

BODY OF REPORT

SEATO Medic Study No. 26                      Studies on Opisthorchis viverrini in Thailand -  
Clinical Manifestations of Opisthorchiasis

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Introduction to Part I (Physical and Clinical Observations)

It is now recognized that the human hepatic trematode Opisthorchis viverrini is highly prevalent in Thailand. Little was known of this liver fluke until 1955, when Sadun reported that it was widespread in the northeastern part of the country. Prior to his investigation there were only a few scattered reports concerning Opisthorchis in Thailand. In 1908, Verdun and Bruyant noted that "Opisthorchis felineus" was found in Indo China, and in 1911 Leiper reported "Opisthorchis

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viverrini" from a human autopsy in Chiangmai. Sixteen years later Prommas (1927) reported a single case of "O. felineus" from a human autopsy in northern Thailand, and in 1929, Bedier and Chesneau reported that "O. viverrini was present in 23% of 1,231 examinees in Thakek and in 15% of 523 persons in Vientiane, Laos. The report of Sadun (1955) focused renewed attention of this parasite. In 1961, the metacercarial stage was described by Vajrasthira, et. al.

Recent investigations by Wykoff, et. al. (in press) have not only confirmed Sadun's report on the prevalence but also have shown that the parasite is much more widespread than previously believed. Some 90% of 7,000 examinees over the age of 10 have been found to harbor this worm. As a consequence of these findings, the present investigation was established to determine the nature and intensity of various clinical symptoms which may be associated with infection by this parasite. The findings have been divided into two parts. The evaluation of changes in hematology and liver-function tests are being published separately as par II of this title.

Although no previous observations have been made on the clinical manifestation of Opisthorchis viverrini, certain symptoms are reported to be associated with infection by the hepatic trematodes O. felineus and Clonorchis sinensis. Loss of appetite, edema, and ascites, together with cholecystitis and colic, have been reported as symptoms of infection with O. felineus. At times, symptoms associated with carcinoma of the bile passages or the pancreas have been noted (Rindfleisch, 1910; Faust and Russell, 1957). The numerous symptoms reportedly associated with Clonorchis sinensis include loss of appetite, edema, ascites, fatigue, loss of weight, abdominal pain, diarrhea, jaundice, nausea, chills, fever, hepatomegaly and polymorphonuclear leukocytosis, (Mayer, 1916; Faust and Khaw, 1927; Oldt, 1927; Bercovitz, 1931; Koenigstein, 1949; Ling, 1949; Germer, et. al. 1955). Symptoms are reported to fall into three stages; 1. mild-essentially asymptomatic; 2. progressive - irregular appetite, fullness of abdomen, diarrhea, edema and hepatomegaly; and 3. severe -with a syndrome associated with portal cirrhosis. (Faust and Russell, 1957).

A careful analysis of pertinent literature is presented by Strauss (1962), along with a controlled study of 105 Clonorchis infections. Contrary to the reports of other investigators, his findings indicate that clonorchiasis is essentially a benign infection.

Materials and Methods. The investigation was carried out in Udorn Thani in a new wing of the Provincial Hospital laboratory, constructed by the Thai Government and equipped by the U.S. Army Medical Department for the purposes of this and future studies.

Subjects were drawn from the hospital, the Udorn Teachers' College and the Udorn Prison. Each person was subjected to a series of intensive physical examinations, and clinical histories were carefully recorded. Each was examined repeatedly by urinalysis, blood studies and certain biochemical tests. Persons

Table 1  
DIETARY HABITS OF PERSONS PARTICIPATING IN THE OPISTHORCHIS  
CLINICAL STUDY, UDORN

Food	Frequency of Eating		
	V/F *	S	R/N
Raw fish (O.v. +)	821 (89)	61 (7)	39 (4)
Raw fish (O.v. -)	150 (79)	7 (4)	34 (18)
Rice	1108	0	4
Vegetables	1008	74	27
Water plants	933	114	55
Pork	533	453	128
Duck	353	445	313
Chicken	676	337	111
Frog	439	354	254
Beef	591	361	160
Milk	248	321	551
Crab	311	480	318
Prawn	312	480	318

\* V/F = Very frequently or frequently  
S = Sometimes  
R/N = Rarely or never

found to be passing ova of O. viverrini were studied by a series of egg counts (Stoll, 1923) to determine the intensity of infection. Data from all examinations were recorded on special data cards prepared for this purpose.

Results. A total of 1,111 persons were included in the present study. In order to more accurately evaluate this group, certain information was solicited in addition to the purely clinical observations reported below. Of the total, 934 were Thai-Lao (speaking the Lao language and retaining the characteristics and habits of that closely neighboring country). The remainder (reporting themselves to be "pure Thai") were largely military and government officers stationed in Udorn. Inasmuch as food preference constitutes the immediate cause of infection with liver flukes (eating of raw fish), the dietary habits of the examined populations are summarized in Table 1. It is interesting to notice that 921 persons infected with liver fluke, 821 (89%) admitted eating raw fish "frequently", 61 (7%) admitted eating it "sometimes" and 39 (4%) insisted that they ate it "rarely" or "never".

Perhaps more valuable as an indicator of the accuracy of the data than for the information per se is the fact that 4 of 917 stated that they ate rice "rarely" or "never". Such a person in Udorn is unknown to the senior author and probably represents the percentage "incorrect" replied to the examiner. Of the 1,111 examinees, 697 were males, of whom 572 (82%) harbored O. viverrini and 414 were females, of whom 348 (84%) were found to be infected. In all, 920 (83%) were found to be infected on the basis of a single stool specimen concentrated

Table 2

AGE/SEX DISTRIBUTION OF OPISTHORCHIS VIVERRINI INFECTIONS IN 1,111 PERSONS PARTICIPATING IN THE CLINICAL STUDY, UDORN THANI

Age	Males			Females		
	No.	Pos.	(%)	No.	Pos.	(%)
0-5	9	5	(56)	2	2	(100)
6-10	4	4	(100)	5	2	(40)
11-15	21	21	(100)	7	4	(57)
16-20	136	127	(93)	159	149	(94)
21-25	90	79	(88)	56	41	(73)
26-30	86	74	(86)	43	34	(81)
31-35	58	45	(78)	34	29	(85)
36-40	75	58	(77)	31	27	(87)
41-45	46	29	(63)	22	16	(73)
46-50	58	45	(76)	12	9	(75)
51-55	40	34	(85)	14	10	(72)
56-60	36	23	(64)	17	12	(71)
61-65	19	15	(79)	8	8	(100)
66-70	7	6	(86)	2	2	(100)
70	12	7	(58)	2	2	(100)
	697	572	(82)	414	348	(84)
Totals 1,111		920	(83%)			

Table 3

THE RELATIONSHIP OF JAUNDICE, EDEMA AND ANEMIA TO THE PRESENCE AND INTENSITY OF INFECTION WITH O. VIVERRINI IN UDORN

	No.	Jaundice		Edema		Anemia	
		N/S *	M/M	N/S	M/M	N/S	M/M
With <u>O. viverrini</u>	%	886 (97)	33 (4)	898 (98)	20 (2)	794 (86)	124 (13)
Without <u>O. viverrini</u>	%	182 (95)	9 (5)	188 (98)	3 (2)	157 (82)	34 (18)
5,000 EPGF **	%	219 (98)	4 (2)	218 (98)	5 (2)	219 (89)	24 (11)
10,000 EPGF	%	137 (99)	2 (1)	137 (98)	3 (2)	127 (91)	13 (9)

\* N/S = Normal or Slight  
M/M = Moderate or Marked  
\*\* EPGF = Eggs per gram feces

Numbers in ( ) are percents to the nearest whole number

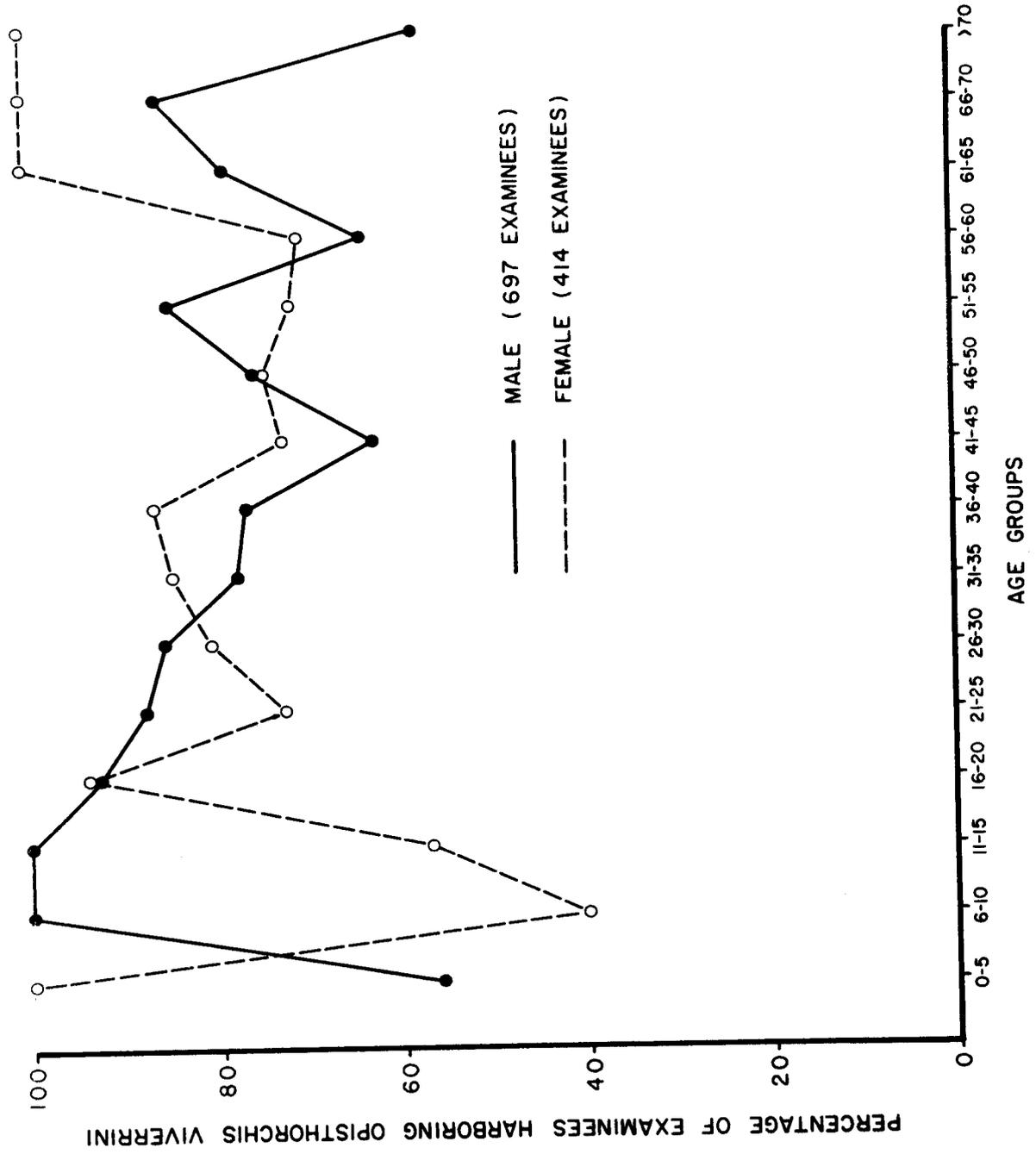


FIGURE 1  
 AGE-SEX DISTRIBUTION OF OPISTHORCHIS VIVERRINI INFECTIONS IN 1,111  
 PERSONS PARTICIPATING IN THE CLINICAL STUDY, UDORN THANI.

by the formalin-ether technique (Ritchie, 1948). (Table 2, Fig. 1).

A study was made to determine the relationship of jaundice to infection by O. viverrini, examinees being reported as "normal", having "slight", "moderate" or "marked" jaundice. Of 919 persons harboring the liver fluke, 886 (97%) were found to be either normal or only slightly jaundiced. A total of 33 (4%) were found to have either moderate or marked jaundice. These findings may be compared with 191 persons who were presumed free of infection with the liver fluke. Of these, 182 (95%) were either normal or slightly jaundiced, and 9 (5%) were moderately or markedly jaundiced. Among persons with light O. viverrini infections (i.e., from 1 to 5,000 eggs per gram feces, of EPGF) a total of 4 out of 223 examinees had moderate or marked edema. In persons heavily parasitized (over 10,000 EPGF) 3 out of 140 (2%) had edema.

Of 1,109 persons examined for anemia, 918 harbored O. viverrini. Of these, 124 (13%) were found to be moderately or markedly anemic. Among 191 persons free of liver flukes (18%) 34 were anemic. Among 223 persons with fewer than 5,000 EPGF, 24 (11%) were anemic, while among 140 persons having over 10,000 EPGF, 13 (9%) were anemic. (Table 3).

Each of 921 persons infected with O. viverrini was queried about the prevalence and severity of dizziness. A total of 263 (29%) were dizzy very frequently or frequently; 343 (37%) were dizzy sometimes; and 315 (34%) were rarely or never dizzy. By comparison, of 191 persons believed free of O. viverrini infection, 39 (20%) were dizzy very frequently or frequently; 92 (48%) were sometimes troubled by dizziness, and 60 (31%) were rarely or never dizzy. Among 223 persons with 5,000 or fewer EPGF, 64 (29%) reported frequent dizziness, 80 (36%) reported some dizziness and 79 (35%) reported being dizzy rarely or never. Among 140 persons having 10,000 or more EPGF, 48 (34%) reported frequent dizziness, 63 (45%) reported some dizziness, and 29 (21%) reported being dizzy rarely or never.

Diarrhea and dysentery were differentiated and each patient was asked about the frequency of these symptoms. Of 920 persons infected with the liver fluke, 131 (14%) reported diarrhea "very frequently" or "frequently"; 330 (36%) reported diarrhea "sometimes"; and 459 (50%) reported diarrhea "rarely or never". By comparison, of 191 persons presumed free of liver flukes, 26 (14%) reported frequent or very frequent diarrhea, 85 (45%) some, and 80 (42%) rarely or never. Concerning 223 persons with moderate worm burdens (fewer than 5,000 EPGF), 36 (16%) reported frequent diarrhea, 73 (33%) reported some diarrhea, and 114 (51%) reported diarrhea rarely or never. Among 140 persons with heavy fluke infections (10,000 or more EPGF), 21 (15%) reported frequent diarrhea, 54 (39%) reported some diarrhea and 65 (46%) reported diarrhea rarely or never.

Dysentery was exhibited frequently or very frequently by 69 (8%) of 921 persons harboring liver flukes. A total of 251 (27%) reported some dysentery and 601 (65%) reported having dysentery rarely or never. Among 191 persons free of

Table 4

THE RELATIONSHIP OF DIZZINESS, DIARRHEA, DYSENTERY AND EPIGASTRIC PAIN TO THE PRESENCE AND INTENSITY OF INFECTION WITH O. VIVERRINI IN UDORN

	V/F *	Dizziness			Diarrhea			Dysentery			Epigastric pain		
		S	R/N	V/F	S	R/N	V/F	S	R/N	V/F	S	R/N	
With <u>O. viverrini</u>	263 (29)	343 (37)	315 (34)	131 (14)	330 (36)	459 (50)	69 (8)	251 (27)	601 (65)	247 (27)	361 (39)	313 (34)	
Without <u>O. viverrini</u>	39 (20)	92 (48)	60 (31)	26 (14)	85 (45)	80 (42)	7 (4)	65 (34)	119 (62)	38 (15)	93 (49)	60 (31)	
5,000 EPGF	64 (29)	80 (36)	79 (35)	36 (16)	73 (33)	114 (51)	14 (6)	67 (30)	142 (64)	71 (32)	87 (39)	65 (29)	
10,000 EPGF	48 (34)	63 (45)	29 (21)	21 (15)	54 (39)	65 (46)	10 (7)	43 (31)	87 (60)	42 (30)	59 (42)	39 (29)	

\* V/F = Symptom experienced very frequently or frequently  
 S = Symptom experienced sometimes  
 R/N = Symptom experienced rarely or never

Table 5

THE RELATIONSHIP OF NAUSEA, FLATULENCE, MALAISE, ANOREXIA AND HEPATOMEGALY TO THE PRESENCE AND INTENSITY OF INFECTION WITH O. VIVERRINI IN UDORN

Examinees	V/F	Nausea			Flatulence			Malaise			Anorexia			N*	1-2	3	4+
		S	R/N	V/F	S	R/N	V/F	S	R/N	V/F	S	R/N					
With <u>O. viverrini</u>	172 (19)	272 (30)	476 (52)	336 (36)	265 (29)	327 (36)	268 (28)	234 (25)	449 (47)	156 (17)	253 (28)	511 (56)	821 (89)	53 (6)	22 (2)	23 (2)	
Without <u>O. viverrini</u>	38 (20)	59 (31)	94 (49)	72 (38)	64 (34)	55 (29)	57 (30)	63 (33)	71 (37)	39 (20)	67 (35)	85 (45)	164 (86)	10 (5)	10 (5)	7 (4)	
5,000 EPGF	39 (17)	72 (32)	112 (50)	82 (37)	65 (29)	74 (33)	60 (27)	49 (22)	113 (51)	24 (11)	73 (33)	126 (57)	207 (93)	11 (5)	4 (2)	1 (1)	
10,000 EPGF	26 (19)	46 (33)	68 (50)	59 (40)	41 (28)	49 (33)	37 (26)	37 (26)	68 (48)	24 (17)	46 (33)	71 (50)	129 (93)	4 (3)	3 (2)	2 (1)	

\* N = Normal. For other abbreviations, see preceding tables.  
 1-2 = 1 to 2 finger breadths (FB) below costal margin.

*O. viverrini* infections, 7 (4%) reported frequent or very frequent dysentery, 65 (34%) reported some, and 119 (62%) reported dysentery rarely or never. In 223 cases of moderate infection (fewer than 5,000 EPGF) 14 (6%) reported frequent dysentery, 67 (30%) reported some, and 142 (64%) reported dysentery rarely or never. Of 140 persons passing over 10,000 EPGF, 10 (7%) reported frequent dysentery, 43 (31%) reported some and 87 (60%) reported no dysentery.

Of 921 persons harboring liver flukes, 247 (27%) reported very frequent or frequent epigastric pain (EGP); 361 (39%) reported some, and 313 (34%) reported little or none. Among 191 examinees free of fluke infection, 38 (15%) reported frequent EGP, 93 (49%) reported some, and 60 (31%) reported none. Among 223 persons having fewer than 5,000 EPGF, 71 (32%) reported frequent EGP, 87 (39%) reported some and 65 (29%) reported little or none. Among 140 persons passing 10,000 EPGF or more, 42 (30%) reported frequent EGP, 59 (42%) reported some and 39 (29%) reported little or none. (Table 4).

Of 920 persons harboring the parasite 172 (19%) reported frequent or very frequent nausea, 272 (30%) reported some nausea and 476 (52%) reported little or none. Among 191 persons believed to be free of liver flukes, 38 (20%) reported frequent nausea, 59 (31%) reported some, and 94 (49%) reported little or no nausea. Among 223 persons with fewer than 5,000 EPGF, 39 (17%) reported frequent nausea, 72 (32%) reported some, and 112 (50%) reported no nausea. By comparison, among 140 persons with over 10,000 EPGF, 26 (19%) reported frequent nausea, 46 (33%) reported some, and 68 (50%) reported no nausea.

The relation between flatulence and infection was considered. Of 928 persons harboring the liver fluke, 336 (36%) reported very frequent or frequent flatulence, 265 (29%) reported some, and 327 (36%) reported none. Among 191 persons free of infection, 72 (38%) reported frequent, 64 (34%) reported some, and 55 (29%) reported no flatulence. Of 221 persons having fewer than 5,000 EPGF, 82 (37%) reported frequent, 65 (29%) reported some, and 74 (33%) reported no flatulence. Among 149 persons having over 10,000 EPGF, 59 (40%) reported frequent, 41 (28%) reported some, and 49 (33%) reported no flatulence.

A relationship between the frequency of malaise and infection with liver fluke was studied by examining 951 persons who harbored the parasite. Of these, 268 (28%) reported frequent malaise, 234 (25%) reported some, and 449 (47%) reported little or none. Of 191 persons free of fluke infection, 57 (30%) reported frequent, 63 (33%) reported some, and 71 (37%) reported no malaise. Of 222 persons with fewer than 5,000 EPGF, 60 (27%) reported frequent malaise, 49 (22%) reported some, and 113 (51%) reported no malaise. Among 142 persons passing over 10,000 EPGF, 37 reported frequent, 37 reported some, and 68 (48%) reported no malaise (Table 5).

Anorexia as a manifestation of infection with *O. viverrini* was studied in 920 persons harboring this parasite. Of these 920, 156 (17%) reported frequent anorexia, 253 (28%) reported some, and 511 (56%) reported none. Among 191

persons presumed free of fluke infection, 39 (20%) reported frequent, 67 (35%) reported some, and 85 (45%) reported no anorexia. Of 223 persons passing fewer than 5,000 EPGF, 24 (11%) reported frequent anorexia, 73 (33%) reported some, and 126 (57%) reported no anorexia. Among 141 persons passing over 10,000 EPGF, 24 (17%) reported frequent, 46 (33%) reported some, and 71 (50%) reported no anorexia.

The relation of hepatomegaly to infection with the liverfluke was studied. Of 919 persons harboring the parasite, 821 (89%) were normal, 53 (6%) had livers enlarged 1 or 2 finger breadths (FB) below the costal margin, 22 (2%) showed livers enlarged 3 FB, and 23 (2%) had livers 4 or more FB below the costal margin. Among 191 persons free of fluke infection, 164 (86%) were normal, 10 (5%) were 1 or 2 FB, 10 (5%) were 3 FB and 7 (4%) were 4 or more FB below the costal margin. Among 223 persons passing fewer than 5,000 EPGF, 207 (93%) were normal, 11 (5%) were 1 or 2 FB, 4 (2%) were 3 FB and 1 was 4 or more FB below the costal margin. Among 138 persons passing over 10,000 EPGF, 129 (93%) were normal, 4 (3%) were 1 or 2 FB, 3 (2%) were 3 FB and 2 (1%) were 4 or more FB below the costal margin. (Table 5) The findings are presented graphically in Fig. 2.

Discussion. Throughout the study there appeared to be only minor differences in the symptoms exhibited by males and females. Although jaundice and edema have been reported to be associated with the presence of O. felineus and Clonorchis sinensis, neither is evidently associated with infection by O. viverrini. By inspection of Table 3, there is no significant difference between the presence of either symptom and the presence or absence of infection. Of interest is the fact that 5% of the examinees who were believed to be free of fluke infection were moderately or markedly jaundiced. Again, no significant differences are found in the prevalence of anemia and the presence or absence of infection. By casual inspection of Table 4, it is seen that dizziness, diarrhea and dysentery are evidently not associated with the presence or absence of O. viverrini. It is noteworthy that 14% of the "fluke-free" examinees had diarrhea very frequently or frequently and 20% of this same group experienced dizziness either very frequently or frequently. Epigastric pain was experienced very frequently or frequently by 27% of those persons harboring liver flukes, whereas only 15% of the individuals free of liver flukes were so afflicted. It should be noted, however, that of those reporting epigastric pain "rarely or never", 34% were infected, and 31% were non-infected. There appears to be no correlation between intensity of infection and frequency of epigastric pain.

Table 5 reveals that in the population studied, nausea, flatulence, malaise, anorexia and hepatomegaly are symptoms which are found with approximately the same frequency in persons harboring and free of infection with O. viverrini. It is particularly interesting to note that 20% of the "fluke-free" population reported being nauseated "frequently" or "very frequently"; that 38% of the same population reported being troubled by flatulence; and that 30% suffered from malaise and 20% from anorexia. While 86% of those examinees free of liver flukes had no evidence of hepatomegaly, 5% had livers enlarged 1 to 2 finger breadths below



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## Introduction to Part II (Hematology and Liver Function)

Although a few scattered reports of human hepatic trematodes in Thailand were available before 1955, the investigations of Sadun (1955) revealed the high prevalence of infection in the northeast part of the country. He showed that Opisthorchis viverrini (rather than O. felineus) was the parasite involved. The metacercarial stage of this parasite was described by Vajrasthira, et. al. in 1962 and the life cycle together with comparisons with O. felineus, were reported by Wykoff, et. al. (a) (in press).

While the clinical symptoms associated with O. viverrini infections have not been previously studied, a host of symptoms have been ascribed to infection by O. felineus and Clonorchis sinensis, similar hepatic trematodes of man. However, Strauss (1962) reporting on a series of Clonorchis infections, indicated that while many infected persons did indeed exhibit certain symptoms, many non-infected controls also tend to show similar conditions. Thus, Strauss found himself in agreement with Oldt, who in 1927 had also used non-infected controls for comparison in contrast to other investigators who simply reported on symptoms exhibited by persons harboring Clonorchis. The findings of these two authors led them to report that clonorchiasis in man is essentially benign and that there appeared to be no specific symptoms or syndrome of clonorchiasis.

The present study was undertaken to detect whether change occurs in the differential blood picture or in biochemical liver - function tests as a result of infection with the Thai liver fluke Opisthorchis viverrini.

Part I of this study (Physical and Clinical Observations) failed to correlate any of the following with the presence or intensity of infection with O. viverrini: jaundice, edema, diarrhea, anemia, dysentery, epigastric pain, nausea, flatulence, malaise, anorexia and hepatomegaly.

Material and Methods. The examinees were drawn from the Provincial Hospital, Udorn; the Udorn Prison, and the Udorn Teacher College. Stool specimens were concentrated by the formalin-ether technique (Ritchie, 1948) and egg counts were made according to the method of Stoll (1923). Biochemical tests were checked weekly with known normal and abnormal blood chemistry control sera (Hyland Laboratories, Los Angeles, Calif.). All biochemical tests were closely supervised by the senior or the last author.

For simplicity in reporting, the results have been grouped into the following categories: a. findings more than 50% below the minimum "normal" value; b. findings as much as, but not more than, 50% below that value; c. the "normal" range (this refers to U.S. or other previously studied Caucasian races as reported in standard texts; d. findings as much as, but not more than, 50% above the maximum "normal" value; and e. findings more than 50% above the maximum "normal" value. To examine the possible effect of severity of infection with O. viverrini, separate studies of liver function have been made on individuals pass-

ing fewer than 5,000 eggs per gram feces (EPGF) and those passing over 10,000 EPGF, these representing, to some degree, "mild" and "severe" infections.

Most of the biochemical tests were carried out by standard procedures. The following pertains to tests where alternate methods were available: Total protein Biuret method. Albumin and globulin precipitated by 22% Na<sub>2</sub>SO<sub>4</sub>, Biuret technique. Bilirubin by method of van den Bergh, both direct and total. Thymol turbidity by method of Mac Lagan, modified for use of pH 7.55. Alkaline phosphatase by the method Shinowara, Jones and Rhinehart. Hemoglobin by cyanmethemoglobin using a Coleman Jr. spectrophotometer. Hematocrit by the micro method. CCF by the hanger flocculation test. SGOT and SGPT by the method of Frankel using Sigma Chemical Company prepared reagents.

Results. Differential Blood Counts, WBC. Among 921 persons infected with liver flukes, 3 had WBC counts below 2,999 cells/mm<sup>3</sup>; 22 (2%) were between 2,999 and 4,999; 470 (51%) fell in the "normal" range of 5,000-10,000; 309 (35%) were between 10,001 and 15,000, and 117 (13%) had counts over 15,000 cells/mm<sup>3</sup>. Among 191 persons evidently free of fluke infection 7 (4%) had counts between 2,999 and 4,999; 94 (49%) were between 5,000 and 10,000; 62 (32%) were in the 10,001-15,000 range and 28 (15%) had counts over 15,000 cells/mm<sup>3</sup>. A total of 223 examinees passed fewer than 5,000 EPGF. Of these 1 had a count below 2,999 cells/mm<sup>3</sup>; 6 (3%) had counts in the 2,999-4,999 range; 130 (58%) were in the "normal" 5,000-10,000 range; 66 (30%) fell in the 10,001-15,000 range, and 20 (9%) had counts over 15,000 cells/mm<sup>3</sup>. Of 140 persons passing over 10,000 EPGF, 3 (2%) had counts in the 2,999-4,999 range; 80 (57%) were in the 5,000-10,000 group, while 43 (31%) had counts from 10,001 to 15,000 and 14 (10%) had counts of over 15,000 cells/mm<sup>3</sup>.

Neutrophiles. A rather peculiar distribution of neutrophiles was noted. Of 921 persons harboring the liver fluke, the distribution of counts was as follows: fewer than 26 neutrophiles/mm<sup>3</sup> were found in 27 (3%) persons; from 26 to 53 cells % were found in 403 (44%) of the examinees; 196 (21%) had counts from 54-62; 284 (31%) had counts from 63-94; and 11 (1%) had neutrophile counts of over 94 cells %. Of 191 persons evidently free of fluke infection the neutrophile counts were: 4 persons (2%) below 26 cells %; 66 (35%) with 26 to 53; 35 (18%) with counts of 54-62; 83 (44%) with counts of from 63 to 94; and 3 (2%) with counts of over 94 neutrophiles per cent. Of 223 persons passing fewer than 5,000 EPGF, the neutrophile counts were less than 26 in 8 (4%); 26-53 in 35 (23%); 54-62 in 57 (26%) and 63-94 cells per cent in 53 (24%) of these examinees. Of 140 persons passing over 10,000 EPGF, 6 (4%) had counts of less than 26; 69 (49%) were 26-53, 19 (14%) were 54-62; 43 (31%) were 63-94; and 3 (2%) examinees had counts over 94 neutrophiles per mm<sup>3</sup>.

Lymphocytes. Of 919 persons harboring the liver fluke 65 (7%) had counts of fewer than 14 cells %; 188 (20%) were 14-24; 258 (28%) were 25-33; 343 (37%) were 34-50 and 65 (7%) had counts of over 50 cells %. Among 191 persons evidently free of fluke infection, 22 (12%) had counts of fewer than 14 cells/mm<sup>3</sup>

Table I

THE RELATIONSHIP OF THE DIFFERENTIAL BLOOD COUNT TO THE PRESENCE AND INTENSITY OF INFECTION WITH *O. viverrini* IN UDORN

		W.B.C.					NEUTROPHILES					LYMPHOCYTES				
		< 2999	2999-4999	5000-10000	10001-15000	> 15000	< 26	26-53	54-62	63-94	> 94	< 14	14-24	25-33	34-30	> 50
With	No.	3	22	470	309	117	27	403	196	284	11	65	188	258	343	65
<i>O. viverrini</i>	%	-	(2)*	(51)	(35)	(13)	(3)	(44)	(21)	(31)	(1)	(7)	(20)	(28)	(37)	(7)
Without	No.	0	7	94	62	28	4	66	35	83	3	22	43	43	69	14
<i>O. viverrini</i>	%	-	(4)	(49)	(32)	(15)	(2)	(35)	(18)	(44)	(2)	(12)	(23)	(23)	(36)	(7)
< 5000 EPGF**		No. 1	6	130	66	20	8	35	57	53	0	14	36	69	90	14
		% -	(3)	(58)	(30)	(9)	(4)	(23)	(26)	(24)	-	(6)	(18)	(31)	(40)	(6)
> 10000 EPGF		No. 0	3	80	43	14	6	69	19	43	3	14	28	44	43	14
		% -	(2)	(57)	(31)	(10)	(4)	(49)	(14)	(31)	(2)	(10)	(20)	(32)	(31)	(10)
		EOSINOPHILES				BASOPHILES			MONOCYTES							
		0	1-3	4-5	> 5	0	1	> 1	0	1-2	3-7	> 7				
With	No.	72	139	124	586	601	82	233	833	73	11	1				
<i>O. viverrini</i>	%	(8)	(15)	(13)	(66)	(66)	(9)	(25)	(91)	(8)	(1)	-				
Without	No.	24	50	37	79	172	11	6	165	22	2	1				
<i>O. viverrini</i>	%	(13)	(26)	(19)	(42)	(91)	(6)	(3)	(87)	(12)	(1)	-				
< 5000 EPGF		No. 16	22	25	160	188	20	11	202	15	4	1				
		% (7)	(10)	(11)	(72)	(85)	(9)	(5)	(91)	(7)	(2)	-				
> 10000 EPGF		No. 17	19	8	96	124	13	3	119	19	2	0				
		% (12)	(13)	(6)	(69)	(89)	(9)	(2)	(85)	(14)	(1)	-				

\* ( ) Percent to nearest whole number

\*\* Eggs per gram feces

43 (23%) were 14-24; 43 (23%) were 25-33; 69 (36%) were 34-50 and 14 (7%) had counts of over 50 cells %. Of 223 persons passing fewer than 5,000 EPGF, 14 (6%) had fewer than 14 cells %, 36 (16%) were 14-24; 69 (31%) were 25-33; 90 (40%) were 34-50; and 14 (6%) had counts of over 50 lymphocytes %. Of 139 persons passing over 10,000 EPGF, 14 (10%) had counts of fewer than 14; 28 (20%) were 14-24; 44 (32%) were 25-33; 43 (31%) were 34-50 and 14 (10%) had counts of over 50 cells per cent.

**Eosinophiles.** A high eosinophilia was seen in both the parasitized and non-parasitized examinees but particularly in the former group. Among 921 positive examinees, 72 (8%) showed no eosinophiles; 139 (15%) had 1-3; 124 (13%) had 4-5 and 586 (66%) had over 6 cells %. Of 190 fluke-free examinees, 24 (13%) had no eosinophiles; 50 (26%) had 1-3; 37 (19%) had 4-5 and 79 (42%) had 6 or more cells %. Of 223 persons passing fewer than 5,000 EPGF, 16 (7%) had no eosinophiles, 22 (10%) were 1-3, 25 (11%) were 4-5 and 160 (72%) had over 6 cells per cent. Of 140 persons passing over 10,000 EPGF, 17 (12%) had no eosinophiles; 19 (13%) had 1-3; 8 (6%) had 4-5 and 96 (69%) had over 6 cells per cent.

**Basophiles and Monocytes.** No remarkable differences were seen between infected and non-infected examinees. For basophiles the infected examinees counts were: zero cells 66%; 1 cell 9% and over 1 cell 25%. The non-infected counts were: zero cells 91%, 1 cell 6% and over 1 cell 3%. For monocytes the infected examinee counts were: zero cells 91%, 1-2 cells 8% and 3-7 cells 1%. For the non-infected

examinees the monocyte counts were: zero 87%; 1-2 12% and 3-7 1%(Table I).

Total Protein. Among 919 persons harboring O. viverrini, 1 had a total protein of less than 2.9 grams %; 125 (14%) were 2.9-5.9; 735 (80%) were in the "normal" 6.0-8.0 range and 58 (6%) had values of 8.1-12 gr. %. Of 191 persons evidently free of liver flukes, 37 (19%) had 2.9-5.9 gr. %; 147 (77%) were 6.0-8.0; and 7 (4%) were 8.1-12. Of 222 persons passing fewer than 5,000 EPGF, 30 (14%) had counts of 2.9-5.9; 180 (81%) were 6.0-8.0 and 11 (5%) were 8.1-12 gr. %. Of 140 persons passing over 10,000 EPGF, 23 (16%) were 2.9-5.9; 114 (81%) were 6.0-8.0 and 3 (2%) were 8.1-12 gr. % total protein.

Albumin. Of 920 persons harboring the liver fluke, 26 (3%) had less than 2.3 gr. % albumin; 664 (72%) had 2.3-4.4; 219 (24%) had 4.5-5.5; 8 had 5.6-8.3 and 3 examinees had over 8.3 gr. % albumin. Of 191 persons evidently free of liver flukes, 3 had less than 2.3 gr. %; 151 (79%) had 2.3-4.4 gr. %; 30 (16%) had 4.5-5.5; 4 had 5.6-8.3 and 3 had over 8.3 gr. %. Of 222 persons passing fewer than 5,000 EPGF, 6 (3%) had less than 2.3 gr. %; 151 (68%) had 2.3-4.4 and 65 (29%) had 4.5-5.5 gr. %. Of 140 persons passing over 10,000 GPGF, 3 (2%) had less than 2.3 gr. %; 115 (82%) had 2.3-4.4; 20 (14%) had 4.5-5.5 and 1 each had 5.6-8.3 and over 8.3 gr. %.

Globulin. Of 921 persons harboring the liver fluke, 26 (3%) had 0.65-1.4 gr.% globulin; 541 (59%) had 1.5-3.0; 317 (34%) had 3.1-4.6 and 37 (4%) had over 4.6 gr. %. Of 190 persons presumably free of infection, 3 (2%) had 0.65-1.4 mg % globulin; 113 (59%) had 1.5-3.0; 66 (35%) had 3.1-4.6 and 8 (4%) had over 4.6 gr. %. Among 223 persons passing fewer than 5,000 EPGF, 4 had 0.65-1.4; 145 (65%) had 1.5-3.0; 65 (29%) had 3.1-4.6 and 9 (4%) had over 4.6 gr. %. Of 140 persons passing over 10,000 EPGF 9 (6%) had 0.65-1.4; 80 (57%) had 1.5-3.0 gr. %; 47 (34%) were 3.1-4.6 and 4 (3%) were over 4.6 gr. %.

Cephalin flocculation. Of 920 persons infected with liver flukes, 500 (54%) were either negative or 1+ while 420 (46%) were 2+ or more. Of 190 persons presumably free of liver flukes, 130 (68%) were negative or 1+ and the remaining 60 were 2+ or more. Among 222 persons passing fewer than 5,000 EPGF, 121 (55%) were negative or 1+ while 101 (45%) were 2+ or more. Of 140 persons passing over 10,000 EPGF, 79 (56%) were negative or 1+ and 61 were 2+ or more.

Hematocrit, male. Of a total of 571 males harboring liver flukes, 15 (3%) had hematocrits of less than 20%; 423 (74%) were 20-44%; 66 (12%) were 45-47%, 62 (11%) were 48-54% and 5 were over 54%. Among 125 males evidently free of fluke infection, 5 (4%) had hematocrits of less than 20%, 33 (26%) were 20-44%, 37 (30%) were 45-47%; 48 (38%) were 48-54%, and 2 had hematocrits of over 54%. A total of 124 males passed fewer than 5,000 EPGF. Of these 4 (3%) had hematocrits of less than 20%; 92 (74%) were 2-44%; 14 (11%) were 45-47%, 13 (10%) were 48-54% and one was over 54%. Of 79 males passing over 10,000 EPGF, 2 (3%) had hematocrits of less than 20%; 59 (75%) were 20-44%; 13 (16%) were 45-47%, 4 (5%) were 48-54% and 1 was over 54%.

Hematocrit, female. A total of 346 females were infected with O. viverrini. Of these 64 (18%) had hematocrits of less than 29%; 200 (58%) were 29-39%; 56 (16%) were 40-42%; 24 (7%) were 43-64% and 2 had hematocrits of over 64%. Among 65 females presumably free of O. viverrini infection, 2 (3%) had hematocrits of less than 29%; 22 (34%) were 29-39%; 16 (25%) were 40-42%; and 25 (38%) had hematocrits of over 64%. Of 98 females passing fewer than 5,000 EPGF, 12 (12%) had hematocrits of less than 29%; 60 (61%) were 29-39%; 17 (17%) were 40-42% and 9 (9%) had hematocrits of over 64%. Of 61 females passing over 10,000 EPGF, 6 (10%) had hematocrits of less than 29%; 38 (62%) were 29-39%; 12 (20%) were 40-42%; 4 (7%) were 43-64% and 1 had a hematocrit of over 64%.

Hemoglobin, male. Of 347 males infected with O. viverrini, 5 (1%) had hemoglobin determinations of less than 6 grams %; 250 (72%) had a 6-13 gr. %, 90 (26%) had 14-17 gr. %, and 2 males had hemoglobins of 18-25 gr. %. Among 64 males evidently free of O. viverrini infection 2 (3%) had less than 6 gr. % hemoglobin; 52 (79%) had 6-13 gr. % and 12 (18%) had 14-17 gr. %. Of 98 males passing fewer than 5,000 EPGF, 1 (1%) had hemoglobin over 6 gr. % 64 (65%) were 6-13 gr. %; 32 (33%) were 14-17 gr. % and 1 (1%) had a hemoglobin reading of between 18 and 25 gr. %. Of 60 males passing over 10,000 EPGF 46 (77%) had hemoglobin values between 6 and 13 gr. %, while the remaining 14 (23%) were 14-17 gr. %.

Hemoglobin, female. Of 568 females infected with O. viverrini 6 (1%) had hemoglobin values below 5 gr. %; 143 (25%) were 5-11 gr. %; 391 (69%) were 12-16 gr. % and 26 (5%) were 17-24 gr. %. Of 124 females presumably free of O. viverrini, 1 had a hemoglobin value of less than 5 gr. %; 41 (33%) were 5-11 gr. %; 76 (61%) were 12-16 gr. %; and 6 (5%) had hemoglobin values from 17 to 24 gr. %. Among 125 females passing fewer than 5,000 EPGF, 3 (2%) had hemoglobin values of less than 5 gr. %; 26 (21%) were 5-11 gr. %; 91 (73%) were 12-16 gr. %; and 5 (4%) had values of from 24 gr. %. Of 79 females passing over 10,000 EPGF, 1 (1%) had a value of less than 5 gr. %; 19 (24%) were 5-11 gr. %; 55 (70%) had values of between 12 and 16 gr. % and 4 (5%) were 17-24 gr. %.

Bilirubin, Direct. Of 920 persons infected with liver flukes, 1 had a bilirubin value of less than 0.04 mg%; 28 (3%) were 0.04 to 0.09; 568 (62%) were in the "normal" range of 0.1-0.4; 162 (18%) were 0.5-0.7 and 161 (18%) had bilirubin values of over 0.7 mg%. Of 191 persons believed free of liver flukes infection 7 (4%) were 0.04-0.09 mg; 131 (69%) were 0.1-0.4; 25 (13%) were 0.5-0.7 and 28 (15%) had values over 0.7 mg%. Among 223 persons passing fewer than 5,000 EPGF 8 (4%) were 0.04-0.09; 163 (64%) were 0.1-0.4; 43 (19%) were 0.5-0.7, and 31 (14%) had values over 0.7 mg%. Of 140 persons passing over 10,000 EPGF 1 had a value of less than 0.4 mg%; 3 (2%) were 0.04-0.09; 94 (67%) were 0.1-0.4; 23 (16%) were 0.5-0.7 and 19 (14%) had values over 0.7 mg%.

Bilirubin, Total. A total of 919 persons harboring liver flukes had bilirubin values as follows: 1 was less than 0.09 mg%; 8 (1%) were 0.09-0.19; 346 (38%) were 0.2-0.4; 245 (27%) were 0.8-1.1 and 319 (35%) had values of over

1.1 mg%. Of 191 persons free of liver fluke infection, 5 (3%) were 0.09-0.19 mg%; 81 (42%) were 0.2-0.7; 45 (24%) were 0.8-1.1 and 60 (31%) had values over 1.1 mg%. Of 223 passing fewer than 5,000 EPGF, 1 had a value of less than 0.09 mg%; 2 (1%) were 0.09-0.19; 76 (34%) were 0.2-0.4; 66 (30%) were 0.8-1.1 and 78 (35%) had values of over 1.1 mg%. Among 140 persons passing more than 10,000 EPGF 2 (1%) had values of 0.09-0.19 mg%; 49 (35%) were 0.2-0.4; 49 (35%) were 0.8-1.1 and 40 (29%) had bilirubin values of less than 1.1 mg%.

Cholesterol. Of 918 persons harboring liver flukes 11 (1%) had total cholesterol values of less than 74 mg%; 353 (38%) were 74-149 mg%; 475 (52%) were 150-240, 74 (8%) were 241-360; and 5 had values of over 360 mg%. Of 190 persons believed free of fluke infections, 1 had a value of less than 74 mg%; 68 (36%) were 74-149; 89 (47%) were 150-240; 28 (15%) were 241-360 and 4 (2%) were over 360 mg%. Among 222 persons passing fewer than 5,000 EPGF 2 (1%) had values less than 74 mg%; 93 (42%) were 74-149; 113 (51%) were 150-240; 12 (5%) were 241-360 and 2 (1%) had values of over 360 mg%. Of 139 persons passing more than 10,000 EPGF 2 (1%) had values of less than 74 mg%; 59 (42%) were 74-149; 55 (40%) were 150-240; 22 (16%) were 241-360 and 1 person had a value of over 360 mg%.

Cholesterol Esters. Of 914 persons harboring *O. viverrini*, 20 (2%) had ester values of less than 29%; 228 (25%) were 29-59%; 259 (28%) were 60-70% and 407 (45%) were 71-100%. Among 190 persons presumed to be free of liver flukes, 7 (4%) had less than 29% esters; 55 (29%) had from 29 to 59% esters; 53 (28%) had 60-70% and 75 (39%) had values of from 71 to 100%. Of 222 persons passing fewer than 5,000 EPGF, 2 (1%) had ester values below 29%; 54 (24%) were 29-59%; 75 (34%) were 60-70% and 91 (41%) had values of 71 to 100% esters. Among 139 persons passing over 10,000 esters, 3 (2%) had less than 29% esters; 40 (29%) had 29-59% esters; 49 (35%) had 60-70 and 47 (34%) had 71 to 100% esters. (Table III).

Thymol Turbidity. Of 919 persons harboring *O. viverrini*, 4 showed fewer than one MacLagan unit of thymol turbidity. A total 765 (83%) showed 1-4 units; 107 (12%) had 5-7 and 43 (5%) had over 7 units. Among 190 persons believed free of fluke infection 3 (2%) showed less than 1 units; 157 (83%) had 1-4; 22 (12%) had 5-7 and 8 (4%) had over 7 units. Of 223 persons passing fewer than 5,000 EPGF, 198 (89%) had 1-4 units; 17 (8%) had 5-7 and 8 (4%) had over 7 units. Among 140 persons passing over 10,000 EPGF, 2 (1%) had less than 1 unit, 125 (89%) had 1-4 and 13 (9%) had 5-7 units.

Alkaline Phosphatase. Of 912 persons harboring the liver fluke, 37 (4%) showed less than 0.9 units of alkaline phosphatase; 357 (39%) had 0.9-1.9; 462 (51%) had 2-4.5 units; 42 (5%) had 4.6-6.8 and 14 (2%) had over 6.8 units. Among 191 persons supposed free of fluke infection 6 (3%) had less than 0.9 units; 72 (38%) had 0.9-1.9; 102 (53%) had 2.4.5; 10 (5%) had 4.6-6.8 and 1 person had over 6.8 units. Of 221 persons passing fewer than 5,000 EPGF, 4 (2%) had less than 0.9 units; 77 (35%) had 0.9-1.9; 129 (58%) had 2-4.5, 7 (3%) had 4.6-6.8

and 4 (2%) had over 6.8 units. Among 138 persons passing over 10,000 EPGF, 9 (6%) had less than 0.9 units; 45 (33%) were 0.9-1.9; 71 (51%) were 2-4.5; 10 (7%) were 4.6-6.8 and 3 (2%) had over 6.8 units.

SGOT. Serum transaminase determinations were made on 919 persons harboring O. viverrini. Of these 14 (2%) had less than 3 Sigma Frankel units; 25 (2%) had 3-7 units; 713 (78%) had 8-40 units; 72 (8%) had 41-61 units and 95 (10%) had over 61 units. Among 191 persons believed to be free of infection, 7 (4%) had less than 3 units; 6 (3%) had 3-7; 126 (66%) had 8-40; 24 (13%) had 41-46 and 28 (15%) had over 61 units. Of 223 persons passing fewer than 5,000 EPGF 4 (1%) had less than 3 units; 10 (4%) had 3-7; 184 (83%) had 8-40; 11 (5%) had 41-61 and 16 (7%) had over 61 units. Of 140 persons passing over 10,000 EPGF, 4 (3%) had fewer than 3 units; the same number had 3-7; 124 (89%) had 8-40; 5 (4%) had 41-61 and 3 (2%) had over 61 units.

SGPT. Of 916 persons infected with liver fluke, 156 (17%) had fewer than 2 Sigma-Frankel units; 107 (12%) had 2-4 units; 578 (63%) had 5-35; 28 (3%) had 26-53 and 47 (5%) had over 53 units. Of 189 persons presumed free of liver flukes 29 (15%) had fewer than 3 units; 22 (12%) had 2-4; 118 (62%) had 5-35; 10 (5%) had 36-53 and 10 (5%) had over 53 units. Among 222 persons passing fewer than 5,000 EPGF, 50 (22%) had fewer than 3 units; 34 (15%) had 1-4; 135 (61%) had 5-35; 1 had 36-53 and 3 (1%) had over 53 units. Among 139 persons passing over 10,000 EPGF 38 (27%) had fewer than 3 units; 27 (19%) had 2-4; 71 (51%) had 5-35; 1 had 36-53 and 2 (1%) had over 53 units.

Zinc Turbidity. Of 920 persons infected with liver fluke, 5 had less than 2 units, 23 (3%) had 2-5; 527 (57%) had 6-14; 251 (27%) had 15-22; and 114 (12%) had over 22 units. Of 191 persons believed free of infection, 10 (5%) had 2-5 units; 100 (52%) had 6-14; 56 (30%) had 15-22 and 25 (13%) had over 22 units. Of 222 persons passing fewer than 5,000 EPGF, 6 (2%) had 2-5 units; 156 (70%) had 6-14 units; 45 (20%) had 15-22 and 15 (7%) had over 22 units. Among 140 persons passing over 10,000 EPGF, 10 (7%) had 2-5 units; 100 (72%) had 6-14; 56 (40%) had 15-22 and 25 (18%) had over 22 units.

Discussion: The results of these investigations indicate that neither the hematological nor the biochemical findings are appreciably affected by the presence of O. viverrini. Without non infected controls, it would have appeared that many symptoms were caused by this parasite, but these same symptoms appeared with essentially the same frequency in the non infected control group. In some possibly questionable cases such as eosinophile count or hematocrit readings, further studies are in progress to determine whether these changes may be associated with the presence of the parasite or not.

No previous studies have been undertaken to determine "normal" hematological or biochemical values for the population of northeast Thailand. The present data help to establish these norms, and it is seen that not all are within the ranges recognized for Caucasian populations. A variety of factors could be

responsible for these manifestations. Most notable of these differences include "average" findings of: neutrophils 26 to 53%; eosinophiles over 5%; albumin 2.3 to 4.4 grams %; hematocrit male 20-44%; hematocrit female 29-39% and hemoglobin male 6-13%.

In spite of certain gross pathological changes associated with this infection, (data to be reported separately) the authors are unable to find specific symptoms or syndromes representing the disease. As Oldt (1927) and Strauss (1962) have reported for Clonorchis sinensis, O. viverrini appears to be an essentially benign infection of man in northeastern Thailand. It was unfortunate that no infected Caucasians were available for comparison as was made by Strauss, but the similarity of findings in the Oriental populations harboring these two parasites indicates the possibility that Caucasians infected with O. viverrini would fail to exhibit symptoms directly attributable to this parasite.

Summary and Conclusions: A study of some 1,100 persons in Udorn Thani failed to reveal specific changes in the differential blood pattern or in a series of liver function tests which could be attributed to the presence or correlated with the severity of infection with the liver fluke, Opisthorchis viverrini.

Certain "normal" or "average" biochemical findings as reported for Caucasian populations in standard textbooks were found to differ from the "average" for the population. These variances were found in neutrophile and eosinophile counts as well as in albumin, hematocrit and hemoglobin levels.

Without the use of infection-free controls, it would have appeared that many biochemical changes were caused by this parasite, but these symptoms were seen to be exhibited with approximately the same frequency by the infection-free examinees.

Table II

THE RELATIONSHIP OF TOTAL PROTEIN, ALBUMIN, GLOBULIN, CEPHALIN FLOCCULATION AND HEMATOCRIT TO THE PRESENCE AND INTENSITY OF INFECTION WITH OPISTHORCHIS VIVERRINI IN UDORN

		TOTAL PROTEIN ( gr. %)					ALBUMIN (gr. %)					GLOBULIN ( gr. %)				
		< 2.9- 6.0- 8.1- >					< 2.3- 4.5- 5.6- >					< 0.65-1.5- 3.1- >				
		2.9	5.9	8.0	12	12	2.3	4.4	5.5	8.3	8.3	0.65	1.4	3.0	4.6	4.6
With	No.	1	125	735	58	0	26	664	219	8	3	0	26	541	317	37
<u>O. viverrini</u>	%	-	(14)	(80)	(6)	-	(3)	(72)	(14)	-	-	=	(3)	(59)	(34)	(4)
Without	No.	0	37	147	7	0	3	151	30	4	3	0	3	113	66	8
<u>O. viverrini</u>	%	-	(19)	(77)	(4)	-	-	(79)	(16)	-	-	-	(2)	(59)	(35)	(4)
< 5000 EPGF	No.	0	30	180	11	0	6	151	65	0	0	0	4	145	65	9
	%	-	(14)	(81)	(5)	-	(3)	(68)	(29)	-	=	-	-	(65)	(29)	(4)
>10000 EPGF	No.	0	23	114	3	0	3	115	20	1	1	0	9	80	47	4
	%	-	(16)	(81)	(2)	-	(2)	(82)	(14)	-	-	-	(6)	(57)	(34)	(3)
		CEPHALIN FLOC. (+)					HEMATOCRIT MALE (%)					HEMATOCRIT FEMALE (%)				
		NEG- 2+ or MORE					< 20- 45- 48- >					< 29- 40- 43- >				
		I+					20 44 47 54 54					29 39 42 64 64				
With	No.	500					15					64				
<u>O. viverrini</u>	%	(54)					(3)					(18)				
Without	No.	130					5					2				
<u>O. viverrini</u>	%	(68)					(4)					(3)				
< 5000 EPGF	No.	121					4					12				
	%	(55)					(3)					(12)				
>10000 EPGF	No.	79					2					6				
	%	(56)					(3)					(10)				

Table III

THE RELATIONSHIP OF HEMOGLOBIN, BILLIRUBIN, CHOLESTEROL AND ESTERS  
TO THE PRESENCE AND INTENSITY OF INFECTION WITH OPISTHORCHIS VIVERRINI IN UDORN

		HEMOGLOBIN (MALE (Gram %))					HEMOGLOBIN (FEMALE (Gram %))					BILIRUBIN (1 MIN) (mg %)				
		<	6-	14-	18-	>	<	5-	12-	17-	>	<	.04-	0.1-	0.5-	>
		6	13	17	25	25	5	11	16	24	24	0.04	.09	0.4	0.7	0.7
With	No.	5	250	90	2	0	6	143	391	26	2	1	28	568	162	161
<u>O. viverrini</u>	%	(1)	(72)	(26)	-	-	(1)	(25)	(69)	(5)	-	-	(3)	(62)	(18)	(18)
Without	No.	2	52	12	0	0	1	41	76	6	0	0	7	131	25	28
<u>O. viverrini</u>	%	(3)	(79)	(18)	-	-	-	(33)	(61)	(5)	-	-	(4)	(69)	(13)	(15)
< 5000 EPGF	No.	1	64	32	1	0	3	26	91	5	0	-	8	143	43	31
	%	(1)	(65)	(33)	(1)	-	(2)	(21)	(73)	(4)	-	-	(4)	(64)	(19)	(14)
>10000 EPGF	No.	0	46	14	0	0	1	19	55	4	0	1	3	94	23	19
	%	-	(77)	(23)	-	-	(1)	(24)	(70)	(5)	-	-	(2)	(67)	(16)	(14)
		BILIRUBIN (30 MIN) (mg %)					CHOLESTEROL (mg %)					ESTERS (%)				
		<	.09-	0.2-	0.8-	>	<	74-	150-	241-	>	<	29-	60-	71-	>
		.09	.19	0.7	1.1	1.1	74	149	240	360	360	29	29	70	100	
With	No.	1	0	346	245	319	11	353	475	74	5	20	228	259	407	
<u>O. viverrini</u>	%	-	(1)	(38)	(27)	(35)	(1)	(38)	(52)	(8)	-	(2)	(25)	(28)	(45)	
Without	No.	5	81	45	60	0	1	68	89	28	4	7	55	53	75	
<u>O. viverrini</u>	%	(3)	(42)	(24)	(31)	-	-	(36)	(47)	(15)	(2)	(4)	(29)	(28)	(39)	
< 5000 EPGF	No.	1	2	76	66	78	2	93	113	12	2	2	54	75	91	
	%	(35)	(30)	(34)	(1)	(35)	(1)	(42)	(51)	(5)	(1)	(1)	(24)	(34)	(41)	
>10000 EPGF	No.	0	2	49	49	40	2	59	55	22	1	3	40	49	47	
	%	-	(1)	(35)	(35)	(29)	(1)	(42)	(40)	(16)	-	(2)	(29)	(35)	(34)	

Table IV

THE RELATIONSHIP OF THYMOL TURBIDITY, ALKALINE PHOSPHATASE, SGOT, SGPT AND ZINC TURBIDITY  
LEVELS WITH THE PRESENCE AND INTENSITY OF INFECTION WITH OPISTHORCHIS VIVERRINI IN UDORN

		THYMOL TURBIDITY (MacLagan)				ALKALINE PHOS. (Units)					SGOT (Sigma-Frankel Units)				
		1	1-	5-	>	<	0.9	2-	4.6	>	3	3-	8-	41-	>
			4	7	7	0.9	1.9	4.5	6.8	6.8		7	40	61	61
With	No.	4	765	107	43	37	357	462	42	14	14	25	713	72	95
<u>O. viverrini</u>	%	-	(83)	(12)	(5)	(4)	(39)	(51)	(5)	(2)	(2)	(2)	(78)	(8)	(10)
Without	No.	3	157	22	8	6	72	102	10	1	7	6	126	24	28
<u>O. viverrini</u>	%	(2)	(83)	(12)	(4)	(3)	(38)	(53)	(5)	-	(4)	(3)	(66)	(13)	(15)
< 5000 EPGF	No.	-	198	17	8	4	77	129	7	4	4	10	184	11	16
	%	-	(89)	(8)	(4)	(2)	(35)	(58)	(3)	(2)	(1)	(4)	(83)	(5)	(7)
>10000 EPGF	No.	2	125	13	-	9	45	71	10	3	4	4	124	5	3
	%	(1)	(89)	(9)	-	(6)	(33)	(51)	(7)	(2)	(3)	(3)	(89)	(4)	(2)
		SGPT (S.F. Units)				ZINC TURBIDITY (Units)									
			2-	5-	36-	>	2	2-	6	15-	>				
			4	35	53	53		5	14	22	22				
With	No.	156	107	578	28	47	5	23	527	251	114				
<u>O. viverrini</u>	%	(17)	(12)	(63)	(63)	(5)	-	(3)	(57)	(27)	(12)				
Without	No.	29	22	118	10	10	-	10	100	56	25				
<u>O. viverrini</u>	%	(15)	(12)	(62)	(5)	(5)	-	(5)	(52)	(30)	(13)				
< 5000 EPGF	No.	50	34	135	1	3	-	6	156	45	15				
	%	(22)	(15)	(61)	-	(1)	-	(2)	(70)	(20)	(7)				
>10000 EPGF	No.	38	27	71	1	2	-	10	100	56	25				
	%	(27)	(19)	(51)	-	(1)	-	(7)	(72)	(40)	(18)				

RESULTS OF STOOL EXAMINATIONS 1964-1965

(VARIOUS AREAS OF THAILAND)

Area	CRC	Bang-kok	Chiang-mai	Ubol	Song-klan	Total
No. Examinees	211	239	158	158	146	912
No. with Parasite	72(34)	75(32)	76(48)	114(72)	137(94)	474(52)
No. with Helminths	44(21)	59(25)	76(48)	110(70)	134(92)	423(46)
No. with Protozoa	14(7)	19(8)	-	4(3)	15(10)	52(6)
Hook worm	21(10)	9(4)	26(16)	57(36)	118(81)	231(25)
Ascaris	23(11)	46(19)	36(23)	-	52(36)	157(17)
Opisthorchis	5(2)	2(1)	17(11)	90(57)	-	117(13)
Enterobius	5(2)	4(2)	4(3)	-	4(3)	17(2)
Strongyloides	1(0.47)	-	-	1(1)	1(1)	3(0.3)
Whip worm	-	-	-	-	102(70)	119(13)
E. coli	12(6)	17(7)	-	7(4)	12(9)	48(5)
E. nana	1(0.47)	-	-	-	-	1(0.1)
Giardia	2(1)	2(1)	-	1(1)	1(1)	6(1)
Iodamoeba	-	-	-	-	-	-
E. histolytica	1(0.47)	-	-	-	-	1(0.1)
Trichomonas	3(1.42)	-	-	-	-	3(0.3)

RESULT OF STOOL EXAMINATIONS 1964-1965

PHITSANULOKE STATE (CHANGWAD)

Area	Wat Jad	Ban Klong	Bang Ta Tong	Ban Ta Phoo	Total
No. Examinees	191	96	326	451	1064
No. with Parasites	61(32%)	42(44)	200(61)	202(45)	505(47)
with Helminths	58(30)	40(42)	197(60)	152(34)	447(42)
with Protozoa	15(8)	13(14)	108(34)	165(37)	301(28)
Hook worm	39(20)	31(32)	176(54)	138(31)	384(36)
Ascaris	8(4)	10(10)	13(4)	1(0.2)	32(3)
Opisthorchis	-	0	7(2)	1(0.2)	8(0.7)
Enterobius	6(3)	0	5(2)	9(2)	20(2)
Strongyloides	2(1)	5(5)	4(1)	3(1)	14(1)
Whip worms	2(1)	0	1(-)	0	3(-)
Schistosoma sp.	1(-)	0	0	0	1(-)
E. coli	14(7)	11(11)	68(21)	75(16)	169(16)
E. nana	0	1(1)	16(5)	43(10)	60(6)
Giardia	1(-)	1(1)	10(3)	19(4)	20(2)
Iodamoeba	0	0	13(4)	20(4)	33(3)
E. histolytica	0	0	0	5(1)	5(-)
C. mesnili	0	0	0	3(1)	3(-)

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### BIOCHEMICAL TESTS-PROVINCIAL HOSPITAL-UDORN-MEDICAL ZOOLOGY, 1964-65

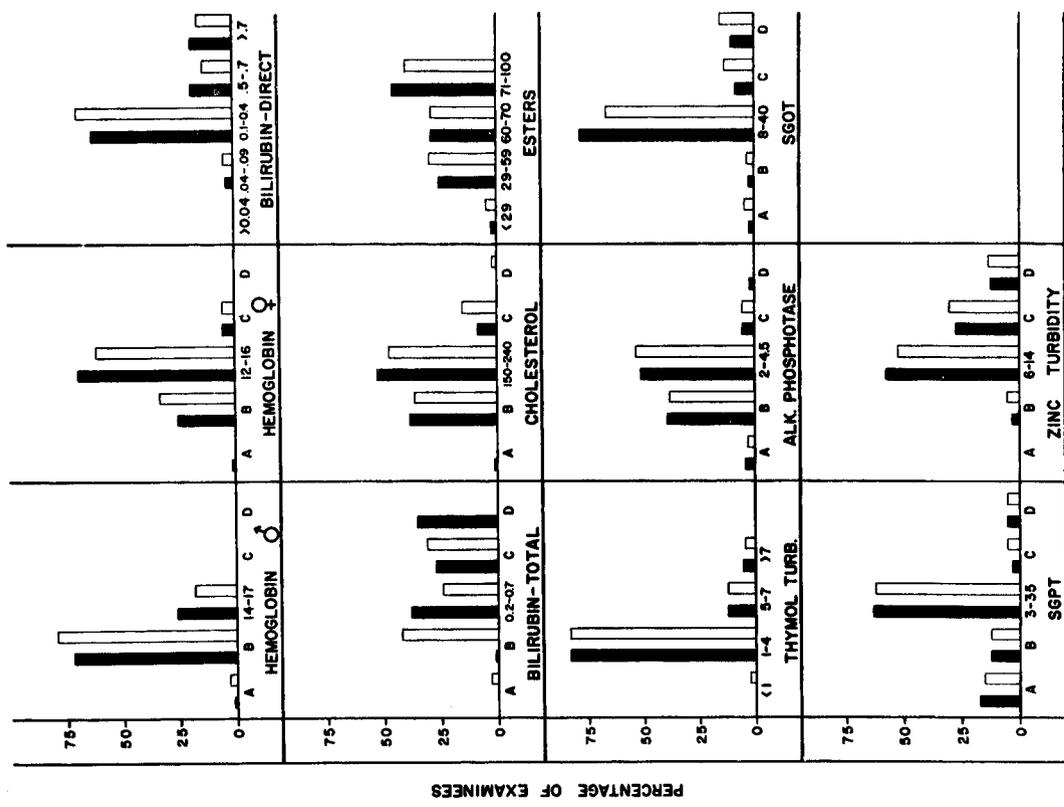
TEST	NO. TESTS IN MONTH OF:												TOTAL	
	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB		
Tot. Prot.	270	183	156	216	214	77	164	160	181	232	148	144	2145	
Albumin	270	183	156	216	214	77	164	160	179	232	148	144	2143	
Glob.	270	183	156	216	214	77	164	160	179	232	148	144	2143	
Ceph. Floc.	270	182	156	217	215	77	167	160	179	233	150	145	2151	
Hemato.	40	30	223	307	257	273	154	111	182	277	237	102	2193	
Hemoglob.	210	137	362	321	282	338	348	410	492	365	311	271	3847	
Bili. 1'	270	183	156	216	215	77	164	160	178	233	149	145	2146	
Bili. 30'	270	183	156	216	215	77	164	160	176	233	149	145	2144	
Cholest.	265	177	157	215	214	77	162	160	177	232	148	145	2129	
Esters	265	177	150	215	214	77	162	160	177	232	148	145	2122	
Thymol	270	183	156	216	215	77	165	160	179	232	150	145	2148	
Alk. Phos.	268	179	157	217	215	77	155	159	169	226	146	139	2107	
SGOT	263	177	155	215	213	77	158	160	177	230	149	144	2118	
SGPT	263	177	155	215	213	77	159	159	177	230	149	144	2118	
Zinc	270	183	156	216	215	77	165	160	179	233	150	145	2149	
													TOTAL	33803

### NUMBER OF EXAMINEES UDORN HOSPITAL-MEDICAL ZOOLOGY, 1964-1965

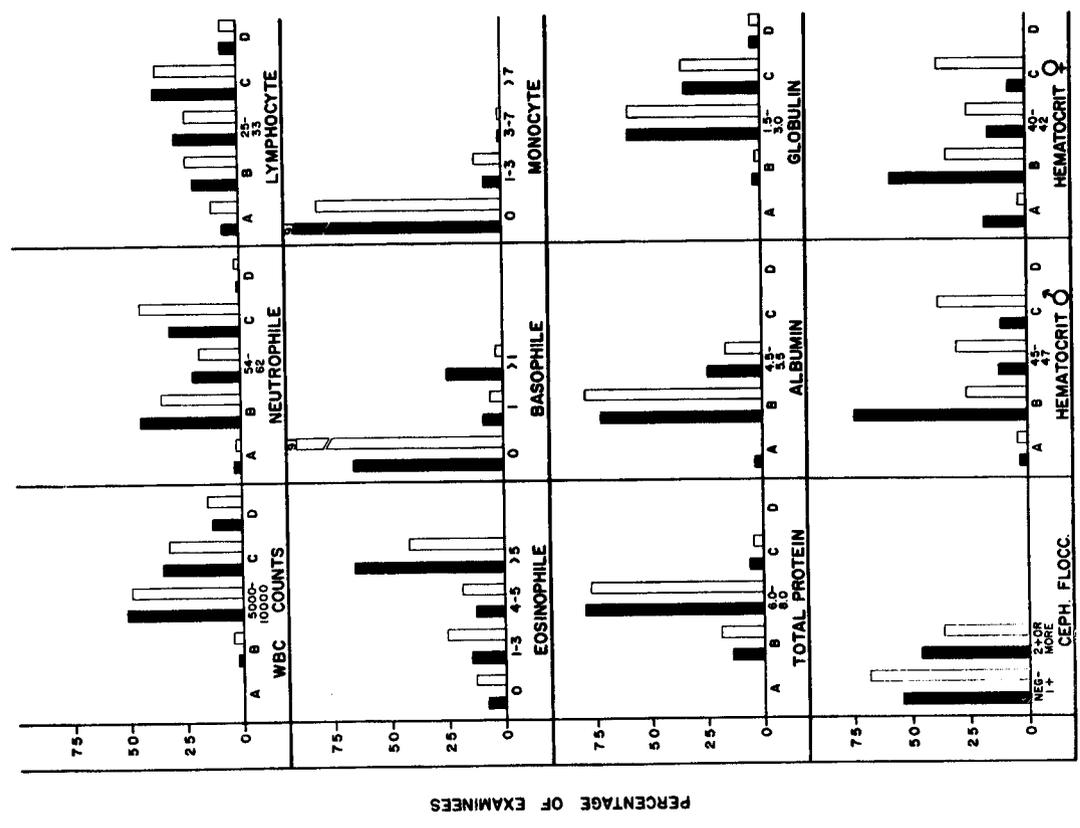
Urine	209	175	272	252	201	277	257	276	272	227	201	228	2847	
Stool	538	177	227	262	290	244	269	333	380	302	248	234	3504	
Stollcount	-	-	30	131	204	162	294	419	425	550	480	287	2982	
Blood Exam.	212	142	371	336	284	359	373	430	519	413	332	301	4072	
VDRL	34	14	2	31	33	47	117	95	145	159	127	167	971	
Bacteria	20	12	13	44	10	13	16	3	12	20	24	62	249	
													TOTAL	14625

As a prerequisite to carrying out biochemical determinations reported in the preceding paper, it was necessary to train and supervise technicians in general biochemical procedures. During the past year a total of 33803 biochemical tests were made on 4072 persons. In addition, Medical Zoology technicians assisted Dr. Kasem Chittayasothorn's technicians in carrying out the following tests: urinalyses (2847), stool examinations (formalin ether concentrations (3504), stool egg counts (2982), VDRL determinations 971. In all some 14,600 separate analyses (in addition to biochemistry) were made. These data are presented on the following page.

In addition to the data reported in the preceding paper, Medical Zoology has carried out stool examinations in various parts of Thailand. The data not being reported elsewhere in this report, they are presented in the previous pages. Perhaps the most remarkable finding is the low prevalence of Endamoeba histolytica in the examined population.



OBSERVATIONS ON HEMOGLOBIN, BILIRUBIN, CHOLESTEROL, ESTERS, THYMOL TURBIDITY, ALKALINE PHOSPHATASE, SGPT, SGOT, AND ZINC TURBIDITY IN PERSONS FREE OF INFECTION WITH OPISTHORCHIS VIVERRINI.



OBSERVATIONS OF DIFFERENTIAL BLOOD STUDIES, TOTAL PROTEIN, ALBUMIN GLOBULIN, CEPHALIN FLOCCULATION AND HEMATOCTRIT IN PERSONS HARBORING AND IN PERSONS FREE OF INFECTION WITH OPISTHORCHIS VIVERRINI.