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Paper No. 10.

## THE PREVENTION AND TREATMENT OF FASCIOLIASIS IN CATTLE.

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For the control and the complete eradication of Fascioliasis (vel Distomiasis) from our herds and flocks it is firstly essential that we should be acquainted with the habits and bionomics of the fresh water snails which may act as intermediate hosts of *Fasciola hepatica* and *F. gigantica* and, secondly, that we should have a drug lethal to these parasites but practically non-toxic to the vertebrate host.

*Dicrocoelium lanceolatum* will not be considered because, if present in Africa, it is not of common occurrence and is regarded as practically non-pathogenic to its definitive host.

### I. THE INVERTEBRATE HOSTS AND THEIR HABITS.

Fascioliasis amongst cattle and sheep in South Africa is limited to those areas where the freshwater snail *Lymnaea natalensis* (Krauss) abound. This mollusc is confined to Africa, south of the Sahara. It is said to be an extremely variable snail and has been described under many names. This species transmits both *F. hepatica* and *F. gigantica*.

In the south-western districts of the Cape the common liver fluke is transmitted by *L. truncatula* (Muller), a snail imported from Europe. This species has also established itself in North Africa. In the Cape I have recovered the cercariae of *Fasciola* from a species of *Bulinus* collected from the waters of a spring on a fluke (*F. hepatica*) infested farm in the field-cornetey of Goudini, Worcester.

That all species of *Bulinus* cannot transmit Fascioliasis is evident by the absence of liver flukes in areas where only certain *Bulinus* species abound. The South African members of this genus are imperfectly known and all attempts to have specimens identified have failed thus far.

*B. Tropicus* (Krauss) is listed by Annie Porter (1925) as an intermediate host of *F. hepatica*. A species of *Bulinus* from the farm "Breezy Brae," near Arlington Station, Orange Free State, transmits a species of paramphistome (*Cotylophoron cotylophoron*), which proved to be very pathogenic for Merino sheep. Near Petrus Steyn one farmer lost approximately 130 sheep out of a flock of 300 from the same parasite.

The only other mollusc which is known to act as an intermediate host of a parasite of domestic ruminants is *Physopsis africana* subsp. *globosa* (Morelet). It has a wide distribution in Tropical and Sub-tropical Africa and transmits a schistosome (*Schistosoma Mattheei*. Veglia and Leroux, 1929). It is also claimed as the intermediate host of the human schistosome (*S. haematobium*) in West Africa.

#### *Bionomics of the Different Molluscs mentioned above.*

The members of the genus *Lymnaea* (Lamarck) prefer slow running water. The back waters of rivers and streams are in some localities teeming with *L. natalensis* during the non-rainy season. They may at time be found in shallow stagnant pools with an abundance of water plants. Their eggs are deposited on submerged bits of plants and stones.

*Bulinus* appears in South Africa to thrive at higher altitudes than do the other species. They are as a rule quite common in permanent collections of water around Johannesburg and in the other higher parts of the Transvaal and the Orange Free State. I have known them to thrive in mud pools practically devoid of any aquatic plants. They may at times be found inhabiting the same waters as does *L. natalensis*.

The genus *Physopsis* is with *Bulinus* included in the sub-family *Bulininae*. In South Africa I have recovered *Physopsis* only from pools where the blue lotus flourishes. This snail prefers the back waters of permanent streams and will be found most plentiful where there is a heavy deposit of mud and decomposing vegetable matter at the bottom. In these situations it is often accompanied by *L. natalensis* and *Planorbis pfeifferi* (Krauss). The last-mentioned is confined to South Africa and transmits *S. mansoni*, the causal agent of intestinal schistosomiasis.

There is undoubtedly no need to stress the importance to the veterinarian of knowing where to look for the different species of snails, and every field officer should be able to recognize the different genera which transmit trematodes parasitising domestic stock.

## II. FASCIOLIASIS IN CATTLE.

As every veterinarian is undoubtedly acquainted with the symptoms and diagnosis of fascioliasis in cattle there is no need for discussing them here. Since cattle cannot graze grass as short as do sheep they do not as a rule become too heavily parasitised.

The annual losses from fascioliasis amongst the herds and flocks in endemic areas must be considerable and warrant the attention which this malady is now receiving. In Central Europe it is so acute that some States are actually assisting in its eradication and control by refunding the farmers part of the money spent on drugs and prophylactic measures. In South Africa the use of carbon tetrachloride and hexachlorethane are recommended as a curative and the adaptation of prophylactic measures are consistently preached. The farmers are prepared to dose their stock, but very little else is done. In the Native Territories very little will be accomplished unless the Governments concerned take active steps. At present the prospects are that fascioliasis of stock will be with us for many years to come.

## III. THE TREATMENT OF FASCIOLIASIS IN CATTLE.

The drugs which have been tested and found effective against fasciola will be considered briefly below:—

### (1) *Male Fern Preparations.*

Grassi and Calandrucio (1884 and 1885) are said to be the first to claim good results for the extract of male fern against flukes in sheep.

Perroncito (1886) reports favourably on the use of male fern.

Borini (1911) claims excellent results for ethereal extract of male fern against fascioliasis in cattle. The fact is mentioned that the animals belonged to a rich owner.

The price of male fern preparations prohibits their general application on a large scale and to scrub cattle.

### (2) *Carbon Bisulphide.*

Floris (1907 and 1908) claims that by administering 10 to 15 grammes of carbon bisulphide in gelatine capsules three or four times a week he freed sheep of *F. hepatica*.

I have been unable to trace any records of its successful use against this parasite in cattle.

### (3) *Carbon tetrachloride.*

The use of carbon tetrachloride for eradicating matured liver flukes from sheep was discovered by Montgomery, experimenting on Welsh sheep. It has since been proved over and over again that 1 c.c. of this drug is a specific cure for fascioliasis in sheep. The administration of carbon tetrachloride as a curative for liver flukes in cattle is in Europe considered a dangerous practice. In Germany the losses resulting from its use on cattle is said to have become so serious that it was listed as a dangerous drug and its sale for use on cattle prohibited except on a prescription from a qualified veterinary surgeon.

Hall (1923) gave a heifer weighing 175 lb. and suffering from hook-worm infestation, 100 c.c. carbon tetrachloride in hard capsules after 36 hours' starvation. The animal was found dead on the fourth day. A second heifer weighing approximately 250 lb. and a clinical case of Bunostomiasis was given 100 c.c. in 350 c.c. castor oil after

36 hours' starvation. This animal was off her feed until she was killed on the 6th day. Hall concludes that the drug was not very well tolerated by these animals.

A Dr. W. A. Barnette informed Hall (1923) that he had excellent results with carbon tetrachloride against hook-worms. He gave one-half ounce in a half pint olive oil to yearlings, while cows weighing 700-800 lb. received one ounce in one pint of oil.

A Dr. W. K. Lewis was not so successful as Dr. Barnette. He dosed 9 adult cattle and 10 calves for the same complaint. Within 36 hours he had lost 4 of the adults and the remainder were sick. The adults had received 22 c.c. each. The youngsters had relatively higher doses without showing ill-effects.

Minot, experimenting with carbon tetrachloride on dogs, found that the toxicity of the drug varied with the calcium-content of the blood. His conclusions were: ". . . . (1) Carbon tetrachloride is relatively toxic for dogs that have been on a prolonged low calcium diet; (2) signs of intoxication can be prevented by the continued addition of calcium to the diet; or (3) cured either by the intravenous injection of calcium chloride or the oral administration of ammonium chloride." He observes that the immediate cause of death in his dogs should be attributed to the lack of ionized calcium in the blood, secondary to the bilirubinemia, following the administration of the drug.

Minot's observations suggest that the treatment of cattle and perhaps sheep for fascioliasis should only be practised after they had been on a bonemeal lick for some time.

The losses following the administration of this drug to fluke infested animals should probably be attributed to a lack of ionized calcium in the blood. Prof. A. I. Malan and Mr. S. D. Rossouw, of the Department of Biochemistry, have recently examined for me the blood of fluky sheep for calcium. They found a marked decrease from the normal. Sheep suffering from paramphistomiasis showed a most marked decrease of calcium. The lack of calcium in the blood of dairy cows would seem to account for the prevalence in Europe of milk fever, which, according to Prof. Sjollem (1929), can be prevented and cured by the administration of calcium salts. Greig (1929) records a fall in the calcium of blood from ewes suffering from "Lambing Disease," which is known in South Africa as "Domsiekte," of pregnant ewes. Prof. A. I. Malan has, some months ago, found the blood calcium decreased in suspected "Domsiekte" cases which at death proved to have the fatty livers described by Prof. McFadyean for pregnant ewes from England. In pregnant animals carbon tetrachloride should, therefore, be used with care.

Hall observed that the simultaneous administration of magnesium sulphate decreased the toxicity of the drug. He also recommends the use of calcium lactate to increase the ionized calcium in the blood of dogs to be treated with this drug for Uncinariasis.

Personally I have dosed six thin dairy cows with 8 c.c. carbon tetrachloride for liver flukes. No ill-effects were manifested, but these animals have had access to a lick of bonemeal and salt for some time. The examination of their faeces showed a decrease in the number of liver fluke eggs.

Calves badly affected with hook-worms stood 10 c.c. carbon tetrachloride and magnesium sulphate well and were cured.

My experience is that fat cattle do not tolerate this drug well, and can be killed by a relatively small dose (10 c.c.).

*The Administration of Carbon Tetrachloride.*

Hall recommends that the drug should be administered in hard gelatine capsules, but most workers seem to favour administering it diluted in either water, milk, salines, or an oily vehicle.

Lamson *et al.* (1923) found that if heavy cream was given an hour after the administration of carbon tetrachloride, its toxicity was increased. This led some workers to conclude that the use of milk as a vehicle was a dangerous practice. Personally I prefer using it mixed in raw linseed oil or liquid paraffin, which both mixes readily with it and there is no separation-out of the drug on standing as is the case when using milk as the vehicle. The use of milk as is often recommended by some is not quite dangerous, but is much slower and the latter is a factor to be considered where many animals are to be treated.

Only chemically pure carbon tetrachloride should be used. The drug is quite inexpensive.

(4) *Hexachlorethane.*

Because the former drug proved to be rather toxic for bovines other drugs of the same class were tried, with the result that hexachlorethane was pronounced safe for cattle and yet effective for the purpose required.

De Blik and Baudet, from Holland, and Noller, Flietner and Schmid, from Germany, pronounced this drug to be excellent for fascioliasis in cattle. They recommend 10 grammes per 25 kg. body-weight. The dose is administered over four days and the animals are dosed first thing in the morning and food withheld for from two to three hours. Food rich in fat should be avoided.

I have never yet used this drug, but the reports by those who have are very favourable, and those who may have to treat cattle should give it a trial. It can hardly be expected to be better than or quite as effective as carbon tetrachloride.

(5) *Patent Medicines against Flukes.*

The discovery of carbon tetrachloride and ethylene hexachloride has flooded the market with anti-fasciola remedies, and because these chemicals are much cheaper than the older male fern preparations, some manufacturing chemists have even substituted the chlorine compounds for male fern, and to retain the former colour of their remedies they had to colour the capsules. Needless to say it paid them well, for they were still charging the old price. Here we should as veterinarians assist the public.

IV. PROPHYLACTIC MEASURES AGAINST FASCIOLIASIS.

The prophylactic measures practised against any fluke disease must include a direct attack on the proper intermediate host, and the measures to be employed in such a campaign will have to be varied according to circumstances and the habits and habitats of the species concerned. Where a pool or a pasture can be readily drained destruction of the snail population by the use of chemicals should not be advised. Most pools, if not all, are veritable sources for the propagation and the dissemination of helminths and should wherever practical be drained. The fencing-off of snail infested pools should only be

advised where draining cannot be effected at a comparative reasonable cost. It must be remembered that certain birds are rather potential factors in the spread of snails from one pool to another, and an infected pool would be a permanent source of danger to dams or other collections of water. Molluscs are almost invariably present only in permanent collections of water, but may during an abnormally wet season establish themselves and flourish in places which in a normal season would have dried up, arresting the multiplication of the disease-spreading snails.

The use of poisonous chemicals should be resorted to where snails have established themselves in the backwaters of streams and rivers where stock have to drink.

Copper sulphate and unslaked lime are probably the most suitable for general application. They are cheap and effective and are used in dilutions non-injurious to man and stock. Chandler (1920) found that copper sulphate was lethal to molluscs when used in dilutions of from 1 in 500,000 to 1 in 2,000,000 of water. According to Leiper (1922) *B. contortus* and *P. boissyi* are killed by a 1 in 5,000,000 dilution, while one of 1 in 2,000,000 was required for the destruction of *L. truncatula*.

Walton and Jones (1925), from England, recommend the use of copper sulphate against the common carrier of *Fasciola* there.

At Humansdorp I found that this chemical readily destroyed *Physiopsis africana* subsp. *globosa* in a pool in the river. It proved practically useless when tried on a *Bulinus* sp. inhabiting a rather muddy pool. The amount of organic matter present in stagnant pools renders the chemical inert.

The use of unslaked lime has been favourably reported on by various workers. It is reported to be extensively used in the Far East for the control of intestinal schistosomiasis.

Other chemicals such as calcium cyanimid, tartar emetic and ammonium sulphate have been tested and found efficient, but their cost prohibits their use on a large scale.

#### *Hand Collecting the Snails.*

It has been recommended that the snails may be collected by hand where their destruction by the use of chemicals or drying has failed or is impracticable. There is little hope of this method being readily resorted to while there is no likelihood of a rise in the price of beef, mutton and wool.

#### *“ Biological ” Methods of Control.*

As everything else, molluscs have their natural enemies and man has even applied to them for help. The results, as may be expected, have not been startling.

The keeping of domestic ducks to devour and so exterminate the snails has been advised. The duck and the snail have frequented the same pool for many years, and several of the duck's helminths have found the snail a most useful intermediate host.

It is also claimed that many species of fresh-water fish feed upon snails. Some of us may accept this as the reason why *L. natalensis* has taken to shallow water.

Another “ biological ” method to be exploited is the utilization of fire-flies whose larvae feed largely upon molluscs, but since the snails which concern us are aquatic in habit we cannot entrust the attack to the fire-fly or glow-worm.

*A Request.*

Finally, I wish to appeal to my colleagues for the collection of snails for identification and the presentation of identified specimens to the various African Veterinary Research Institutions and Colleges. The various institutions would undoubtedly not hesitate to exchange specimens.

Veterinary malacology is a subject to which the veterinary colleges should pay more attention in the immediate future than has been the case in the past.

*Paper No. 11*

## ONCHOCERCIASIS OF CATTLE, WITH SPECIAL REFERENCE TO ITS POSSIBLE LIFE-CYCLE AND CONTROL.

By P. L. LE ROUX, B.Sc. (Edin.), M.R.C.V.S., Veterinary Research Officer, Department of Agriculture, Union of South Africa.

ONCHOCERCIASIS of cattle has been known in Australia for almost fifty years, and is there due to the nematode *Onchocerca gibsoni* (Cleland and Johnston, 1910). York and Maplestone list fourteen species of *Onchocerca* Diesing, 1841, as parasitizing ligaments, vessels, subcutaneous or intramuscular connective tissue of mammals. Four of the fourteen species are imperfectly known, and eight of the remaining ten have been recorded from domestic stock. Man harbour the remaining two.

The *Onchocerca* recorded from domestic stock are:—

- (1) *Onchocerca reticulata*, Diesing, 1841, parasitizes the horse, and is chiefly met with in the tendons of the forelegs. It may occur in subcutaneous nodules and elsewhere.
- (2) *O. cervicalis*, Railliet and Henry, 1910, is a parasite of the *ligamentum nuchae* of horses.
- (3) *O. armillata*, Railliet and Henry, 1909, is recorded from the wall of the *aorta* of the zebra and cattle in the East Indies.
- (4) *O. bovis*, Piettre, 1912, was collected in France from the ligaments and tendons off the knees of cattle.  
Cretien, 1920, observed a species of *Onchocerca* in the subcutaneous tissues in the neighbourhood of the *ligamentum nuchae* of bovines in France.
- (5) *O. gutturose*, Neumann, 1910, is recorded as the causal agent of subcutaneous and muscular Onchocerciasis of North-African cattle.
- (6) *O. indica*, Sweet, 1915, is named as the worm responsible for Onchocerciasis of *Bos indicus* in the Peninsula of India.
- (7) *O. fasciata*, Railliet and Henry, 1910, from subcutaneous nodules in camels from India and Australia.
- (8) *O. gibsoni* parasitizes cattle and occasionally sheep in Australia and cattle in the Malay Archipelago, and infests *Bos indicus* in the Malay Peninsula.