# SOME ENTOZOA OF MAN AS SEEN IN CANADA AND SOUTH AFRICA*

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DURING the past two years of residence in Montreal opportunity has been afforded us of examining microscopically fæcal and other materials from a number of persons for animal parasites. Following on our sixteen years of similar examinations in Johannesburg, S.Af., it is of interest to compare the results of the examinations made by us in the two cities, especially as there are considerable differences in altitude, climatic conditions, and composition of the population in the two places.

Johannesburg is situated in the Transvaal, 5,800 to 5,900 feet above sea level, on a high tableland, 26.11° S. latitude and 28.7° E. longitude. It is thus only 3 degrees south of the Tropic of Capricorn. Its air is exhilarating, as it has a so-called "plateau climate", and there is much sunshine even during the winter. The rains in Johannesburg are summer rains and so the winter is dry. The temperature in the summer may reach 90° F. in the shade, while even in the coldest winter weather it is relatively warm at mid-day, and only a few degrees of frost are experienced during a few winter nights. Only a very small amount of snow falls during some winters.

Montreal is on an island in the St. Lawrence, nearly at sea level, 45.31° N. latitude and 73.35° W. longitude. There is a long, cold winter, when −40° F. may occasionally be experienced. The spring is short, the summer hot and humid, when the temperature may reach 90° F., and a short autumn or fall introduces the winter, when 11 to 14 feet of snow may fall in the city.

With regard to the population of the two places, each is cosmopolitan in some respects, though the composition of the population is different. Johannesburg, on the greatest producing gold field of the world, has a cosmopolitan European population, mainly Dutch and English, but with Portuguese, Italian, French, German, Greek and Scandinavian elements, a rather large population of Jewish people, mostly from Central Europe and Russia, a very large population of natives, members of many Bantu tribes, who are employed as house boys, shop delivery boys, labourers and workers in the gold mines, a small Indian population, chiefly grooms, vegetable growers and sellers, small shopkeepers, and a few silk merchants, and a very small Chinese population, chiefly engaged as vegetable growers, small shopkeepers, laundry workers, and a few silk merchants. The Asiatic population is mainly descended from people imported as indentured labourers for work on mines or railway construction or for work on the Natal sugar plantations, many years ago, and all have been born in South Africa. Many of the native mine workers come under contract from Portuguese East Africa. Both natives and Asiatics have added directly to the health problems of the Union, for they have brought certain parasitic diseases with them.

In Montreal there is the usual white cosmopolitan European element, due to it being a very large port, in addition to the settled population, in which the French Canadian is most numerous and the British next. A distinct Balkanic and Russian Jewish element is also fairly strong. Italian, Greek and Scandinavian peoples are present in small numbers. A prosperous Chinese element has its own district and engages in commerce and laundry work. There is a small African element consisting of negroes originally from the West Indies and the United States, largely West African in ultimate origin, and a sparse representation of North American Indians or hybrids between them and other elements in the population. The Asiatic and African elements in Montreal perhaps also appear to be of some significance in relation to parasitic disease, though more investigations are certainly needed in this direction.

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## MATERIAL AND METHODS

Fæcal examinations may first be considered and then blood examinations.

In Montreal we have made examinations of fresh stools of hospital patients, many in the Royal Victoria Hospital, some patients of private practitioners, and a few students. In the first instance the investigation was undertaken in an attempt to ascertain the excitant in some cases of colitis,[4] stools of patients not suffering from gastrointestinal complaints being used as checks or controls and as samples of the general population. In some respects the cases became more of a selective nature, for, *Entamœba histolytica* having been established by us as the causal agent of certain cases of colitis, interest was aroused and resulted in more stools of such colitis cases and of patients suffering from diarrhœic conditions being submitted for examination. A few of these patients came to Montreal from other Quebec cities and from other provinces, but the greater number were residents of Montreal or its vicinity. The few students were apparently normal, healthy young males.

The stool of each person was examined at least once microscopically and once by concentration or enrichment methods. In some cases as many as twenty examinations were made for one patient. Fresh preparations in normal saline, in 0.5 per cent methyl green, and in Gram's iodine were always examined. Occasionally fixed and stained preparations were used. A number of stools were washed for parasitic worms.

In Johannesburg, the examinations made by us at the South African Institute for Medical Research were of stools derived from patients at the large Johannesburg General Hospital, the Non-European Hospital, Children's Hospital, various mine hospitals and private patients of various medical practitioners from all parts of South Africa. The same procedure was used as in stool examinations in Montreal. While many were sent for examination on account of abdominal malaise, others were sent as routine measures only. Thick and thin blood and lymph smears, sent for examination for hæmatozoa, were usually stained with Giemsa's solution or with hæmatoxylin and eosin.

While the results are not entirely comparable, yet there is a parallelism, as will be shown subsequently, and this emphasizes that conditions of entozoal infestation in a place almost in the tropics, such as Johannesburg, may be duplicated, at any rate to some extent, in a city in a geographically more temperate region, such as Montreal.

In this paper the term "parasite" is used in a general sense and is practically synonymous with "entozoon".

## ENTOZOA FOUND IN HUMAN STOOLS IN MONTREAL

During two years in Montreal, the stools of 563 persons, comprising 242 men and 321 women, have been examined for Entozoa, both Protozoa and Helminthes, and of these 208 persons (94 men and 114 women) harboured some species of intestinal Entozoa. While 148 persons had one species of intestinal Entozoa, 50 harboured two kinds of Entozoa, 9 had three species and 1 had an intestinal fauna of four different kinds of animal parasites. These may now be summarized.

### SINGLE PROTOZOAL INFECTIONS

Nine kinds of Protozoa have been observed as the sole animal parasite present in the stools of persons examined. These were:—

| | *Name* | *No. of persons* |
|---|---|---|
| Sarcodina | | |
| | *Entamœba histolytica* | 63 |
| | *Entamœba coli* | 15 |
| | *Endolimax nana* | 8 |
| | *Iodamœba butschlii* | 2 |
| | *Dientamœba fragilis* | 5 |
| | Free-living amœba (*Vahlkampfia* sp.) | 1 |
| Mastigophora | | |
| | *Trichomonas hominis* | 7 |
| | *Chilomastix mesnili* | 26 |
| | *Giardia intestinalis* | 15 |

### SINGLE HELMINTHIC INFECTIONS

Five kinds of single Helminthic infections have been found, thus:—

| | *Name* | *No. of persons* |
|---|---|---|
| Cestoda | | |
| | *Hymenolepis diminuta* | 1 |
| | *Diphyllobothrium latum* | 1 |
| Nematoda | | |
| | *Trichuris trichiura* | 2 |
| | *Enterobius vermicularis* | 1 |
| | *Necator americanus* | 1 |

### DOUBLE ENTOZOAL INFECTIONS

Seventeen combinations of two animal parasites have been found in stools from 50 patients, 14 of the combinations being of 2 species of Protozoa and 3 of them of Protozoa and Helminthes. These may be tabulated as follows:—

| Parasites | | | No. of persons |
|---|---|---|---|
| *Entamœba histolytica* | + | *E. coli* | 5 |
| " " | + | *Endolimax nana* | 2 |
| " " | + | *Iodamœba butschlii* | 1 |
| " " | + | *Dientamœba fragilis* | 7 |
| " " | + | *Chilomastix mesnili* | 12 |
| " " | + | *Trichomonas hominis* | 1 |
| " " | + | *Giardia intestinalis* | 5 |
| *Entamœba coli* | + | *Chilomastix mesnili* | 1 |
| " " | + | *Giardia intestinalis* | 3 |
| *Endolimax nana* | + | *Trichomonas hominis* | 1 |
| " " | + | *Chilomastix mesnili* | 2 |
| *Dientamœba fragilis* | + | *Giardia intestinalis* | 1 |
| *Chilomastix mesnili* | + | *Trichomonas hominis* | 4 |
| " " | + | *Giardia intestinalis* | 1 |
| *Endolimax nana* | + | *Hymenolepis nana* | 1 |
| *Entamœba coli* | + | *Enterobius vermicularis* | 1 |
| *Dientamœba fragilis* | + | *Trichuris trichiura* | 2 |

### Triple Entozoal Infections

Nine cases of infection with 3 species of animal parasite have been observed. Of these, 8 persons each harboured a different combination of three species of Protozoa and the remaining patient harboured mixed Protozoa and Helminthes. The organisms and their combinations were:—

*Entamœba histolytica, E. coli, Dientamœba fragilis.*
" " " *Iodamœba butschlii.*
" " *Endolimax nana, Chilomastix mesnili.*
" " *Iodamœba butschlii, Trichomonas hominis.*
" " *Chilomastix mesnili, Trichomonas hominis.*
" " " " *Giardia intestinalis.*
*Entambœba coli, Endolimax nana, Iodamœba butschlii.*
*Trichomonas hominis, Chilomastix mesnili, Giardia intestinalis.*
*Entamœba histolytica, Giardia intestinalis, Enterobius vermicularis.*

### Quadruple Mixed Infection

One case only of a patient with 4 intestinal Entozoa came under observation, the organisms being *Endolimax nana, Diphyllobothrium latum, Tœnia saginata* and *Ascaris lumbricoides.* The worms were diagnosed from embryophores or ova in the stools and recovered from stools passed after treatment.

From the foregoing, several points of interest accrue. It will be seen that 103 persons (45 men and 58 women) harboured *Entamœba histolytica* out of 563 people examined, that is, an infection of 18.3 per cent. While remembering the partly selective nature of the cases already mentioned, it is evident that amœbiasis is a factor to be borne in mind, even in places far north of the Equator and with severe winters, such as Montreal, particularly if such places are ports. As four other Sarcodina may be present in the human alimentary tract, it is necessary to use both caution and skill in discriminating between the pathogenic *Entamœba histolytica* and the non-pathogenic *E. coli, Endolimax nana, Iodamœba butschlii* and *Dientamœba fragilis.* Factors contributory to the occurrence and ultimate control of *E. histolytica* will be discussed later.

In 85 persons, flagellate infections occurred, either singly or with other Entozoa.

Four tapeworms, *Tœnia saginata, Hymenolepis nana, H. diminuta* and *Diphyllobothrium latum,* have been found in man in Montreal.

Four Nematodes, *Necator americanus, Enterobius vermicularis, Ascaris lumbricoides* and *Trichuris trichiura,* have been observed.

In addition to the foregoing animal parasites observed in stools, mention must be made of two other parasites obtained at operations or at post-mortem examinations and made available to us by the kindness of several colleagues in Montreal during the last two years. The parasites are the human liver fluke, *Clonorchis sinensis,* found twice in Chinese men who died in Montreal, and large, living hydatid cysts of *Echinococcus echinococcus,* from three patients. Several samples of cerebrospinal fluid have also been examined by us for parasites, and in one sample a few hooklets, brood capsules and scolices of Echinococcus were present. A very small cyst from human cerebrospinal fluid, sent to us privately by a medical friend, proved to be *Cysticercus cellulosæ,* the larva of *Tœnia solium,* but the patient did not belong to Montreal.

### Entozoa Found in Human Stools in South Africa

In connection with our South African work, reference may be made to figures and differential analyses of parasitological results published in the Annual Report of the South African Institute for Medical Research for 1928, at which time one of us was Honorary Protozoologist and the other Head of the Department of Parasitology in the Institute. Some figures relating to the incidence of animal organisms will also be quoted from other of the Institute Reports, and also remarks made from personal knowledge where certain information was not published in the necessarily condensed Annual

Reports. For instance, in 1931, there is the statement that "*Entamœba coli* was of such frequent occurrence that records were not kept," a statement that is equally true of other years. Unfortunately, records of *Endolimax nana, Iodamœba butschlii* and *Dientamœba fragilis* in Johannesburg are also unpublished and are no longer available to us. The Report for 1928 has been chosen as more details are given in it than in many of the other Reports.[1] It must be emphasized that the figures given relate to the number of stools examined and not to the number of persons, as was the case for Montreal.

In the year 1928, the stools examined for animal parasites numbered 5,094, of which 1,739 were suspected of dysentery. The incidence of certain parasites only, as recorded in the Annual Report, is as follows: —

| Protozoa | *No. of stools* |
|---|---|
| *Entamœba histolytica* | 264 |
| *Trichomonas hominis* | 94 |
| *Chilomastix mesnili* | 106 |
| *Giardia intestinalis* | 118 |
| Cestoda | |
| *Tænia solium* | 3 |
| *Tænia saginata* | 8 |
| *Hymenolepis nana* | 9 |
| *Hymenolepis diminuta* | 2 |
| Trematoda | |
| *Schistosoma mansoni* | 26 |
| Nematoda | |
| *Ancylostoma duodenale* | 315 |
| *Necator americanus* | 12 |
| *Ascaris lumbricoides* | 39 |
| *Trichuris trichiura* | 41 |
| *Strongyloides stercoralis* | 7 |
| *Enterobius vermicularis* | 2 |
| *Hepaticola hepatica* | 1 |

Considering the pathological significance of *Entamœba histolytica,* out of 1,739 suspected dysenteric stools it was found in 264, or 15 per cent. In 202 it was the only animal parasite present, and in 62 it was associated with from one to four other animal parasites, 25 combinations of parasites having been found. The following analysis gives some idea of the association of *E. histolytica* with various other parasites in fæces.

*Entamœba histolytica* with one other animal parasite:—

| | | | |
|---|---|---|---|
| *E. histolytica* | + | *Chilomastix mesnili* | 13 |
| " | + | *Trichomonas hominis* | 7 |
| " | + | *Giardia intestinalis* | 6 |
| " | + | *Entamœba coli* | 3 |
| " | + | *Ancylostoma duodenale* | 2 |
| " | + | *Enterobius vermicularis* | 1 |
| " | + | *Schistosoma mansoni* | 3 |

*Entamœba histolytica* with two other animal parasites:—

| | | | |
|---|---|---|---|
| *E. histolytica* | + | *Chilomastix mesnili* and *Trichomonas hominis* | 6 |
| " | + | *Chilomastix mesnili* and *Giardia intestinalis* | 2 |
| " | + | *Trichomonas hominis* and *Giardia intestinalis* | 2 |
| " | + | *Entamœba coli* and *Giardia intestinalis* | 1 |
| " | + | *Entamœba coli* and *Ancylostoma duodenale* | 1 |
| " | + | *Entamœba coli* and *Chilomastix mesnili* | 1 |
| " | + | *Trichomonas hominis* and *Spirochæta eurygyrata* | 1 |
| " | + | *Giardia intestinalis* and *Tænia solium* | 1 |
| " | + | *Trichomonas hominis* and *Ascaris lumbricoides* | 2 |
| " | + | *Trichomonas hominis* and *Ancylostoma duodenale* | 1 |
| " | + | *Ancylostoma duodenale* and *Ascaris lumbricoides* | 2 |
| " | + | *Ancylostoma duodenale* and *Necator americanus* | 1 |
| " | + | *Ancylostoma duodenale* and *Schistosoma mansoni* | 1 |
| " | + | *Schistosoma mansoni* and *Ascaris lumbricoides* | 1 |

*Entamœba histolytica* with three other animal parasites:—

| | | | |
|---|---|---|---|
| *E. histolytica* | + | *Chilomastix mesnili, Giardia intestinalis* and *Ascaris lumbricoides* | 1 |
| " | + | *Chilomastix mesnili, Schistosoma mansoni* and *Ancylostoma duodenale* | 1 |
| " | + | *Entamœba coli, Chilomastix mesnili* and *Trichomonas hominis* | 1 |

*Entamœba histolytica* with four other animal parasites:—

| | | | |
|---|---|---|---|
| *E. histolytica* | + | *Ascaris lumbricoides, Ancylostoma duodenale, Trichuris trichiura* and *Trichomonas hominis* | 1 |

Another pathogen of much importance occurring in stools is *Schistosoma mansoni,* particularly in certain districts in Portuguese East Africa from which native labour is recruited for the gold mines of the Witwatersrand. In 26 stools ova of *S. mansoni* were found, and in 14 they were associated with other parasites as follows:—

| | | | |
|---|---|---|---|
| *Schistosoma mansoni* | + | *Entamœba histolytica* | 3 |
| " | + | *Trichomonas hominis* | 1 |
| " | + | *Ancylostoma duodenale* | 2 |
| " | + | *Ascaris lumbricoides* | 2 |
| " | + | *S. hæmatobium* and *Ascaris lumbricoides* | 1 |
| " | + | *Trichuris trichiura* and *Ascaris lumbricoides* | 2 |
| " | + | *Trichomonas hominis* and *Enterobius vermicularis* | 1 |
| " | + | *Ancylostoma duodenale* and *Enterobius vermicularis* | 1 |
| " | + | *Ancylostoma duodenale* and *Entamœba histolytica* | 1 |

The incidence of certain animal parasites in stools for some other years may be of interest.

In 1931, the stools examined were 4,491. *Entamœba histolytica* was detected in 271 of them; *Chilomastix mesnili* in 173; *Giardia intestinalis* in 152; *Trichomonas hominis* in 121; *Tœnia saginata* in 18; *Tœnia solium* in 1; *Hymenolepis nana* in 2; *Hymenolepis diminuta* in 1; *Schistosoma mansoni* in 9; *Ascaris lumbricoides* in 19; *Enterobius vermicularis* in 1; *Trichuris trichiura* in 24; *Strongyloides stercoralis* in 4; and *Ancylostoma duodenale* and *Necator americanus* together numbered 220.

In 1932, the stools examined numbered 4,684. *Entamœba histolytica* was found in 226, being the sole animal organism present in 174 and occurring with one, two or three other parasites in 52 specimens. *Chilomastix mesnili* occurred as the sole infection in 156 stools, and *Giardia intestinalis* in 122. In this year 418 stools were specially examined for hookworm ova, and these were found in 197 of them, while they also occurred in 10 stools sent in for examination but not under suspicion of hookworm infection. *Ancylostoma duodenale, Necator americanus* and *Ternidens deminutus* were represented.

Special attention having been given for several years to the incidence of hookworm on the gold mines of the Witwatersrand, the stools of Europeans and of natives suspected of hookworm as contributory to anæmia and run-down conditions were systematically examined for parasites. The number of hookworm cases among white men was relatively small compared with the large number of unaffected white workers, but such cases were contracted through soil pollution on the mines by careless natives, who disregarded the abundant latrine accommodation provided. The cases among natives were mainly of the carrier type, the mine labourers having brought the hookworms with them from their distant homes.[3]

### HÆMATOZOA IN MONTREAL

With regard to blood-inhabiting parasites, in Montreal there has been little opportunity to examine human blood films, but of the few so far examined, three contained malarial parasites. Two of them had young trophozoites (''rings'') and one of the two also rosettes of *Plasmodium vivax;* the other harboured fairly numerous rings and a very few gametocytes (''crescents'') of the malignant or sub-tertian parasite, *Plasmodium falciparum.* As far as could be ascertained, none of the three persons had ever lived in or visited the tropics. One was born on Montreal Island and was stated never to have been farther south than Sherbrooke, Que. No mixed infections of malarial parasites so far have been observed. There are several species of Anopheles around Montreal.

One blood film containing a Spirochæte, either *Spirochæta recurrentis* or a variety thereof, has been shown to us, the patient having perhaps contracted the parasite in the Southern States, where he had visited.

Two series of blood films have been examined for Microfilariæ, but in neither case were the parasites observed. One series of lymph slides examined for evidence of filarial infection was also negative.

There has been no opportunity in Montreal for us to examine post-mortem material in the blood vessels of which adult *Schistosoma hæmatobium, S. mansoni* or *S. japonicum* may occur. We have obtained ova of *S. hæmatobium* from the urine of one person who had contracted bilharziasis in West Africa and have examined a number of stools from another man who had been treated for bilharzial dysentery when resident in East Africa, the treatment apparently having been successful, as judged by the absence of ova of *S. mansoni.*

### HÆMATOZOA IN SOUTH AFRICA

With regard to Hæmatozoa in Johannesburg, every year about 1,500 to 1,600 blood smears were examined by us for malarial parasites. In 1928 at the South African Institute for Medical Research, 1,592 slides were examined, of which 233 contained malarial parasites, 140 being *Plasmodium vivax,* 61 *Plasmodium falciparum,* and 32 a mixed infection of *P. vivax* and *P. falciparum.* In 1932, when 1,619 slides were examined for Hæmatozoa, 291 contained malarial parasites. Of these 48 contained *P. vivax,* 64 *P. falciparum* and 177 both *P. vivax* and *P. falciparum.* Two slides had *P. malariæ,* quartan malaria being infrequent in South Africa and occurring at the end of the malarial season. Human trypanosomiasis does not occur in the Union of South Africa. *Spirochæta duttoni,* the causal agent of African tick fever, was found in the blood of three patients from different

places in the Transvaal in 1932. Specimens of blood examined for filariasis in 1932 proved negative. However, the writers have seen a few cases of human infection with Microfilariæ, to which brief reference will be made later.

The blood flukes, *Schistosoma hæmatobium* and *S. mansoni,* or their ova, were seen fairly often in Johannesburg. Thus, in 1932, 616 samples of urine were examined and ova of *S. hæmatobium* were found in 256 of them. In one of these, ova of *S. mansoni* as well as of *S. hæmatobium* were present. In 1928, the number of urines examined for animal parasites was 496, of which 172 contained ova of *S. hæmatobium* and in 5 of which ova of *S. spindalis* also occurred. In this year ova of *S. mansoni* were found in 26 stools.

Ova of *Schistosoma japonicum* were found in three Indian children in a village near Durban, where Japanese and Chinese sailors had visited from the port.

### SOME COMPARATIVE REMARKS

In comparing the results of human stool examinations for animal parasites made in Montreal with those made in Johannesburg, it is clear that there is a distinct similarity between the two intestinal faunas. Even taking into account the partly selective nature of the cases in Montreal, it is evident that certain human maladies due to animal parasites, to which the term "tropical diseases" has been inappropriately applied, can occur in a city where −40° F. can be registered in winter as well as in a city where 70° F. occurs in midwinter, while in Montreal damp heat prevails in summer and in Johannesburg, relatively dry heat. Montreal is nearly at sea-level; Johannesburg at approximately 5,800 feet above the sea.

The composition of the entozoal faunas may be broadly compared. *Entamœba histolytica* has been found in men and women in Montreal. Of 563 persons whose stools were examined by us, there were more women than men and more women were infected. The percentage of men harbouring *E. histolytica* was 18.6, the corresponding percentage for women being 18.0. As before mentioned, the Montreal cases became of a somewhat selective nature. According to reports from various sources in the United States more men than women have been found to be infected. In Johannesburg in 1928 the stools found to contain *E. histolytica* were 15 per cent of those suspected to be dysenteric. However, the incidence of *E. histolytica* in all the stools examined in Johannesburg for animal parasites in that year was only 5 per cent, the sex distribution not being given.

Relatively, the number of cases in which *Entamœba coli* was found in Montreal is much smaller than in Johannesburg. *Endolimax nana* and *Iodamœba butschlii* are of about the same frequency in both places. *Dientamœba fragilis* has been found relatively more frequently in Montreal than in Johannesburg.

Intestinal flagellates are more or less cosmopolitan. In some cases in each city, Flagellates were the only organisms, bacterial or animal, of possible pathogenic significance present, and with their elimination subsidence of symptoms occurred. So far, the massive infections with Chilomastix and Giardia encountered so frequently in the Great War, and fairly commonly in South Africa, have not been observed in Montreal, where the numbers of flagellates per stool have been moderate or relatively small. In one case in Montreal, where *Giardia intestinalis* was present in a stool in fairly large numbers, the flagellate was abundant in aspirated bile. In this patient gall bladder trouble had been diagnosed clinically. Under appropriate treatment by the physician concerned, Giardia was eliminated and the gall bladder discomfort subsided. Such gall bladder infections with Giardia appeared to occur more frequently in Johannesburg—at any rate, there were many more requests for examinations of bile for these parasites.

When helminthic parasites are considered, there is also a resemblance between conditions in Montreal and Johannesburg.

So far as Cestoda are concerned, *Tænia saginata, Hymenolepis nana* and *H. diminuta* have been found in human fæces in both cities. In Johannesburg, *Tænia solium* also was found, more particularly among Bantu people, while in Montreal *Diphyllobothrium latum* has been observed. This latter parasite was not seen by us in South Africa, where fresh-water fish are coarse and of few species, and are rarely used for food by Europeans or natives, sea fish being sent inland for European consumption. To many natives, for example, the Zulu, fish are taboo and are never eaten. Pork is favoured

by them and, unfortunately, measly pork (infected with *Cysticercus cellulosæ*) is still a matter of some concern to the health authorities, though it is much less prevalent than formerly. Its use as food cannot be stopped in remote native areas. In Montreal one small cysticercus of *Tænia solium* has been seen in cerebrospinal fluid, as already mentioned, and several such cases were seen in Johannesburg. *Echinococcus echinococcus* has been found in man in both cities. *Cœnurus cerebralis* has been seen in man in Johannesburg, but not in Montreal. It may be mentioned that plerocercoids of a fish tapeworm, *Tetrarhynchus erinaceus,* occur in marine fish in South Africa. While they do not develop in man, they reduce the nutritional value of the fish as food, though that does not seem to cause much concern to the coloured people of Cape Town who consume such fish as food.

The commonest Trematode parasite observed in man in Johannesburg was *Schistosoma hæmatobium,* the adult flukes being found chiefly in the veins of the bladder, liver and mesentery, while the ova occurred in the urine. Infection is incurred chiefly by bathing in water to which infected urine has gained access and in which the appropriate molluscan intermediate hosts occur. The molluscan hosts of *Schistosoma hæmatobium* in South Africa are *Physopsis africana, P. globosa, Limnœa natalensis* and *Bulinus tropicus.* One imported case of *S. hæmatobium* has been seen in Montreal. Regarding rectal schistosomiasis due to *S. mansoni,* no case has been found so far in Montreal, though one treated case has been examined. In tropical Africa, rectal schistosomiasis is fairly common. Native labourers on the Witwatersrand gold fields sometimes bring the parasite with them, and cases have been contracted by bathing in polluted pools, ponds and rivers, where the molluscan intermediate hosts of *S. mansoni* occur; such infections have been contracted in small numbers both in the Transvaal and in Natal. The appropriate molluscs there are *Planorbis pfeifferi, Physopsis africana* and *Bulinus tropicus.* While no cases of *Schistosoma mansoni* have been seen so far by us in Montreal, it is possible that such might be imported from southern parts of the United States, Porto Rico, Central America, the West Indies or South America. Sporadic cases are liable to be found in any large port. It may be mentioned that in Johannesburg in 1925, at an autopsy on a native, *Fasciola hepatica* was found in his small intestine, and that in the stools of a very few patients in hospital in Johannesburg ova of Fasciola were detected.

It has already been mentioned that adult *Clonorchis sinensis* have twice been obtained at post-mortem examinations of Chinese in Montreal. In South Africa, the same fluke was obtained from Chinese people, born in South Africa, who had never been in China, but who had imported fish and tubers and other vegetable food from China for their own consumption. Dried fish from China containing agamodistome cysts, morphologically resembling those of *Clonorchis sinensis,* were also examined by us there. Such imported foodstuffs need careful supervision and examination.

Nematode infections also show likeness in the two cities. Among cosmopolitan Nematodes, *Enterobius vermicularis, Ascaris lumbricoides* and *Trichuris trichiura* have been found, more frequently in Johannesburg, as would be expected. Ova of *Necator americanus* have been seen once in Montreal, in the stool of a negro from the West Indies. On the gold mines of the Witwatersrand, Necator and Ancylostoma both occurred, though the number of worms recovered after treatment was in no way comparable with the enormous numbers of worms passed after treatment in other parts of the world, such as China and the Southern States; this may be ascribed to the provision of ample latrine accommodation underground and extensive use of rock salt in the vicinities most liable to contamination.[3] An occasional case of *Ternidens deminutus* was also found, usually in a mine native from Portuguese East Africa. *Strongyloides stercoralis* occurred both in Europeans and natives, but the number of cases seen was relatively few. None has been seen so far in Montreal where far fewer stools have been examined by us.

With regard to filarial infections, *Microfilaria bancrofti* and *Microfilaria perstans* have been observed in very small numbers in blood smears sent to Johannesburg, the preparations having been made from the blood of natives in the copper belt in North West Rhodesia.

The Hæmatozoa, *Plasmodium vivax* and *P. falciparum,* occurred in material examined both in Johannesburg and in Montreal. *Spirochæta*

*duttoni* was occasionally seen in South Africa, and *S. recurrentis,* or a variety thereof, has been seen in the blood of a patient examined in Montreal.

From the preceding, it is evident that many of the animal parasites found in man in South Africa also occur in Canada, and probably more extended examinations would reveal still others, especially as our personal observations in Canada are limited to two years in Montreal and this paper is confined to our personal experiences. The possibility of the presence of animal parasites, often popularly associated with the tropics or subtropics, needs to be borne in mind in obscure cases of human malaise in more temperate zones. Essentially there is little difference in the kinds of Entozoa that may be encountered in these areas, though the degrees of infestation may differ.

## BRIEF REMARKS ON SOME PREVENTIVE MEASURES

It is not our intention in this paper to discuss preventive measures against human Entozoa; only a few remarks will be made thereon.

So far as human intestinal Protozoa are concerned, the consumption of food, especially green vegetables and salads, or of water contaminated with human excrement, appears to be indicated as the main source of infection, and proper sanitation and methods of sewage disposal are essential. Foods eaten raw should be well washed with boiling water and subsequently chilled, if necessary, with cold boiled water. The greatest care should be exercised regarding the purity of the water used in making ice and the subsequent handling of the ice. We have ourselves, unfortunately, seen blocks of ice, taken from delivery carts, dragged along the edge of the road and the pavement on their way to delivery to the customer. It is rather surprising that such is allowed, but we have seen such occurrences in at least two large North American cities. There must be increased use of household refrigerators.

Carriers of infection certainly are a problem, and special attention needs to be given to all persons engaged in handling or in the preparation of food, drink and ice used in connection with food. Scares, such as occurred after the outbreak of amœbiasis in Chicago, accomplish little—the public has a short memory.

There has been progress in the screening of flies from shops where meat or vegetables or fruits are for sale. Such is necessary, as flies can convey protozoal cysts or helminthic ova. Screening of houses against biting insects seems nowadays better understood than formerly. Also, house larders are now often better screened and the use of household refrigerators instead of larders or pantries should be encouraged.

In schistosomiasis areas, natural, fresh-water bathing places should be very carefully chosen and supervised to prevent contamination of the banks and of the water by human dejecta.

Cestode infections indicate the need for careful scrutiny of meat and fish for such parasites, and for great attention to thorough cooking. Meat inspection has, indeed, made great advances in cities, but in small communities there is still need for improvement.

International campaigns against hookworm are too well known to warrant any comment here. The occurrence of such Nematodes as Ascaris and Trichuris indicates the need for adequate food protection and for proper arrangements for the disposal of night soil.

In conclusion, preventive measures against human Entozoa must not be overlooked in temperate zones any more than in tropical and subtropical regions.

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