Parasites fall only roughly into the two categories implied in the title of this discussion. While a few of them are totally dependent upon human hosts, and some are able to develop only in other animals, a majority of the parasites commonly referred to as "parasites of man" are in reality parasites of other animals. In the latter group are such familiar examples as Trichinella, found in rats and many other animals, including pigs; Balantidium and some lesser protozoa of pigs; Toxoplasma, which occurs in many wild and domesticated animals. Trypanosoma cruzi, which is carried by a variety of animals, is the cause of Chagas' disease commonly seen in parts of South America and found recently in a child in Texas. Other examples include Isospora of undetermined hosts, possibly including the dog; Trichostrongylus species that commonly are found in sheep and goats; the small tapeworms, Hymenolepis nana and Hymenolepis diminuta, of rats and mice; and the common dog tapeworm, Dipylidium caninum. There are others whose endemicity in any area depends somewhat on the presence of suitable non-human hosts, and still others that are able to reach maturity in man but are rarely involved in medical problems because infection is acquired only by eating uncooked earthworms and insects. It might be mentioned, as a matter of interest, that occasionally other animals may acquire parasitic diseases from their human associates, as for example dysentery and diarrhea in dogs, caused by Entamoeba histolytica and Strongyloides stercoralis.

In all of the above mentioned parasitic infections, diagnosis is usually based on conventional laboratory methods, and both clinical and laboratory workers are generally familiar with the problems presented by them. In recent years attention has been directed to parasitic infections caused by worms which, regardless of length of residence in the human body, do not reach full reproductive maturity and are therefore not diagnosable by the usual laboratory methods. It is of course the larval stages or immature adults that are involved and, owing to their tendency to be mostly in the tissues and in many instances difficult to find and identify, the infections caused by them are often unrecognized. Largely for this reason the frequency and severity of infections of this nature have not been fully determined. There are, however, some familiar examples.

Certain well known larval tapeworm infections are acquired from other animals. Examples are echinococcus (hydatid) and coenurosis whose infective stages are carried in the feces of dogs, and sparganum which comes from infected cats and dogs but requires development in aquatic hosts before it is infective for man. These infections are uncommon in the United States and are especially rare in children.

It is sometimes stated that the common ascarids and whipworms of children (Ascaris lumbricoides and Trichuris trichiura) are identical with those of pigs. It has not been satisfactorily demonstrated that they are cross-infective to the extent of reaching full maturity in the reciprocal hosts, but it can be safely assumed that when children swallow the infective eggs of pig ascaris, the larvae invade the liver and the lungs even if they fail to reach maturity in the intestine.

Creeping eruption, or cutaneous larva migrans, has been recognized for many years as due to larval stages of the dog and cat hookworm, Ancylostoma braziliense. It is not always appreciated, however, that other species of nematode larvae also produce creeping eruption, and that after a
period of migration in the outer layers of the skin some of the larvae move into deeper tissues, including the lungs.3

Among those infections acquired through contact with dogs and cats in the United States, it is believed that visceral larva migrans, caused by ascarids of dogs, is probably the most widespread and most damaging to children. Although this infection probably has been common among toddler-age children for many years, it was not recognized and described until 1952.4

During the past 5 years much has been written about visceral larva migrans and case reports, including some fatalities, have appeared abundantly in pediatric journals.5-8 It will therefore suffice merely to review some of its main features. The parasite, Toxocara, is a large roundworm which in its appearance and life cycle resembles Ascaris lumbricoides, the common large roundworm of children. The dog and the cat each commonly harbors a species of its own, T. canis and T cati, respectively. Eggs eliminated in the animals’ feces are not infective when passed but after 2 or 3 weeks in warm, damp, shaded soil each egg, of which there may be hundreds in 1 or 2 gm of soil, contains an infective larva capable of producing a new mature infection in a natural host, or a long-lasting larval infection in a child. When infective eggs are ingested by children, the larvae erupt from the egg, migrate to the liver, and from there to other parts of the body including the central nervous system and the eye. Destructive eosinophilic granulomatous lesions are formed around the minute worms or along their migratory paths through the tissues. Marked eosinophilia of the blood, hyperglobulinemia and enlargement of the liver are characteristically noted, along with variable symptoms including fever, cough, loss of appetite, irritability and neurologic disturbances. Threatening lesions in the eye bearing a superficial resemblance to retinoblastoma have occurred in a number of instances. Larvae persist alive in the tissues for many months, during which time the eosinophilia may remain high while the other indications of infection gradually disappear. Conclusive diagnosis can be made only by direct demonstration of larvae in liver tissue or in other tissues post mortem. Usually a satisfactory diagnosis can be made on clinical grounds, especially if supported by serodiagnostic tests presently being developed.9-12

Toxocara is the only larval nematode yet identified in the tissues of children with visceral larva migrans. It is anticipated, however, that others will be discovered. It was mentioned earlier that dog and cat hookworm larvae that cause creeping eruption also invade the deeper tissues. Their behavior in experimental animals suggests that several species of hookworms not ordinarily infesting man probably behave somewhat like Toxocara in humans and may therefore produce the visceral larva migrans type of disease. Studies by Nichols have made it possible to identify some of these larvae either after isolation from fresh tissues or in stained sections.13,14 Two of the Toxocara larvae recently identified in our laboratory are noteworthy. One (to be reported from California by Dr. A. R. Irvine) was the first to be found in the eye since Wilder reported a series of such cases in 1950;15 and the other (reported a few months ago from Washington, D.C. by Bruton and Jaffurs16) was the first to be found in a needle biopsy.

Biopsies of the liver for diagnosis of suspected cases of visceral larva migrans have revealed three infections of Capillaria hepatica in children—one each in Baltimore,17 Hawaii18 and South Africa.19 Necropsy examination earlier had brought to light only three such cases, one of which was in a child in New Orleans.20 This worm’s natural location is in the liver of rats and other small rodents, and it has the peculiar trait of putting its eggs in the tissues where they can not be eliminated from the body. Capillaria has not been adequately studied but it appears probable that human infection is acquired through the ingestion of soil contaminated by animals whose feces bear the eggs digested from the
liver of infected rats. Like Toxocara, the eggs must undergo development outside the host before they are infective. Clinically, Capillaria infection can not be distinguished from visceral larva migrans caused by Toxocara. Although it appears to be an uncommon infection in children it seems to be especially damaging since only one individual infected with Capillaria is known to have survived, and even in this case the child had not entirely recovered when the report was made. On the other hand, its real prevalence is unknown and it is possible that some clinically significant but non-fatal infections are being overlooked.

One other type of zoonotic infection should be mentioned. In 1941 a worm resembling the heartworm of dogs (Dirofilaria) was discovered in the inferior vena cava of a woman in New Orleans. More recently other filarial worms of the same general type have been found in subcutaneous nodules or abscesses in adult residents of Florida. In addition to two reported in 1952 and one in 1957, at least five unreported cases have come to our attention within the past year. These worms are several centimeters long and, although none have been found mature and reproductive, all have been fully differentiated. Thus far these worms have not been specifically identified and the natural host is therefore unknown. It is suspected that dogs carry the infection and that mosquitoes transmit it.

Perhaps stress can justifiably be placed on the incompleteness of our knowledge of the larval worm infections acquired from other animals, particularly household pets. A few years ago we might have said that ascarids of dogs and cats rarely if ever cause disease in children, although warning on this matter had been given by Schwartz in 1932 and by others even earlier. Also, up to a year ago we did not know that the dog whipworm, Trichuris vulpis, ever infects man. Now that Hall and Sonnenberg have reported infection with a mature worm in a child, we must immediately be curious about the frequency and clinical importance of infection with immature stages of this common parasite. Indeed its possible role in dysenteries of unknown cause in children has already been considered by the speaker, as it must also have by others. There are doubtless still some important parasitic diseases unidentified. Some of them may fill the gaps among the diseases of unknown or doubtful etiology, such as tropical eosinophilia which, according to some preliminary reports, appears to be a non-patent nematode infection related to visceral larva migrans.

Since the nonpatent, cryptic parasitic infections, especially the filth-borne, soil-generated ones, are more common in children than in adults, it is expected that new knowledge of these infections will come from pediatricians who look for them. Fortunately, there are certain common signals which serve to alert the clinical and laboratory observer. They are, somewhat in order of their significance or frequency, eosinophilia of the blood, especially if high and sustained, liver enlargement, pneumonitis, bronchial asthma, urticaria, neurologic disturbances, sharp deviations in behavior, intra-ocular granulomatous lesions, or subcutaneous cysts, masses, or swellings. With or without peripheral eosinophilia, hidden parasitic infections of the intestine are suggested by the presence of eosinophils and Charcot-Leyden crystals in exudates of the bowel or in feces.

The trend towards suburban and exurban residence probably is encouraging more families to acquire household pets. At the same time, better housing and general improvements in sanitation are bringing about a decrease in the prevalence of human parasitic infections transferred directly from individual to individual. On the other hand, modern implements and principles of sanitation have had relatively little influence on the management and defecation habits of household pets. This situation may be bringing about an actual rise in the frequency of human disease contracted from these animals. It is certainly true that the
control of other parasitic diseases in some communities has elevated the animal-borne infections to a position of much greater relative importance. This matter is mentioned to emphasize that while it may appear that the prevalence of zoonotic infections among children is increasing, the apparent increase is due, in part at least, to the greater ease with which these infections can be recognized in the absence of others that often produce many of the same symptoms.

In conclusion, several of the parasites of animals, particularly household pets, are known to cause serious diseases in children. Other less damaging ones are readily transmissible to humans, and it can not be said with confidence that still others are not responsible for certain diseases of unknown cause. Moreover, even if certain parasites of pets are harmless to the human members of a household they may be harmful to the pets themselves. It would therefore seem that from almost every reasonable point of view parasites deserve much the same consideration whether they occur in children or in their childlike animal companions. Finally, we must be reminded that household pets have such values as to entirely rule out any suggestion that they impose such responsibilities and involve such hazards as to make them undesirable, except in special cases. Though it is not a simple matter, by preventive and therapeutc measures, dogs and cats can be kept free of harmful parasites, or at least they can be managed in such a way as to minimize their threat to health. The same holds for other less common household pets, such as mice and monkeys.

REFERENCES
Rickettsial diseases of animals transmissible to children

By Lauri Luoto, D.V.M., M.P.H.

U. S. Department of Health, Education and Welfare, Public Health Service, National Institutes of Health, National Institute of Allergy and Infectious Diseases, Rocky Mountain Laboratory, Hamilton, Montana

Because rickettsial infections occur sporadically, pediatricians may not be as thoroughly familiar with them as they are with common diseases of children that are characterized by rash. Hence, the rickettsias are infrequently considered in the etiology of febrile exanthemas or fevers of undetermined origin. Rickettsial diseases of primary interest in this country are Rocky Mountain spotted fever, murine typhus, rickettsialpox and Q fever. The agents causing these diseases exist as latent infections in arthropods and animals, and they are transmitted accidentally to man through well-defined channels of spread. An awareness of the epizootiology of rickettsial diseases in nature and of the means by which these agents are transmitted to man is helpful in establishing a diagnosis of a rickettsial disease. Therefore, salient features of the natural cycles of infection which may suggest a clinical diagnosis will be stressed, and characteristics of these diseases in children will be reviewed briefly.

Rocky Mountain spotted fever is usually contracted during the spring or summer through the bite of an infected tick although infection also may be acquired by dermal contact with tissues of a crushed or improperly removed tick. The wood tick, Dermacentor andersoni, the dog tick, D. variabilis, and the lone-star tick, Amblyomma americanum, which are found, respectively, in the western, eastern, and southern United States are responsible for transmitting the organism to man. Natural infection with Rickettsia rickettsii in these species is maintained by transovarial passage of the agent and by the feeding of immature stages on infected small mammals. Environmental factors such as rainfall, temperature, food supply of small mammals, and prevalence of predators indirectly affect the abundance of ticks. The
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