HELMINTHIC (INTESTINAL WORM) INFECTION IN RURAL CHIANGMAI.

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Some people of the Chiangmai province, especially in the rural areas, show severe symptoms of secondary anaemia, a diagnosis verified by low hemoglobin content of their blood. Of the possible causes, malaria can likely be excluded in the author's opinion, as he found it either absent in cases where the hemoglobin content (tested by the Thalquist method) was below 40%, or, when present, not to cause the severe anæmia observed. The other cause, suspected by the author, namely the infection with intestinal parasites had already been disclosed by previous work, including his own observations of such anæmia, resulting from prolonged hookworm disease.

In order to establish such infection definitely as a factor leading to secondary anemia the following examinations were made, 2 years ago (B. E. 2481) in 10 villages of rural Chiangmai. For the identification of the eggs of the intestinal worms in the carefully collected faces of the individual villagers, the faceal smears were diluted with saline solution, and each specimen examined twice under the microscope. Even though protozoal infection with amoeba and their cysts was observed at times, only the degree and the nature of the helmintic infections are recorded in this report.

LOCATION OF VILLAGES AND LIFE-HABITS OF INHABITANTS.

The villages included in this examination are Tambol Sanpong of Amphur Maarim, and Tambol Nongharn of Amphur Sansai. The geographic location, the economical site of the villages, and the living habits of the villagers will be discussed for etiological reasons of the parasitic infection.

Tambol Sanpong is situated in the north of Amphur Maarim, about 2 kilometres from the Amphur or 20 kilometres from town. Some of the villages are passed through by Chiangmai–Farng Highways; while others are surrounded by paddy fields, with only carttracks for communication between them. Every villager, either young or old, usually walks bare-footed; some of them will use shoes only when going to town on business. Water supply comes from unhygienic wells for the most part, and also from irrigation streams passing through the villages.

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The food consists of rice and partially cooked or dried meat. One of the delicious food stuffs of these villagers is the so called "larb," formed by fresh blood (pig or cow), mixed with fresh chop meat; it is fried with vegetables or eaten in the raw state. The vegetables used in diet consists of the fresh vegetables or young green edible leaves. These are grown in the village around the houses. The condition of the diet and habit of eating is not hygienic.

The excreta are disposed in the fields or the surroundings by every member of the village at very early before dawn. Sanitary sewage disposal is not welcomed, even when the sanitary inspector will induce them. It has been known that in some places where the people are forced to make a pit-privy for disposing their excreta, they will make it according to the order but they never use it.

Tambol Nongharn of Amphur Sansai is situated in the North-west of the Amphur, about 10 kilometres from the office and 19 kilometres from town. Maajoe Agricultural College is situated near-by Chiangmai—Prao Highways is in construction passing through the villages, and is not yet opened for traffic. Cart tracks communicate between villages, are not as good as that of Tambol Sanpong. Small irrigation streams are also present.

The living conditions of these people are closely similar to those of Banpong villagers, but the economic condition is poorer. They walk without shoes, take unhygienic diet, and dispose their excreta in the field, just the same as others do. Because the land is not fertile for rice-cultivation, the number of the households of each village is less than that of Tambol Sanpong.

SCOPE OF SURVEY AND EXTENT OF INFECTION

Table I. presents the number of villages and persons examined with percentage of examination. Almost all villages surveyed in these two Tambols show over 80 percent of persons examined.

Villages	Household	Population	Persons examined	Percentage
Sanpong			14	
1	135	661	650	98.3
2	92	459	412	89.7
3	78	357	144	*
4	108	548	534	97.4
Nongharn				
1	47	235	171	72.7
2	45	221	210	95.0
3	46	252	231	91.6
4	80	422	357	84.5
5	29	167	136	81.4
6	46	235	178	75.7
Total 10 villages	706	3557	3023	84.9

TABLE I.

SCOPE OF SURVEY.

* Only 28 households of 167 persons were examined, or 86.2 percent of the number to be examined.

The examination discloses the fact that among 3023 persons examined, 2551 cases were found to be infected with one or more species of intestinal parasite belonging to the Phylum of Nemahelminths; that is to say, 84.9% of the villagers. This percentage is below that mentioned in Dr. Barnes' report. The fifth village of Tambol Nongharn shows the highest percentage of infection, being 94.1 percent of the villagers; and is followed by the sixth village of the same Tambol. Besides these, the percentage of infection among each village ranges between 80 to 88 percent. It is also found that the people of Tambol Nongharn show a higher percentage of infection than those of Tambol Sanpong.

When the parasitic helminths ova are classified according to their group into Nematodes, Cestodes and Trematodes, the examination reveals that the most common infection of all intestinal helminths belonged to the group of Nematodes, which can be identified in every village. 2396 cases proved to be infected by worms of the Nematodal group, or 79.1 percent of the total persons examined. The second and third villages of Tambol Sanpong together with the fifth and sixth villages of Tambol Nongharn have higher percentage of nematodal infection than the total percentage.

HELMINTH-INFECTION

Other groups of parasitic intestinal helminths, which can be indentified by their ova in the faecal specimens, are as shown in table II. There is a variation in density of these infection among villages, some villages show a negative result of a certain group. As it seems to be, the cestodal and trematodal infections are the specific infection of certain villages only, the species, being present in the carriers, who live in that village.

TABLE II.

INCIDENCE OF INTESTINAL HELMINTHS.

Tambol	Families	Persons examined			Nema- todes		Cestodes		Trema- todes	
		Total	found	%	Found	%	Found	%	Found	%
Sanpong										
ĩ	135	650	522	80.3	516	79.3	64	9.8	53	8.1
2	92	412	347	84.2	332	80.5	48	11.6	21	0.5
3	28	144	128	88.8	121	84.0	3	2.0	-	-
4	108	534	433	81.3	414	77.7	20	3.7	14	2.6
Nongharn							-			
1	47	171	141	82.4	129	75.4	3	1.7	13	7.6
2	45	210	175	83.3	153	70.2	8	3.8	8	3.8
3	46	231	196	84.8	168	72.7	10	4.2	10	4.2
4	80	357	317	88.7	284	79.5	-	-	16	4.4
5	29	136	128	94.1	122	89.6	7	5.1	4	2.9
6	46	178	164	92.1	157	88.2	15	8.4	21	11.7
Total 10 villages	656	3023	2551	84.1	2396	79.1	178	0.5	160	0.5

The intestinal helmiths belonging to the group of nematode are found to be

Ankylostoma duodenale,Old World Hookworm,Strongyloides stercoralis,a Nematode or Roundworm,Ascaris lumbricoides,Eel-or Roundworm,Trichuris trichiura,Whipworm,

Ankylostome ova show the highest percentage of all groups; 1664 cases from 3023 examined specimens are infected, making 55.04 percent. This range is lower than Dr. Barnes' report which is 76.7 percent. The first and second villages of Tambol Sanpong show

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heaviest infection successively. The fifth village of Tambol Nongharn comes third. The density of hookworm infection in the two Tambols is almost in the same range.

The genus of nematodal helminth that comes next in frequency is Strongyloides stercoralis. These worms are found mostly in the larval stage. 1383 persons or 45.7% are infected while Dr. Barnes found only 0.6 percent. The third village of Tambol Sanpong has the highest incidence of all, being 76.3 percent of the persons examined in that village. It should be noted that only 29.8 percent of hook worm infection is present in this same village; and Strongyloidosis in the Tambol Sanpong is more prevalent than in Tambol Nongharn.

1165 cases are reported to be infected by Ascaris lumbricoides; this member is 38.5 percent of all specimens. It is higher than Dr. Barnes' finding which was 32.7 percent. The sixth village of Tambol Nongharn show the highest percentage, as much as 66.8 percent; and the first village of the same Tambol comes second.

It should be mentioned that these two villages have a low percentage of strongyloidosis. On the contrary, while strongyloide infection seems to be prevalent in the first and second village of Sanpong, these two villages have a low percentage of ascariasis. Also the prevalence of ascariasis in Nongharn is in the reverse to the prevalence of strongyloidosis.

Trichuris ova are present in only a small number, it being the least infectious species identified. Only 61 cases, or 0.2 percent are reported; while Dr. Barnes' finding gave 20.2 percent of this infection. Sanpong people are not heavily infected, especially the second, third, and fourth of that Tambol; while Nongharn specimens prove to be more abundant, and can be observed in every village.

NEMATODAL INFECTION.

This data is presented in table III, which will show the difference between the incidence and prevalence of infection by intestinal helminths of each village. For example, the first village of Sanpong has more specimens of hookworm and strongyloides ova than the third village of the same Tambol, in which only many strongyloides larvae are found; in like manner, the fourth village of this Tambol is infected by all of these three nematodes in a very close range of frequency.

TABLE III.

Tambol	Persons	Ankylos- toma.		Strongy- loides.		Asc	aris	Trichuris	
and villages	examined	Found	%	Found	%	Found	%	Found	%
Sanpong									
1	650	441	67.8	381	58.4	97	14.7	2	0.03
2	. 412	260	63.1	201	48.7	80	19.4		-
3	144	43	29.8	110	76.3	37	25.6		-
4	534	265	49.6	266	49.0	270	50.5	-	-
Nongharn	-		1 11 1 11						14
1	171	83	47.3	49	28.6	100	58.4	3	0.1
2	210	99	47.2	58	26.6	110	52.3	6	0.2
3	231	96	41.5	74	32.0	114	49.3	5	0.2
4	357	214	59.9	138	38.6	186	52.1	6	0.1
5	136	84	61.9	47	34.5	52	38.2	2	0.1
6	178	79	44.3	59	33.1	114	66.8	37	2.0
Total 10 villages	3023	1664	55.04	1383	45.7	1165	38.5	61	0.2

INCIDENCE OF NEMATODAL INFECTION.

Although the hook worm infection shows the highest percentage, the number of ova found in the film of many specimens is not so abundant in comparison with the larvae of strongyloides. This may mean that ankylostomiasis is not so prevalent as strongyloidosis.

Obviously the majority of the population is infected with more than one species of parasites. Most frequent of all is the combined infection of ascariasis, ankylostomiasis, and strongyloidosis, especially in children. There is also a difference of this combined infection in each of the villages; for example, the villages of Tambol Nongharn show mixed infection of ascariasis and ankylostomiasis to a high percent, while the villages of Tambol Sanpong have ankylostomiasis, combined with strongyloidosis.

In the Table below are data, part of which presents the taenia or tape worm infection of various species. Most frequent of all are T. saginata and T. solium; and T. saginata exceeds T. solium in number. It is necessary to say that there may be some confusion in the differentiation between these two species, except in special cases where the segment of the parasite was accidentally collected,

TABLE IV.

Villages &	Persons	Taenia Solium		Taenia Saginata		Opist ch	hor- is.	Chlonor- chis	
Tambol	examined	Found	%	Found	%	Found	%	Found	%
Sanpong								-	
1	650	15	0.2	49	0.7	22	0.3	31	0.4
2	412	24	0.5	24	0.5	12	0.2	9	0.2
3	144	_	-	3	0.2	_	-	-	-
4	534	9	0.1	11	0.2	10	0.1	4	0.07
Nongharn								+	
1	171	-	-	3	0.1	13	0.7	-	
2	210	2	0.09	6	0.2	8	0.3	-	-
3	231	4	0.1	6	0.2	10	0.4	-	-
4	357	-	-	-	-	16	0.4	-	-
5	136	4	0.2	3	0.2	4	0.2	-	-
6	. 178	6	0.3	9	0.5	21	1.1	-	-
Total 10 villages	3023	64	0.1	114	0.3	116	0.3	44	0.1

INCIDENCE OF TREMATODAL & CESTODAL INFECTION.

Tambol Sanpong presents more cases of Taenia infection than Tambol Nongharn, and especially the first village of Tambol Sanpong shows highest incidence, succeeded by the second village. There are also some other helminthic infections of the trematodal class. Opisthorchis felineus and Chlonorchis sinensis are of frequent occurrence among this class while the former out-number the latter. Tambol Sanpong shows chlonorchis infection in three villages,-first,-second,and fourth. Opisthorchis felineus is prevalent in Tambol Nongharn, being observed in every village, and consequently gives a higher percentage of infection; chlonorchis sinensis is entirely absent.

Relation of Age to Incidence of Infestation

The examination discloses the fact that nematodal infestation is the most prevalent of all helminths among the inhabitants of these 10 villages.

It then seems convenient to consider the relationship between the age and infestation incidence of each nematodal group, as shown by data in Table V and VII.

TABLE V.

AGE	INCIDENCE (OF ANKYLOSTON	IE INFECTION.
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Tambols and	Ag 1-10	Age Age 0 yrs. 11-20 yrs.		ge) yrs.	Age 21-30 yrs.		Age 31-40 yrs.		Age 41-50 yrs.		Age 51 yrs. up		Total
Villages	Exam.	found	Exam.	found	Exam.	found	Exam.	found	Exam.	found	Exam.	found	infected
Sanpong													
1	215	114	115	83	118	88	86	65	46	32	70	59	441
2	138	73	59	40	54	34	60	46	32	70	59	39	260
3	44	7	15	6	26	12	.18	5	22	8	19	5	43
4	168	69	114	51	74	35	72	35	43	36	63	39	265
Nongharn													
1	44	19	46	20	18	9	25	20	23	10	15	5	83
2	81	33	45	21	26	10	29	18	18	10	11	7	99
3	74	21	54	25	24	15	28	11	35	16	16	8	96
4	113	51	73	48	48	33	48	40	45	28	30	14	214
5	40	19	28	18	15	12	21	15	21	15	11	5	84
6	55	22	50	25	24	10	22	11	19	5	8	6	79
Total 10 villages	972	428	599	337	427	258	409	226	316	188	300	187	1664

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Tambols and	Ag 1-10	ge yrs.	Age 11-20 yrs.		Age 21-30 yrs.		Age 31-40 yrs.		Age 41-50 yrs.		Age 51 yrs. up		Total
Villages	Exam.	found	Exam.	found	Exam.	found	Exam.	found	Exam.	found	Exam.	found	infected
Sanpong					-		-						
1	215	86	115	75	118	82	86	55	46	33	70	50	381
2	138	53	59	30	54	29	60	37	44	23	57	29	201
3	44	37	15	10	26	21	18	15	22	15	19	12	110
4	168	70	114	50	74	34	72	42	43	35	63	35	266
Nongharn									1				
1	44	15	46	13	18	3	25	9	23	5	15	4	49
2	81	19	45	9	26	9	29	9	18	7	11	5	58
3	74	17	54	17	24	10	28	7	35	14	16	9	74
4	113	36	73	29	48	23	48	26	45	16	30	8	138
5	40	11	28	9	15	8	21	7	21	10	11	2	47
6	55	18	50	19	24	4	22	10	19	5	8	• 3	59
Total 10 villages	972	362	599	261	427	223	409	217	316	163	300	157	1363

AGE INCIDENCE OF STRONGLYLOIDS INFECTION.

TABLE VII.

AGE INCIDENCE ASCARIS INFECTION.

Tambols and	Ag 1-10	ge yrs.	Age 11-20 yrs.		A 21-30	Age 21-30 yrs.		Age 31-40 yrs.		Age 41-50 yrs.		Age 51 yrs. up	
Villages	Exam.	found	Exam.	found	Exam.	found	Exam.	found	Exam.	found	Exam.	found	infected
Sanpong				1									
. 1	215	43	115	19	118	15	86	10	46	6	70	4	97
2	138	33	59	11	54	10	60	* 13	44	8	57	5	80
3	44	18	15	2	26	7	18	6	22	2	19	2	37
4	168	116	114	55	74	26	72	32	43	19	63	22	270
Nongharn												- 1	
1	44	33	46	21	18	9	25	18	23	11	15	8	100
2	81	54	45	21	26	11	29	11	18	9	11	4	110
3	74	37	54	32	24	8	28	11	35	14	16	12	114
4	113	79	73	44	48	20	48	15	45	17	30	11	186
5	40	14	28	17	15	6	21	6	21	7	11	2	52
6	55	44	50	37	24	15	22	12	19	6	3	5	119
Total 10 villages	972	471	599	259	427	127	409	134	316	99	300	75	1165

When we consider the examination as one whole group and classify according to age, especially the nematodal infection, we find, as shown by table VIII, the relationship between the age of the village and the density of nematodal infection of each species.

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TABLE VIII.

RELATIONSHIP BETWEEN AGE OF VILLAGERS

	Num-	Ankylo	ostoma	stoma Strongyloides			aris.
Age group	amined	Positive	percent	Positive	percent	Positive	percent
1-10 years	972	428	44.03	362	37.3	471	45.4
11-20 years	599	337	56.20	261	43.5	259	43.2
21-30 years	427	258	60.4	223	52.2	127	29.5
31-40 years	409	266	65.03	217	53.05	134	32.5
41-50 years	316	188	50.9	163	51.5	99	31.3
51 years up.	300	187	62.3	157	52.3	75	21.6
Total	3023	1664	55.04	1383	45.4	1165	35.2

AND DENSITY OF NEMATODAL INFECTION.

Up to 10 years of age is the group having lowest percentage of ankylostomiasis and strongyloidosis, but showing the highest percentage of ascariasis. The former species is densely infected in adults, but the latter species is scanty in this age group. The highest percentage of infection among age-groups is the hook worm infection among the age of 31 to 40 years, being as much as 65.03 percent; and also followed by 60.4 percent of this same infection among the age of 21 to 30 years. (The group of 51 years of age upward is excluded because it covers more than the range of 10 years).

Strongyloidosis densely infect adults, but in lesser percentage than ankylostomiasis, ascariasis is still lesser in percentage than strongyloidosis even in its highest peak of the age group up to 10 years.

The result of the investigation then shows up a fact that most of the inhabitants, especially among the examined groups, are infected by one or other species of intestinal parasites, as much as 84.9 percent; and that ankylostomiasis, strongyloidosis and ascariasis are the chief among them. Obviously lack of sanitation in the household and poor personal hygiene play a very important part in producing infected soil by human excreta; so that the intestinal parasites ova are lodged in this soil. And since the villagers walk bare-footed, use unsterile vegetable or unripened meat as their meal, they expose themselves to the infection.

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Many prominent authors in tropical medicine such as Manson-Bahr, Katsurada and Delangen, have proved that intestinal parasites of various kinds, especially those found to be heavily infected, are able to produce syndromes or the diseases, e.g. chronic diarrhoea, and other forms of digestive disturbances such as abdominal pain, nausea, flatulence. Besides gastro-intestinal symptoms secondary anaemia usually developed in the long-run cases, and by so doing the vitality of the body is lowered through this vicious cycle. What will therefore happen in the end is that the patient will easily succumb from either new secondary infections such as malaria and pneumonia, or to the intestinal parasite infection itself.

ACKNOWLEDGEMENT.

The headmen of the various villages, where these examination were made—incident to malaria control—assisted greatly in obtaining the cooperation of the villagers and the large number of specimens, which—without their help,— could not have been collected. The microscopic examination was made possible by the cooperation of the medical assistants Nai Sombadhi Kaewthong, Nai Prasert Chittayaphad and Nai Boondharmraj Na Chiangmai. The author, therefore, wishes to acknowledge his obligation to all of them.

SUMMARY :

1. It is found that 84.9 percent of the examination group of 10 villages of Chiangmai inhabitants are infected with one or more than one species of intestinal helminths.

2. Nematodal infection is the most frequent occurrence of all; 55.04 percent belongs to ankylostomiasis, 45.4 percent to strongy-loidosis, and 35.2 percent to ascariasis.

3. Cestodal and trematodal infection are rare and uncommon; they are to be found only in certain village and certain species.

4. There is a variation as to the species, of the infection, and the density of infection among each village.

5. Lack of sanitation and hygiene are the causes of high endemicity of intestinal helminth infection.

6. Another cause of secondary anaemia, beside chronic malaria, is ankylostomiasis and strongyloidosis. This intestinal helminth infection is also the cause of death, recorded in the death certificate often as diarrhoea, which is among the chief causes of death in Thailand at present. U. D. SANDH.: Helminthic Infection in Rural Chiangmai 117

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BULLETIN THAILAND RESEARCH SOCIETY, VOL. XIII. PLATE 1,

INTESTINAL PARASITES.



INTESTINAL PARASITES AND THEIR EGGS FOUND IN MAN (THAILAND)

1.	Ankylostoma duodenale, Old	World Hookwo	orm,	
	$M = Male, F = Female \times 14$		after	Looss
		$E = Egg \times 400$	after	Ford
2.	Strongyloides stercoralis, Ne	ematoda-or Ro	undwor	m
	$M = Male, F = Female \times 30$		after	Looss
		$E = Egg \times 400$	after	Ford
3.	Trichuris trichuria, Whipwo:	rm		
	$M = Male, F = Female \times 3$		after	Brumpt
		$E = Egg \times 400$	after	Ford
4.	Ascaris lumbricoides, Eel—o	or Roundworm-	-magni	fied
	ex=External View of	$E = Egg \times 400$	after	Ford
	in=Internal View of	$E = Egg \times 400$	after	Ford
	a=Unfertilized. View of	$E = Egg \times 400$	after	Ford
5.	Taenia saginata, Tapeworm,	magnified	after	Bryce
	sa=saginata	$E = Egg \times 400$	after	Ford
	so = solium	$E = Egg \times 400$	after	Ford
6.	Opistorchis felineus, Cat Flu	ike	after	Barker
		$E = Egg \times 400$	after -	Ford
7.	Clonorchis sinensis, Chinese	Fluke, x = mag	nified,	
	n.s=natural size		after	Looss
		$E = Egg \times 400$	after	Ford

