

ROLE OF DOMESTIC ANIMALS IN THE SPREAD OF HELMINTHIC INFECTIONS IN MAN

By GOBIND SINGH THAPAR, M.Sc., Ph.D. (Lond.)

(Lucknow University)

ANIMALS have long been associated with man and their domestication has naturally led to the transmission of their diseases. These diseases thus transmitted are due to the bacteria, protozoa, worms or insects, but the present article aims at dealing with only such cases of infections to man as are caused by the presence of helminth parasites of domestic animals with particular reference to Indian conditions.

Helminths, like *Ancylostoma duodenale*, *Enterobius vermicularis*, *Wuchereria bancrofti*, *Schistosoma hæmatobium*, *Schistosoma mansoni*, *Tænia solium* and *Tænia saginata*, are exclusively human in their habitat, but there are a majority of helminths that man shares with the lower animals living in association with him. As an instance of helminthic infection from one animal to another we could mention the invasion of the kangaroo by *Fasciola hepatica* of sheep caused by the introduction of the latter into Australia. Similar infections may have occurred in man from animals and *vice versa*, due evidently to their association with each other. Thus, human *Ascaris* and *Necator* have been reported also from pigs in various parts of the world. It would, however, be interesting to note that in spite of the close association of horse with man from times immemorial, none of the parasites of horse has ever been found in man and *vice versa*, and this immunity according to Leiper, appears to be of an eternal nature. No systematic survey of helminthic infections in man has been carried out in India, but from the meagre available data the following points would be of interest in stimulating further work in this field.

A certain number of these parasites may pass their adult stage as commonly in man as in domesticated animals while others pass their adult stage in man and larval stages in animals or sometimes *vice versa*. Hence, in dealing with the subject we may conveniently discuss it under three categories.

I. *Helminths living as adults, both in man and animals.* Some helminths normally found in man may frequently occur also in animals; some other parasites are rarely found in man and hence are obviously "accidental".

Diphyllobothrium latum which is a normal parasite of man is found to occur in carnivores as well and is cosmopolitan in distribution. The eggs are passed out with the fæces into water where in due course they hatch. The larvæ are swallowed by minute water-fleas (*Diaptomus oregonensis*) in which they undergo some development until the flea is swallowed by a fish. The infective stage is attained in the fish and if the fish is eaten raw or in an improperly cooked condition development is completed in man. The parasite causes anæmia in man showing marked eosinophilia. The perocercoid of another species of

Diphyllobothrium has been said to occur in the Far East and it develops into an adult in the dog, cat and other carnivores. The adult proglottides have recently been recovered by us from cats in Silchar (Assam).

Another instance under this head is that of *Trichiuris trichiuris* which occurs both in man and in pigs, but is nowhere serious. Again, *Hymenolepis nana* occurs commonly in man and in rats and mice in India and elsewhere and has been recovered at Lucknow on several occasions.

Of the abnormal parasites, many are of sufficient frequency to enable us to regard animals as reservoir hosts. Thus, *Paragonimus* species are normally found in the lungs of mink, but they also occur in musk-rat, dog, cat, pig, goat and man. The eggs are coughed up into the mouth and then pass down the intestine and out to the exterior with fæces. They hatch out in about three weeks and enter the operculate snail, *Pomatiopsis lapidaria*. A large number of cercariæ emerge out of the snails and infect the crayfish where they encyst in the musculature. Infection occurs by eating crayfish in an uncooked condition when the young flukes penetrate the intestine and migrate directly to the lungs. No case of human infection is reported from India.

The liverflukes usually found in man and in carnivorous hosts belong to the family *Opisthorchiidæ*. It includes the genera, *Opisthorchis* and *Clonorchis*. They are carried by fish and are common in certain Eastern countries. Cases have been reported of *Clonorchis* infection in Calcutta. Besides the usual snail intermediary the Cercariæ encyst in the scales or flesh of fish which serves as second intermediate host and thus they are transmitted to man in the same way as *diphyllobothrium* or *Paragonimus* infections. A heavy infection causes progressive weakness, emaciation and anæmia. Man owes freedom from fluke infection to cooking, as heat quickly destroys the cysts and hence the fluke infection is not very common in human beings. But it must be admitted that very little search has yet been made for it in this country.

Diphylidium caninum is prevalent in dogs and cats, but it also occurs in children, the intermediate stage being found in fleas and dog-lice that may be accidentally swallowed by children playing about with dogs. Children also become infected with Ascarid worms of dogs and cats, producing infection through swallowing embryonated eggs. It may imply fæcal contamination of food and of utensils. Khalil (1926) has indicated the viability of *Ascaris* eggs even under high temperature and this indicates the necessity of extreme hygienic precautions in the prevention of such infections.

Trichostrongylus is a parasite of domestic animals but there are records of its occurrence

in man. A systematic examination may reveal the frequency of its occurrence in man.

Onchocerciasis of cattle, under suitable examination has been revealed to occur in man in Guatemala. The infection in man is caused by the *Simulium* flies and it has been shown not only to be the cause of tumours and dermal lesions of the face but may at times affect even the loss of vision.

II. *Helminths which occur as adults in man but as larvæ in animals.* Under this head, we consider first of all tapeworm infections. *Tænia solium* and *Tænia saginata* are both exclusively human parasites in their adult condition. Both these species were at one time confused with each other, so much so that many of the older workers regarded *Tænia saginata* as an old and decayed specimen of *Tænia solium* in which hooks on the rostellum had fallen off, as a consequence of old age. Leuckart definitely demonstrated them to be two distinct species, that are distinguished by the character of the Scolex—by the possession of the typical double row of hooks on the scolex of *Tænia solium*, while *Tænia saginata* is a hookless form from its birth. The larval form of *Tænia solium* occurs in pigs (*Cysticercus cellulosæ*), while that of *T. saginata* is found in the cattle (*Cysticercus bovis*). It may, however, be mentioned that *Cysticercus cellulosæ* occurs abnormally in other animals including man. Maplestone and Bhaduri (1937) have summarised all cases of its occurrence in man in India from the available literature at their disposal. Occasionally *Cysticercus cellulosæ* gets into the brain of man, thereby causing lunacy. It is thus a dangerous infection and a number of such cases have been reported.

Mention may also be made of the occurrence of *Bertiella studeri* as an accidental and rare parasite of man, and cases are recorded by Maplestone (1933) and Maplestone and Riddle (1936) in Bengal.

The next important parasite is the Trichina worm, *Trichinella spiralis*, causing Trichinosis in man. The infection in this case depends entirely upon the habits of the people in eating pork. Where raw, uncooked or smoked pork is customarily eaten, its infection is to be feared. In the United States of America alone about 2,000 human cases have been reported. Generally the disease is chronic in pigs and there may be no symptoms at all and the flesh is unchanged macroscopically. We need not discuss the course of the disease in man, but it would be interesting to know the frequent diagnosis of typhoid fever or ptomain poisoning in the acute cases and rheumatism in the subacute later stages of Trichinosis. The cases are traceable to the consumption of raw sausages or ham. Like most parasitic infections, here also there is observed in earlier stages considerable eosinophilia. It is stated that they are generally parasites of carnivores. Recently larval stages encysted in the muscles of squirrel have been recovered at Lucknow and they may possibly occur at other places.

III. *Helminths that occur as adults in animals but as larvæ in man.* Such cases are

accidental. Mention may be made in this connection of 'Hydatid' cysts, cysticercus, "Cercarial dermatitis, hookworm and other larvæ causing 'creeping diseases'.

The adult *Echinococcus granulosus* lives in carnivorous animals. The intermediate hosts are quite numerous, in fact, any mammal may harbour the hydatid cyst. Sheep are most often infected but horses, pigs and wild ruminants are also important sources of infections. The disease is prevalent in pastoral countries where sheep serves as a reservoir of infection to dogs and thus the chances of human infection increase. Recently it has been found that the disease is prevalent in man in India, where several cases, originally recorded as tumours, have, on re-examination, been reported by Mahadevan (1933) to be those of hydatid cysts. Maplestone (1933) concludes that cases of hydatid in man are perhaps commoner than is indicated by its record in medical literature. Drinking water has been said to be the common source of infection but it must be mentioned that the eggs of *Echinococcus* do not float in water but sink at the bottom. Hence this may not be a source of danger. The disease is usually contracted through contact with dogs. Children during play acquire dried eggs on the hands from dog's coating. Fæcal contamination of foodstuffs, particularly vegetables, is also a probable source of infection. Washing of hands before cooking or eating food would diminish the infection.

Cercarial Dermatitis is a disease caused by the skin penetration of the infective stages of a number of trematode larvæ. The *Schistosomes* are the most important of such infections. Whether they are in normal host or not, they cause a pronounced reaction at the seat of entry and the name "cercarial dermatitis" has been given to the resulting lesions. The entrance or infection results in a prickly sensation and urticarial blotches quickly develop round the seat of entry. Fortunately no case of such infections is reported so far from India but recently I have examined the urine of a patient at a Lucknow hospital harbouring eggs of *Schistosoma hæmatobium*. The case is an imported one and unless it is properly disposed of, it is feared that the disease may take up a serious shape in this country owing to the presence of the snail intermediaries like *Indoplanorbis* species.

Allied to this, there is the condition called creeping eruptions, in which a variety of parasites of lower animals penetrate the skin of man and finding the environment unsuitable, move about in or under the skin. Chief amongst these are immature hookworms of dogs and cats. *Gnathostoma* is also responsible for the creeping eruptions in man in certain parts of the world and it has also been reported by Maplestone (1929) from Jalpaiguri (Bengal) in India.

RESERVOIR HOSTS

Many flukes which infect man are the common parasites of animals which are thus termed as "Reservoir hosts". Examples are found in *Clonorchis*, *Paragonimus* and *Fasciolopsis*. These are parasites of dogs, cats or

pigs, but may at times infect man. Cases of *Clonorchis* and *Fasciolopsis* have been reported from India, but *Paragonimus* infection is not known. Again *Schistosoma japonicum* has recently been reported by Bhalerao (1934) from pigs in India. All these occurrences help to keep the supply of infected snails from which infections can spread in all directions. It would thus appear that the control of human disease due to helminth parasites is not possible without control of disease in animals, and if we wish to control human disease we must simultaneously attempt to control disease in animals.

Unfortunately, there are great many difficulties for the adequate control of helminthic infections in animals. For instance, we find that the animals soil their food with their own faeces, they eat uncooked food and drink from ponds and streams which they contaminate themselves and thus there are limitations of sanitation for animals. All these lead to the abundance of parasites of the stock animals.

Besides, the modern means of transportation add further to the source of infections. The responsibilities of tourists in the transportation of disease are fully recognised. Similarly the transportation of stock would predict the transportation of their parasites.

The parasitism of the live-stock is, therefore, a real threat, and with it the eradication of human parasites is difficult. There is, thus, a necessity of work on co-operative basis between the medical and veterinary staff of a country. They must work together to bring about an adequate solution of parasitic infections of man and animals, as there must be simultaneous eradication of disease in all.

The general methods of prevention and control were summarised by Leiper thus:—

1. Medication by means of anthelmintics and therapeutic drugs.
2. Prevention of the entry of the infective stage by any of the following means:—
 - (a) Avoid exposure to infective soil. Use of boots recommended.
 - (b) Avoid open air bathing in places liable to contamination.
 - (c) Avoid use of unfiltered water for domestic purposes.
 - (d) Avoid use of uncooked foods.
 - (e) Avoid overstocking.
3. Destruction of intermediaries by chemical and other means.
4. Destruction of reservoir hosts.
5. Proper disposal of manure.
6. Clean stables.

These methods individually or collectively would greatly reduce chances of infections. But perhaps, the best means to avoid the perpetuation of the parasite is to cut down its life-cycle. This needs co-operation of workers in various fields.—Medicine, Veterinary, Agriculture and Zoology. The necessity of co-operation between medical and veterinary investigators is emphasised on the fact of the com-

mon type of helminthic infections of man and animals and attention has been drawn (earlier in this article) to the difficulties of the control of helminthic infections of animals. It is true that the application of sanitary methods will eradicate diseases that are exclusively human, but this cannot apply to animal diseases. Co-operation of workers is essential to find a common solution. There are a large number of parasites whose life-histories have not been worked out and this needs the assistance of zoologists. A zoologist, on account of his training in comparative anatomy, is in a better position to understand and help in the study of the intricate problems connected with the life-histories. Leuckart suggested, from the study of the structure of the infective larvæ of *Cucullanus* and *Dracunculus*, the solution of the life-history of the latter. Recently, zoologists have shown by the study of "Casado" in Dutch East Indies that the cause of this skin disease is not "mange mite" as was originally supposed, but the disease is due to the presence of a nematode worm of the genus *Stephanofilaria*. In this connection I would like to draw attention to the organisation of the Institute of Agricultural Parasitology in London, which is based on such co-operation. On the staff of this Institute under the direction of Professor R. T. Leiper, F.R.S., there are medical and veterinary graduates co-operating with those in agriculture and zoology, and we know that as a result of co-operation researches of far-reaching importance have been conducted at this Institute. This co-operation has been emphasised even by the Royal Commission on Agriculture in India, presided over by our ex-Viceroy, Lord Linlithgow.

The foregoing remarks have sufficiently stressed the economic importance of the subject. It is, therefore, suggested that this matter may be given due consideration both by the Government and the public with a view to give it a proper place in the post-war reconstruction of scientific research in India.

1. Bhalerao, G. D., "On the occurrence of *Schistosoma japonicum* in India," *Ind. Jour. Vet. Sci. Anim. Husband.* 1934. 2. Cameron, T. W. M., "The helminth Parasite of animals and human disease." *Proc. Roy. Soc. Med.* 1926. 3. —, "Parasitic diseases common to man and animals," *Brit. Med. Jour.*, 1934. 4. Khalil, M. "The relation between sanitation and Parasitic Infections in the Tropics." *Jour. Roy. Sanit. Inst.* 1926. 5. Mahadevan, V., "Hydatid Disease in South India." *Ind. Med. Gaz.*, 1933. 6. Maplestone, P. A., "A case of human infection with gnathostome in India," *Ibid.*, 1929. 7. —, "A new case of *Bertiella Studeri* in Human being." *Ibid.*, 1930. 8. —, "The frequency of Hydatid disease in India." *Ibid.*, 1933. 9. —, "The eggs of *Tenia Solium* and *Tenia Saginata*." *Ibid.*, 1937. 10. Maplestone, P. A., and Bhaduri, N. V., "*Tenia solium* and *Cysticercus cellulosus* in India." *Ind. Jour. Med. Res.*, 1937. 11. Maplestone, P. A. and Riddle, J. S., "Infection with *Bertiella Studeri*." *Ind. Med. Gaz.*, 1936.