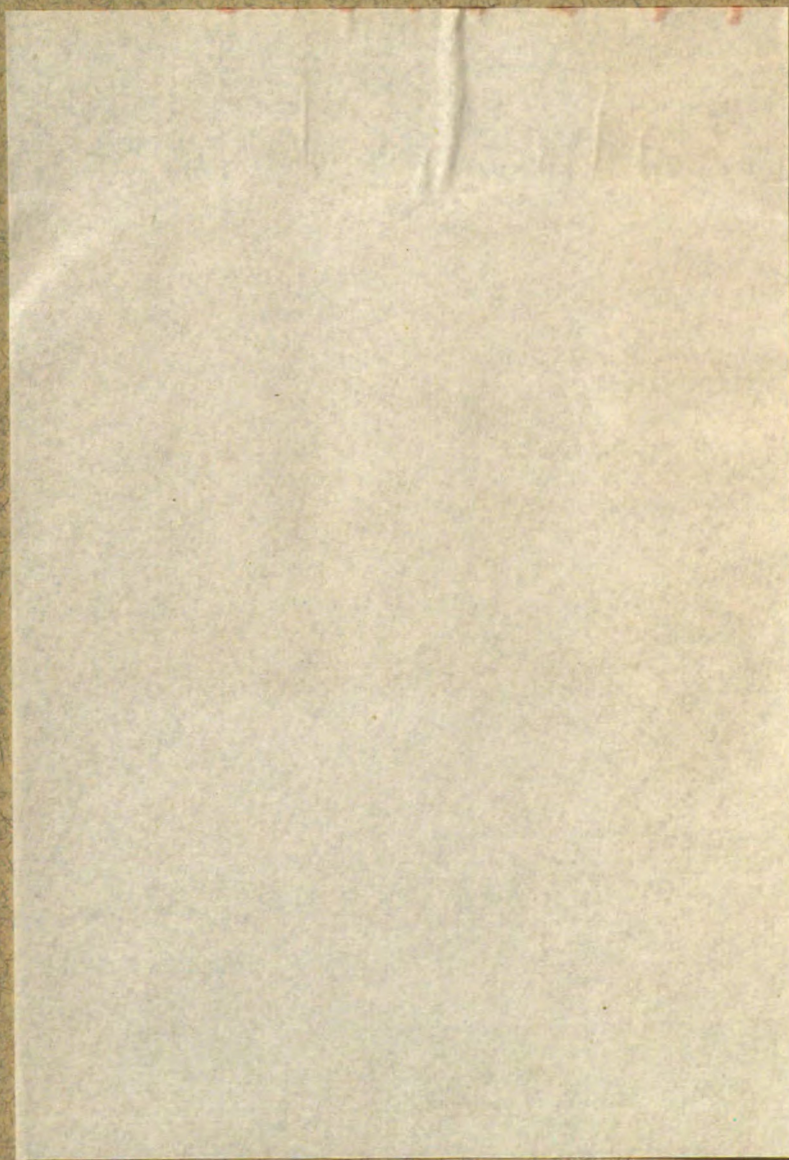
Lining of Horse's Stomach, showing attached
Habronema and darkened congested area.

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