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Studies on Nebraska Parasites

Henry B. Ward
University of Nebraska - Lincoln

STUDIES ON NEBRASKA PARASITES.

BY HENRY BALDWIN WARD, PH.D., LINCOLN.

The intimate relations in which domestic animals stand to man have always made the transfer of parasites from the one to the other a matter of much greater probability than exists between man and the other forms of animal life. It is but natural that the most common species of human tapeworm come to man from his two chief sources of animal food—beef and pork. The chances of *accidental* infection, however, are evidently much greater in the case of those forms that are intimately associated with man, and hence clearly greatest in those he holds as household pets,—the dog and the cat. It is also evident that the chances of parasitic infection are greatest in the case of those peoples or individuals who live on terms of closest intimacy with these domesticated forms. Thus, the Icelander, who is known to permit his dog to occupy, not only the same room, but even the same bed with himself, is most seriously troubled with the parasites common to dogs and man, and the infant or child is more likely to be infected than persons of maturer years. It becomes, then, a matter of great importance to determine in any region or community what is the average percentage of these animals infected with parasites, since, as will be evident later, the percentage of infection varies widely in different regions. It is, however, by no means a matter of indifference what parasites occur in the dogs or cats of a specific locality, for certain of the species are entirely harmless to the human race, not being known to be at home in man at any stage of his existence, and certain species are comparatively harmless, even when pres-

ent, while certain others are the causes of grave disorders, among them the most serious parasitic disease which is known.

In a paper on the prevalence of Entozoa in the dog and their relation to public health, published in 1867 by Dr. Cobbold, of London, perhaps the most eminent helminthologist that England has ever produced, the author emphasizes again and again the importance of helminthological studies on this animal, and the necessity of extended knowledge concerning the number and kinds of its parasites. Hence it seemed of importance to ascertain for Lincoln the extent to which its canine population is infected, as well as the species of parasites which occur in dogs here. The cat, although not so closely associated with man, and not furnishing him with so many species of parasites, has also been included within the limits of this investigation. During the last three years a large number of animals of both species have been carefully examined for parasites and the results of the examination recorded. For kindly assistance in this work I am indebted to a considerable number of students, who have been connected with the University during this time. The final examination and determination of the parasites, as well as the tabulation and discussion of the same, are the results of my own study. Many other animals of these species have been examined in part, or owing to circumstances, with less care; they have not been considered in the tabular results given, although no facts have been observed which do not bear out the conclusions reached. All of the animals included in the statistical results came from the city of Lincoln, although it is evidently impossible to say that all of them had been long residents of that place. Among the animals which were examined were representatives of all the varied conditions

of life under which these forms are found, from the half-wild strays of city streets and alleys to the pets accustomed to the luxury of a home. I shall consider first the results from the study of the dog, and later those which bear on the parasites of the cat. Table "A" indicates the degree of infection of the dogs examined, and table "B" the kinds of parasites found together with the frequency of each.

TABLE A.

	Total numb'r examined.	Free from parasites.	With one kind of parasite.	With two kinds of parasites.	With three kinds of parasites.	Slightly infected.	Badly infected.
Actual number...	20	5	3	8	4	4	4
Percentage.....	.....	*25*	*15*	*40*	*20*	*20*	*20*

TABLE B.

DOGS INFECTED WITH SPE IES AT RIGHT.	Taenia marginata.	Taenia serrata.	Taenia serialis.	Dipylidium caninum.	Ascaris mystax.	Uncinaria trigonocephala.	Echinorhynchus sp.?
Actual number...	1	9	1	13	4	2	1
Percent'g infected	*5*	*45*	*5*	*65*	*20*	*10*	*5*
Slightly infected	*5*	*20*	*5*	*25*	*20*	*10*	*5*
Badly infected...	.....	*15*	.....	*15*	.....	.....	.....
Infected with....							
Small number of parasites(1-9)	1	4	1	3	4	2	1
With medium number (10-25).	.....	4	.....	2	.....	.....	.....
With large number (25-100).....	.....	.....	.....	5	.....	.....	.....
With very large number (100-500)	.....	1	.....	3	.....	.....	.....
Average number of parasites in each animal infected with the species.....	1	12	1	100	5	4	1

For comparison with this I have records of only two dogs from any other part of the state. These were examined at Table Rock last summer by one of my students. One individual contained a dozen specimens of *Taenia serrata*, and the other harbored one hundred and fifty-two of the same species, but no other parasites were found in either. To compare the results of similar examinations that have been made in other parts of the world I compiled a table, from that given by Deffke, with the addition of recent investigations made in Washington, D. C., and in Lincoln.

EXAMINER AND LOCALITY.	Hemistoma alatum.	Taenia serrata.	Taenia marginata.	Taenia coenurus.	Taenia serialis.	Taenia echinococcus.	Dipylidium caninum.	Bothriocephalus latus.	Bothriocephalus fuscus.	Cysticercus cellulosae.	Echinococcus polymorphus.	Mesocestoides lineatus.	Ascaris mystax.	Uncinaria trigonocephala.	Spiroptera sanguinolenta.	Enstrongylus gigas.	Trichocephalus depressiusculus.	Echinorhynchus sp.	Pentastoma taenioides.	Fly larvae.	No. of animals examined.	Percentage infected.
Krabbe, Copenhagen	.....	17.3	2.16	.....	.....	1.08	47.03	.....	.....	.....	.....	.....	20.54	1.62	.....	.....	.....	.....	.....	.....	500	72.
Krabbe, Denmark	.....	14.	1.	.....	.....	0.40	48.	0.2	.....	.....	.....	.....	24.	2.	.....	.....	.....	.....	.....	.....	.....	.....
Krabbe, Iceland	0.2	75.	18.	.....	.....	28.	57.	.....	5.	.....	.....	21.	2.	.....	.....	.....	.....	.....	.....	.....	100	100.
Thomas, Victoria	.....	40.	.....	.....	.....	40.	60.	.....	.....	.....	.....	27.	27.	.....	.....	.....	.....	.....	.....	.....	.....	90.
Thomas, South Australia	.....	27.	.....	.....	.....	40.	60.	.....	.....	.....	.....	27.	24.	.....	.....	.....	.....	.....	5.	.....	100	63.
Schoene, Leipzig or Saxony	1.	15.	27.	1.	.....	.....	25.	.....	.....	.1	1.	.....	24.	1.	.....	.....	.....	.....	.....	.....	200	62.
Deffke, Berlin, Germany	.....	.5	7.	0.5	.....	1.	40.	0.5	.....	.....	.....	.....	18.5	4.5	2.	1.	.....	.....	6.5	2.	200	62.
Sommer, Washington, D.C.	.....	12.	2.	.....	.....	.....	44.	.....	.....	.....	.....	.....	28.	56.	2.	2.70	.....	.....	.....	.....	50	96.
Ward, Lincoln, Neb.	.....	45.	5.	.....	5.	.....	65.	.....	.....	.....	.....	.....	20.	10.	.....	.....	.....	5.	.....	.....	20	75.

The first and last thirteen columns may be dismissed without particular discussion since the parasites listed in them are not found in man, or are so infrequent and so harmless as to be of little importance in our present consideration. Considering the tape worms which alone are worthy of attention in the present connection, it may be said that *Taenia serrata* does not occur either as an adult or a larva (*Cysticercus*) in the human system. *Taenia marginata* has been said to occur in man in its larval condition (*Cysticercus tenuicollis*) but the weight of authority seems to disprove this statement, and to demonstrate that these were cases of incorrect determination of the species of parasite found. *Taenia coenurus* is also foreign to man; it is, however, of great hygenic importance since it is the cause of the so-called "gid" of sheep, a disease which in some parts of the world entails a serious loss to sheep raisers. It will be noticed that the species is not known to exist in America as yet. *Taenia serialis* is a rare form at most; it has been met in Europe and in Washington, though not included in the lists tabulated. It is not known to be of pathological importance. *Dipylidium caninum* is found in man rarely, and usually only in children of immature years among whom it seems to be not very uncommon. The intermediate host is the dog flea, and the infection comes through the accidental swallowing of some of these parasites, which have come from a pet dog in the house. This, of itself, is sufficient reason for training children to avoid fondling household pets, at least in such an intimate way as is frequently seen.

There remains to be considered, then, merely the single species *Taenia echinococcus*. The adult form, which lives in the intestine of the dog, is an insignificant tapeworm, consisting of only three or four segments, and having a

total length of not more than 5 mm. Its larval form, however, the hydatid, known as *Echinococcus*, which in its various forms has received something like a dozen different specific names, is the most insidious and dangerous parasite which inhabits the human system. It will easily be seen how serious an evil the presence of the adult in the dog must be regarded, since the eggs thus set free from the canine intestine would be scattered here and there with the dust of the dwelling or its immediate surroundings, and would easily by chance reach the intestine of a human host and there be hatched out; the larva would pass to some point in the abdominal cavity, there to attain gradually its enormous development with probable fatal results to the host. It is certainly fortunate that this form is so rare in America as not to have been found in the course of the systematic investigations quoted here. It does, however, occur, since the adult has been found in Washington on at least one occasion. Sommer has also listed one hundred cases of the occurrence of the Echinococcus disease which are recounted in the various medical publications of the country for the last fifty years.

Having thus considered the characteristics of each species of the more important dog parasites, let us review a few facts with reference to the frequency of these forms in our own country. It will be noticed that Iceland and Australia are the only localities in which investigations have been made, that show a larger percentage of dogs infected than was found in Lincoln, while the number infected in Denmark, Prussia, and Saxony is decidedly less. A closer study of the table also shows, however, that the high percentage of dogs infected in Lincoln is due to the extraordinarily large number of hosts that harbored *Taenia serrata* and *Dipylidium caninum*. With reference to the first of these, Lincoln dogs were three

times as frequently infected as those from any other part of the world, and very many times more than those from regions listed. With reference to *Dipylidium*, it will also be noticed that it is present in somewhat larger percentage than is found anywhere else in the world, and in a decidedly greater percentage of dogs than is shown for almost all places. So far as the other species of parasites are concerned there is, in the first place, at least as small a percentage as in other localities, and the species which have already been designated as peculiarly dangerous to the health of man, or of some of the domestic animals, are entirely lacking so far as the limits of the investigation go. In other words, though the total percentage of dogs infected is larger than has been found in most places, yet the most dangerous parasites seem to be entirely lacking, and the excessive total percentage is due to an unusual number of two species in particular, which are not to be regarded as dangerous parasites. So far as the Washington dogs are concerned, the total percentage is again very much greater than in most places. This is due, not to the presence of the more dangerous forms, but to the large number of forms which, in themselves, are comparatively harmless. Regarding only the more recent, and presumably more careful examinations, those listed in the last four lines of the table, it may be said that the number of kinds of parasites found in the various parts of this country is only about two-thirds as great as the number of species reported from Germany. If it be asked, then, what are the causes which give us, on the one hand, a large percentage of harmless parasites, and on the other, excessive rarity or entire lack of the more dangerous forms, I believe that some part of the answer at least may be given at once. The recent settlement of this part of the country, and the uncontaminated condition of fields

and pasture lands, is undoubtedly a reason for the existence of a less number of parasites than are found in the longer settled portions of the world. But in addition to this, and, I am inclined to think, of even greater importance, is the general prevalence in this western country at least, of the large slaughter-houses. According to the primitive mode of slaughtering which was in general vogue throughout the country a few years ago, and which is still practiced in many of the more conservative portions of our country, animals were slaughtered on the farm, or in some temporary slaughtering-house, and the remains were thrown to the dogs or hogs as the easiest way of getting rid of them. In this way the larval forms reached their final host, and the number of parasites was unquestionably augmented. Under the present conditions the various parts of the animal are utilized to such an extent that, as the packers say, "The only part of the hog which goes to waste is the squeal." By this means all the larval stages, particularly of the tapeworms which are present as bladder-worms in the omentum or in the connective tissue of various parts, are destroyed and never reach their ultimate host.

Thus it is that *Taenia marginata*, *Taenia coenurus* and *Taenia echinococcus* are so rare as to be almost lacking. It is evident also that with more perfect methods of slaughtering and more complete utilization of the fragments, the number of stages of larval tape worms which reach the final host will be still further diminished, and the danger from such parasites proportionately removed.

In Berlin, Germany, it has been shown by Deffke that a reduction in the number of canine parasites has taken place since the introduction of compulsory meat examination, and the destruction of infected portions of all animals slaughtered.

A further support to this opinion seems to be found in the abundance of *Taenia serrata* in dogs obtained in Lincoln. The larva of this parasite is a bladder worm (*Cysticercus pisiformis*) found abundantly in the rabbit; the latter is not only extremely common in this region, and frequently hunted by dogs as a matter of mere sport, but also if used as human food, dressed at home or in the smaller butcher shops, where the refuse easily falls in the way of dogs of all kinds. Thus not only the natural hunting proclivity of the dog, but the element of chance as well, favors the increase of this particular species of parasite.

It may then be properly affirmed that, although the dogs in this country are apparently more seriously affected with parasites than their relatives of modern Europe, they are yet not such a menace to public health, since the parasitic species peculiarly dangerous to the human family at least are either wanting or extremely rare. This, however, does not mean that intimate association with the dog tribe is more worthy of encouragement here. If for no other reason than the extreme abundance of *Dipylidium caninum*, it would be best to limit the association of dogs and children, since this form is a comparatively frequent parasite of man in his earlier years.

The records that have been kept of the parasites of cats, which have been subject to a complete examination, during the past three years, are also given in the two following tables (C, D). As compared with the dogs it will be seen in the first place that fewer cats are free from infection, and in the second, that a smaller number of species of parasites has been taken from the cat than from the dogs of this region.

TABLE C.

CATS EXAMINED.	Total.	Free from parasites.	With one species.	With two species.	With three species.	With four species.	Slightly infected.	Badly infected.
Actual number	20	1	12	3	1	3	13	3
Percentage....	*100*	*5*	*60*	*15*	*5*	*15*	*65*	*15*

TABLE D.

CATS INFECTED WITH SPECIES AT RIGHT.	Taenia crassicollis.	Dipylidium caninum.	Distoma felineum.	Ascaris mystax.	Uncinaria trigonocephala.
Actual number.....	5	3	7	14	5
Percentage infected.....	*25*	*15*	*35*	*70*	*25*
Percentage slightly infected	*25*	*15*	*20*	*55*	*15*
Percentage badly infected.	.....	.....	*10*	*5*	.....
Average number of parasites found in cases infected with each.....	1	6	19	9	6

Again the total number of parasites present in any one individual falls far short of that found in some of the dogs. Thus the largest total number of parasites taken from any cat was less than sixty, whereas four dogs out of twenty harbored from two hundred to five hundred parasites each. Furthermore, twelve of the nineteen infected cats contained each but a single species of parasites, whereas twelve of the fifteen infected dogs yielded more than one species of parasite from each host.

Among the parasites listed from cats *Dipylidium caninum* has already been discussed. *Distoma felineum*, which

is the most abundant parasite of cats in this region has been reported from Siberia as a frequent human parasite. It should be stated that the two forms are possibly not the same species; but practitioners in this region should be alert in cases of hepatic cirrhosis to see whether this form may not be the cause of the difficulty. The other feline parasites are not found in man. I regret to state that extended search has not yet discovered tables giving the frequency of parasites of cats in other parts of the world so as to afford basis for comparison with the results obtained here. It would then be hardly more than a guess as to whether the conditions represented here are favorable or unfavorable.

Zoological Laboratory,
The University of Nebraska.