

## Parasitic Diseases as an Index of Environmental Changes in Twentieth-Century Taiwan: A Preliminary Study

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Ts'ui-jung Liu\*, Shi-yung Liu\*\*, and Ya-wen Ku\*\*\*

### Introduction

In the early twentieth century, parasitic infection rate among Taiwanese was rather high. For instance, a health examination conducted during 1921-1929 with a sample of 77,011 males and females from 32 localities in 8 administrative areas found that parasitic infection rate was 78.3%. Among various parasites, the infection rate of *Ascaris lumbricoides* (abbr. Al) was 54.4%, *Trichuris trichiura* (Tt) 29.3%, and *Ancylostoma duodenale* (Ad) 14.4%. These rates were quite close to those found in Japan around the same time.<sup>1</sup> As for the cause of death, the statistics during 1906-1942 showed that in addition to malaria induced by plasmodium, two entries related to parasites were specified as “diseases caused by parasitic protozoa and helminth” and “other infectious and parasitic diseases”; and the figures of these two entries are either separated or combined. If combined together, the death rate was lowest at 0.4% in 1909 and highest at 6.4% in 1941.<sup>2</sup> As for malaria induced by plasmodium, it was the most important cause of death among Taiwanese before 1911 and in 1915-1916; the death rate during 1906-1916 was around 10% and mostly above 5% during 1917-1929, once fell to 3% in 1934 but returned to 5.35% in 1942.<sup>3</sup>

In 2000, according to the health statistics of the Department of Health, Executive Yuan, classified by international standard of the cause of death, the total number of death was 124,481 and those died of “infectious and parasitic diseases” were 3,016, or 2.4%. Under this major entry, details related to parasitic diseases were as follows: 1 amoebiasis, 1 malaria, 3 helminthiasis, 1 other trematode infections, 1 ancylostomiasis and necatoriasis, and 1 other and unspecified helminthiasis; adding

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\*Distinguished Research Fellow, Institute of Taiwan History, Academia Sinica..

\*\*Assistant Research Fellow, Institute of Taiwan History, Academia Sinica.

\*\*\*Post-doctoral Fellow, Research Center for Humanities and Social Sciences, Academia Sinica.

<sup>1</sup> Health Division of the Bureau of Police Affairs, Taiwan Government-general (comp.), 1931, *The Tenth Report of Health Examination: The Second Part of Field Examination on Diseases* (Taipei: Taiwan Sotokufu), pp. 55-56. Also see Liu Ts'ui-jung and Liu Shi-yung, 1999, “Disease and Mortality in the History of Taiwan”, *Taiwan Historical Research*, 4:2, p. 114. For a list of parasites mentioned in this paper, see Appendix 1.

<sup>2</sup> The Statistic Department of the Head Administrator's Office in Taiwan (comp.), 1946, *Summaries of statistics in Taiwan during the past 51 years* (Taipei: Head Administrator's Office in Taiwan). The percentages are calculated with statistics in Table 91.

<sup>3</sup> Ibid., Also see Liu Ts'ui-jung and Liu Shi-yung, 1999, pp. 114-115.

up to 8 persons died of these causes. When 1 died of “other and unspecified infectious and parasitic diseases” and 204 died of “late effects of infectious and parasitic diseases” were added again, there were altogether 213 deaths and the rate was 0.17%.<sup>4</sup> Although it is difficult to separate precisely the shares of infectious and parasitic diseases with existing statistics, the above rates at least suggest that the share of parasitic disease could be in decline during the twentieth century. In other words, changes in parasitic infections can be used as an index for investigating environmental change in Taiwan during the twentieth century.

Parasites in human body are classified into three main categories: protozoa, helminth (including trematoda, cestodea, nematoda, gordiacea, acanthocephala, and hirudinea), as well as insect. Parasitic infections are related to food, residence, custom and migration of mankind. This is not only testified in individuals but also in groups. Geographical distribution of parasites relates to various factors. The way of life and the custom of human beings may confine living conditions for the host. From the perspective of parasites, those living with a complicated life cycle will have more limitations than those with a simple one. In the course of its growth, a parasite may require a change of host and needs to have other animals than humans to serve as its host, and thus limitations are even more obvious. In other words, in the case that a parasite requires a certain host or disseminator, it can only survive at places where there are this species. On the contrary, those do not need to change the host will survive according to human conditions and migrations. However, the growth of parasites is also related to the environment and climate. Perfect condition for a single host is not a sufficient condition for the survival of parasites. With a prerequisite of sufficient humidity, places and seasons with high temperature are more suitable for the growth of parasites. In the tropical area, parasites have more varieties and spread more widely, particularly in the summer. In addition to the environment, it is obvious that the survival of parasites is also affected by animals serving as hosts and disseminators.<sup>5</sup>

This paper aims to provide a review of literature in two periods: the Japanese colonial period (1895-1945) and the period after Taiwan restoration in 1945. The discussion will be focused on the infection of helminthes with some mentions of protozoa. Among protozoa, this paper will not particularly deal with malaria as there are already some studies in recent years.<sup>6</sup>

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<sup>4</sup> Department of Health, Executive Yuan, Health and National Insurance Annual Statistics Information Service, <http://www.doh.gov.tw/statistic/data/生命統計/89/08.XLS>, Table 8 and 8.3-8.5.

<sup>5</sup> Yokogawa Sadamu and Morishita Kaoru, 1931, *Human Parasitology*, Vol. 1 (Tokyo: Tohodo), p. 5, pp. 66-70 ; Yokogawa Sadamu and Morishita Kaoru, 1943, *The Newest Summary of Human Parasitology* (Tokyo: Tohodo, second edition), pp. 1-5.

<sup>6</sup> For example see, Fann Yann-chiou, 1996, “Medicine and Colonial Expansion: Taiwan’s Malaria Research under Japanese Rule,” *New History*, 7:3, pp. 133-173. Ku Ya-wen, 2004, “Anti-parasite vs.

## I. Japanese Colonial Period (1895-1945)

Reports and essays published in the *Journal of the Formosan Medical Association* (hereafter *JFMA*) demonstrate that during the Japanese colonial period many examinations of parasitic infections were conducted among patients, prisoners, soldiers, students of primary, middle and vocational schools, inhabitants in general, and aborigines. As the scale and representation of these examinations are different and may imply certain limitations, it is thus appropriate to illustrate these results in separate classifications.

### 1. Patients of Hospitals

The first report regarding parasitic infections among patients was presented in 1908 by Wang Chen-chien concerning the results of stool examinations conducted from January to December 1907 among 1,648 patients, of them 1,360 males and 288 females, at the Red Cross Taiwan Branch Hospital. The age of these patients ranged from under 1 year old to 65 years old. It was found that 151 males (or 11.1% of males examined) and 1 female suffered from ancylostomiasis. Of those males suffered from this disease, 134 (88.7%) were farmers.<sup>7</sup>

In 1912, Hou Chi-fa and Li Chin-fu presented another report with statistics compiled from the record of internal medicine of the Red Cross Taiwan Branch Hospital in 1906-1911.<sup>8</sup> Table 1 showed that during 1906-1911, the Red Cross Taiwan Branch Hospital had 1,587 patients suffered from ancylostomiasis; they counted for 8.8% of the total number of patients in the internal medicine, and 19.4% for those suffered with nutrition deficiency diseases. During these 6 years, the highest infection rate of Ad was found in 1919, it was 19.7% among patients of the internal medicine and 32.1% among patients of nutrition deficiency diseases.

Of the 1,587 patients, there were 1,516 Taiwanese and 71 Japanese; and among Taiwanese, there were 1,140 (75.2%) farmers and 118 (7.8%) laborers. These patients came mostly from the Taipei area, including 506 from Paichieh Pao 擺接堡, 345 from Tachiana Pao 大加蚋堡, 282 from Wenshan Pao 文山堡, 120 from Hsingchih Pao 興直堡, 48 from Palifen Pao 八里坌堡, 54 from Chihlanyi Pao 芝蘭一堡, 51

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Anti-mosquito—Anti-malaria Program in Colonial Taiwan,” *Taiwan Historical Research*, 11:2, pp. 185-222. Ku Ya-wen, 2005a, “The development and the epidemic of malaria in Taiwan during Japanese colonial period—the ‘bad environment’ built up,” *Shakai keizai shigaku* (Social Economic History), 70: 5, pp. 67-89. Ku Ya-wen, 2005b, *The transition of malaria epidemic and its control policy in Taiwan* (Yokohama: Ph.D. dissertation of division of international social sciences, Yokohama University, 2005/09). Liu Shi-yung, 2001, “GIS, Malaria and Highland Environment in Colonial Taiwan,” in *Proceedings of the International Workshop on Colonial Medicine*, (2001/10/25-26), Institute of Taiwan History, Academia Sinica.

<sup>7</sup> Wang Chen-chien, 1908, “On Ancylostomiasis in Taiwan,” *JFMA*, No. 69, pp. 289-308.

<sup>8</sup> Hou Chi-fa and Li Chin-fu, 1912, “Some statistics concerning Ancylostomiasis around Taipei,” *JFMA*, No. 114-115, pp. 357-366.



In addition, there were 92 from Taoyuan Ting 桃園廳, 6 from Hsinchu Ting 新竹廳, 6 from Taichung Ting 臺中廳, 2 from Chiayi Ting 嘉義廳, 1 from Taitung Ting 臺東廳 and 1 from Yilan Ting 宜蘭廳. In general, there were more patients came from places nearby Taipei city and the number declined with the distance. However, because the majority of the patients suffered from ancylostomiasis were farmers and those living far away would not come to the hospital unless they were ill seriously, therefore, the above statistics might not reflect the true situation of geographical distribution of hookworm infection.<sup>9</sup>

Moreover, this report also pointed out that, together with ancylostomiasis, there were 609 patients suffered from ascariasis, 77 chronic splenomegalia, 48 gastrointestinal catarrh, 14 bronchial catarrh, 10 malaria, 7 enterobiasis, 4 beriberi, 3 pleurisy, 2 epilepsy, and 1 each paragonimiasis, cirrhosis of liver, tuberculosis, and nephritis. It was pointed out that as quite a number of patients suffered both from chronic splenomegalia and ancylostomiasis, there was a coexistence of malaria and ancylostomiasis in rural area of Taiwan.<sup>10</sup>

There are three reports concerning patients of Taichung 臺中 Hospital established by the Taiwan Government-general. In 1915, Ooi conducted stool examinations with in-patients, of them 41 Taiwanese and 80 Japanese. The Taiwanese patients came from Taichung Ting and Nantou Ting; among them 31 (75.6%) were from Taichung, 2 each from Hulutun 葫蘆墩 and Nantou 南投, and 1 each from Changhua 彰化, Shalu 沙轆, Erlin 二林, Peitou 北斗, Lukang 鹿港, and Wushe 霧社. Their families were mostly belonging to middle class and above.<sup>11</sup> In Ooi's 1919 report, there were results of examinations with 120 Taiwanese in-patients and out-patients after 1916.<sup>12</sup> Furuichi's report in 1919 showed the result of examinations with in-patients, of them 130 Japanese and 44 Taiwanese, but it was not clear where did these Taiwanese patients come from.<sup>13</sup>

For the patients of Taipei Hospital, Yamasaki Shigeru presented a report in 1925 concerning the result of examinations from October 6, 1924 to October 5, 1925 with 555 Japanese out-patients.<sup>14</sup> For the patients of Hualienkang 花蓮港 Hospital, Ooi presented in 1927 the result of examinations conducted from November 1924 to

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<sup>9</sup> Hou Chi-fa and Li Chin-fu, 1912, pp. 361-363. It should be noted that this paper adopts the Wade-Giles system (with omission of phonetic symbols) for spelling place names in Taiwan to avoid making many differences with those currently in use.

<sup>10</sup> Hou Chi-fa and Li Chin-fu, 1912, pp. 363-364.

<sup>11</sup> Ooi Tsukasa, 1915, "An investigation of intestinal parasites in Middle Taiwan," *JFMA*, No. 154, pp. 816-825.

<sup>12</sup> Ooi Tsukasa, 1919, "On the infection of *Clonorchis sinensis* among Taiwanese, with a supplement on the second host of *Clonorchis sinensis*," *JFMA*, No. 195-196, pp. 107-117.

<sup>13</sup> Furuichi Torakuma, 1919, "Some experiences about intestinal parasitosis," *JFMA*, No. 195-196, pp. 117-131.

<sup>14</sup> Yamazaki Shigeru, 1925, "An investigation of human intestinal parasites in Taipei area with an emphasis on *Clonorchis sinensis*," *JFMA*, No. 249, pp. 1129-1135.

November 1926 with 220 out-patients. Ooi identified these patients as inhabitants around Hualienkang; it was possible that most of them were Taiwanese.<sup>15</sup>

Table 2 shows parasitic infections among patients of different hospitals. In 1915 and 1919, the highest infection rate among in-patients of Taichung Hospital was with Tt, Taiwanese had 92.7% and 70.5% and Japanese had 82.5% and 71.5% respectively. The infection rates of Al among Taiwanese were 65.9% and 38.6% and among Japanese 60.0% and 54.6% respectively. The infection rates of Ad among Taiwanese were 43.9% and 43.2% and among Japanese 35.0% and 40.0% respectively. The infection rates of *Necator americanus* (Na) among Taiwanese were 12.2% and 6.8% and among Japanese 15.0% and 6.2% respectively. The two species of hookworm together made the infection rates of 56.1% and 50.0% for Taiwanese and 50.0% and 46.2% for Japanese respectively.

Table 2: Parasitic Infections among Patients in Hospitals, 1915-1929 ( % in parenthesis)

Hospital	Taichung		Taichung	Taichung		Taipei	Hualienkang
Year	1915		1916	1919		1924-25	1924-26
Patients	Taiwanese	Japanese	Taiwanese	Taiwanese	Japanese	Japanese	Inhabitants
No. Examined	41	80	120	44	130	555	230
No. Infected	--	--	118 (98.3)	38 (86.4)	120 (92.3)	394 (71.0)	216 (93.9)
Al ( <i>Ascaris lumbricoides</i> )	27 (65.9)	48 (60.0)	88 (73.0)	17 (38.6)	70 (53.8)	194 (35.0)	97 (42.7)
Tt ( <i>Trichuris trichiura</i> )	38 (92.7)	66 (82.5)	106 (90.0)	31 (70.5)	93 (71.5)	259 (46.7)	115 (50.0)
Ev ( <i>Enterobius vermicularis</i> )	0	3 (3.8)	3 (2.4)	1 (2.3)	6 (4.6)	16 (2.9)	2 (0.9)
Ad ( <i>Ancylostoma duodenale</i> )	18 (43.9)	28 (35.0)	67 (56.0)	19 (43.2)	52 (40.0)	72 (13.0)*	56 (24.3)*
Na ( <i>Necator americanus</i> )	5 (12.2)	12 (15.0)	29 (24.0)	3 (6.8)	8 (6.2)		
Ss ( <i>Strongyloides stercoralis</i> )	0	2 (2.5)	6 (5.0)	0	0	5 (0.9)	0
To ( <i>Trichostrongylus orientalis</i> )	2 (4.9)	8 (10.0)	6 (5.0)	2 (4.5)	5 (3.8)	7 (1.3)	4 (1.7)
<i>Heterophyes</i>	1 (2.4)	16 (20.0)	2 (1.6)	2 (4.5)	10 (7.7)	39 (7.0)	2 (0.9)
Cs ( <i>Clonorchis sinensis</i> )	3 (7.3)	32 (40.0)	6 (5.0)	4 (9.1)	38 (29.2)	59 (10.6)	7 (3.0)
Tae ( <i>Cestodea, Taenia</i> sp.)	0	2 (2.5)	0	0	1 (0.8)	0	2 (0.9)
Unspecified	0	1 (1.3)	0	0	0	4 (0.7)	0

\*A combination of *Ancylostoma duodenale* (Ad) and *Necator americanuse* (Na).

Source: Ooi Tsukasa, 1915, pp. 820-821, Tables 2 and 3. Ooi Tsukasa, 1919, p. 109, Table 3. Furuichi Torakuma, 1919, p. 119, Table 3 (Errors of percentages in the original table had been corrected). Yamazaki Shigeru, 1925, pp. 1130-1131, Table 1. Ooi Tsukasa, 1927, p. 230, Table 2.

Regarding the high infection rate of hookworm, Ooi pointed out that the

<sup>15</sup> Ooi Tsukasa, 1927, "Some statistical observations on the parasitic infections among residents of colonist villages in eastern Taiwan with a particular emphasis on *Ancylostoma duodenale* and *Ancylostomiasis*," *JFMA*, No. 263, pp. 224-239.

infection was usually through skin and the majority among Taiwanese patients was farmers and laborers, it was easy for them to become infected because they used to work barefoot.<sup>16</sup> Furuichi also noted with a similar observation.<sup>17</sup> It should be noted that the infection rate of hookworm among patients at Taichung Hospital can be a cross reference with the estimate of James Maxwell (1836-1921). Maxwell considered the two species of hookworm together and estimated that nearly 40% of inhabitants in Taiwan harbored the parasite. He also said that the ordinary channel of infection was through the unbroken skin of legs and feet, and depended almost entirely on the use of night soil as a fertilizer in agriculture. At places where vegetable and flower gardening were predominant the infestation rate was 90%.<sup>18</sup>

In addition, in 1915 the infection rate of *Trichostrongylus orientalis* (To) among Japanese was 10% and among Taiwanese 4.9%; but in 1919, the rate was 3.8% among Japanese and 4.5% among Taiwanese. The infection rate of *Metagonimus* & *Heterophyes* in 1915 was 20% among Japanese but only 2.4% among Taiwanese; and in 1919, Japanese had 7.7% and Taiwanese 4.5%. As for pinworm (*Enterobius vermicularis*, Ev), *Strongyloides stercoralis* (Ss) and tapeworm (*Cestoidea*, Tae), only a few Japanese and none Taiwanese patients were infected in 1915, but in 1919 one Taiwanese was infected with pinworm.

In 1916, the parasitic infection rate of Taiwanese in- and out-patients at Taichung Hospital was as high as 98.3%. Among various parasites, the highest infection rate was 90% counted for Tt, followed by 80% for Ad and 73% for Al. Moreover, the infection rates of Ss, To, and *Clonorchis sinensis* (Cs) were all 5%; the rate of pinworm (Ev) was 2.4% and that of *Metagonimus* & *Heterophyes* 1.6%.

It is notable that the infection rate of Cs was 40% among Japanese and 7.3% among Taiwanese in 1915, while in 1919 Japanese had 29.2% and Taiwanese had 9.1%. Regarding the infection rate of Cs, Ooi pointed out that the rate among Japanese was much higher than among Taiwanese, but the later had gradually been influenced by Japanese culture and there were more opportunities to eat Japanese food and thus got infected.<sup>19</sup> Furuichi also noted that Taiwanese had gradually adopted the habit of eating raw fish and this was related to the infection of this parasite.<sup>20</sup> Moreover, Ooi discovered that among Taiwanese patients he examined in 1916, one came from Yuanlin 員林. In order to understand the fact thoroughly, Ooi asked the Police Office to assist investigating at every district. He summarized reports gathered from various districts and said, "After inquiring, it is known that at Yuanlin and Peitou

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<sup>16</sup> Ooi Tsukasa, 1915, p. 824.

<sup>17</sup> Furuichi Torakuma, 1919, p. 121.

<sup>18</sup> James Maxwell, 1929, *The Disease of China, including Formosa and Korea*, second edition (Shanghai: A. B. C. Press), pp. 180, 182.

<sup>19</sup> Ooi Tsukasa, 1915, p. 825.

<sup>20</sup> Furuichi Torakuma, 1919, p. 121.

districts the inhabitants used to eat raw fish since the old days. The patient himself often prepared a dish called ‘yu-sheng’ with slices of raw ‘grass fish’ (Chinese ide, *Ctenopharyngodon idellus*) and thus the larva of the fluke could enter easily into human body. Besides, it is particularly notable that food of the Japanese style such as sliced raw fish (*sashimi*) was gradually popularized among Taiwanese and thus also increased the opportunity of infection.”<sup>21</sup>

Compared with Japanese patients at Taichung Hospital, those at Taipei Hospital were also infected mostly with Tt, less with Al and further less with Ad, but with lower rates at 46.5%, 35.0%, and 13.0% respectively. Also, the infection rate of Cs among Japanese patients at Taipei Hospital was 10.6%, lower than 40.0% and 29.2% at Taichung. Yamasaki pointed out that except for 5 among the 59 Japanese infected with Cs, these patients all resided in Taipei city at that time.<sup>22</sup> As for patients at Hualienkang Hospital, Table 2 shows that the total infection rate was 93.9% and the infection rates of various parasites were somewhat lower than those at Taichung and Taipei Hospital.

Another report concerning patients of hospital was presented by Muto in 1941. This report showed the result of stool examinations with infants and children hospitalized in Muto Children’s Hospital in 1938-1939.<sup>23</sup> During these two years, stool examinations were conducted with 1,434 patients aged 1-15, of them 990 were Japanese and 444 Taiwanese. Table 3 shows that the total infection rate among Japanese children was 13.7% and among Taiwanese children 35.1%. With specific parasite, the infection rate of Al Taiwanese was 88.5%, of Tt 31.4% and of Ad 1.3%, all higher than those among Japanese, 66.2%, 20.6% and 0.7% respectively. However, the infection rate of Ev among Japanese was 12.5% which was much higher than 1.9% accounted for Taiwanese. Moreover, one Japanese child, but no Taiwanese, was infected with *Metagonimus yokogawai* (My). Muto did not specified the species of parasites for those multiple infections, but it was clear that Japanese infected with 2 species accounted for 7.4%, while Taiwanese infected with 2 to 3 species accounted for 24.3%.

Muto also tried to illustrate the relation between living standard and parasitic infection. He found that among Japanese, the infection rate of children from the upper class family was 15.2%, from the middle class family 13.3% and from the lower class family 28.2%; and among Taiwanese, the rates were 37.1%, 25.7%, and 70.8% respectively; similarly, the lowest rate was found with the middle class family and the highest rate with the lower class family. From the point of view of location, Muto

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<sup>21</sup> Ooi Tsukasa, 1919, pp. 111-113.

<sup>22</sup> Yamasaki Shigeru, 1925, p. 1132.

<sup>23</sup> Muto Sangoro, 1941, “On the results of a faecal examination of patients in Muto Children’s Hospital during the last 2 Years,” *JFMA*, No. 432, pp. 490-500.



divided the area into three parts: Taipei city center, near center and outside the city. The infection rates of Japanese were 11.8%, 15.6% and 34.5% and those of Taiwanese were 26.7%, 33.9% and 47.5% respectively. In other words, the lowest rate was found in the city center and the highest rate outside the city.<sup>24</sup> Moreover, Muto pointed out that because Taiwanese did not eat raw food, infections of roundworm and whipworm were due less from food directly, but rather from unclean hands due to contacting with polluted soil.<sup>25</sup>

Table 3: Parasitic Infection Rates among Patients of Muto Children's Hospital, Taipei, 1938-1939 (% in parenthesis)

Examinee	Japanese			Taiwanese		
	Male	Female	Total	Male	Female	Total
No. Examined	561	429	990	316	128	444
No. Infected	75(13.4)	61(14.2)	136(13.7)	112(35.4)	44(34.4)	156(35.1)
Al ( <i>Ascaris lumbricoides</i> )	52(69.3)	38(92.3)	90(66.2)	102(91.1)	36(81.8)	138(88.5)
Tt ( <i>Trichuris trichiura</i> )	14(18.7)	14(23.0)	28(20.6)	35(31.3)	14(31.8)	49(31.4)
Ev ( <i>Enterobius vermicularis</i> )	7(9.3)	10(16.4)	17(12.5)	3 (2.7)	0	3 (1.9)
Ad ( <i>Ancylostoma duodenale</i> )	1(1.3)	0	1(0.7)	0	2 (4.5)	2 (1.3)
My ( <i>Metagonimus yokogawai</i> )	0	1 (1.0)	1(0.7)	0	0	0
1 species	68(90.6)	52(85.2)	120(88.2)	85(75.9)	29(65.9)	114(73.1)
2 species	4(5.3)	6 (9.8)	10 (7.4)	22(19.6)	12(27.3)	34(22.4)
3 species	0	0	0	2 (1.8)	1 (2.3)	3 (1.9)

Source: Muto Sangoro, 1941, pp. 491-492, Tables 1 and 2.

There are two reports concerning the infection of parasitic protozoa. The first one presented by Kodama Tarou of the Health Department of Central Research Institute in 1924 included both in- and out-patients, 27 Taiwanese and 27 Japanese, at Taipei Hospital and Hakuai Hospital.<sup>26</sup> The second one, by Namikawa Hiroshi of Taipei Hospital, included 250 in-patients of internal medicine in 1931.<sup>27</sup>

As shown in Table 4, among patients of Taipei Hospital in 1924 and 1931, infection rates of *Entamoeba histolytica* (Eh) were 3.7% and 3.6% and those of *Entamoeba coli* (Ec) both 9.2%. But in 1931, the infection rates of Taiwanese (Eh 4.5%, Ec 11.3%) were higher than those of Japanese (Eh 3.1%, Ec 8.0%). In addition, the infection rate of *Endolimax nana* (En) was higher in 1931 but that of *Iodamoeba bütschlii* (Ib) was higher in 1924.

It should be noted that these two reports are relatively brief. There was no differentiation between Taiwanese and Japanese in the first report and in the second one, differentiations were only available in Eh and Ec. However, Kotama pointed out

<sup>24</sup> Muto Sangoro, 1941, p. 494.

<sup>25</sup> Muto Sangoro, 1941, p. 496.

<sup>26</sup> Kodama Tarou, 1924, "On carriers of amoebic cysts in Taipei (a brief report)," *JFMA*, No. 236, pp. 393-395.

<sup>27</sup> Namikawa Hiroshi, 1931, "On parasitic protozoa in human intestines in Taiwan," *JFMA*, No. 321, p. 1496.

in his 1924 report that the two persons infected with Eh were both Taiwanese. One of them suffered from disease like dysentery in the summer in the past two to three years and a large number of cysts were discovered from the examination; the other person only found one cyst and it was not clear whether he suffered from amoebic dysentery before.<sup>28</sup> Namikawa pointed out that Taiwanese had a higher rate of infections with the *Entamoeba* group (Eh and Ec), but Japanese had higher rates with the other 5 species of protozoa.<sup>29</sup>

Table 4: The Infection of Protozoa among Patients of Taipei Hospital, 1924 and 1931  
(% in parenthesis)

Year	1924*	1931		
Examinee	Total	Total	Taiwanese	Japanese
Number examined	54	250		
Eh ( <i>Entamoeba histolytica</i> )	2(3.7)	(3.6)	(4.5)	(3.1)
Ec ( <i>Entamoeba coli</i> )	5(9.2)	(9.2)	(11.3)	(8.0)
En ( <i>Endolimax nana</i> )	3(5.5)	(8.0)		
Ib ( <i>Iodamoeba bütschlii</i> )	2(3.7)	(2.8)		
Df ( <i>Dientamoeba fragilis</i> )	0	(1.6)		
Gl ( <i>Giardia lamblia</i> )	0	(1.2)		
Tricho ( <i>Trichomonas hominis</i> )	0	(0.4)		

\*Including Hakuai Hospital.

Source: Kodama Tarou, 1924, pp. 393-395; Namikawa Hiroshi, 1931, p. 1496.

## 2. Prisoners

The parasitic infection rates of prisoners appeared first in Ooi's report in 1915. In that report, Ooi examined 120 prisoners in Taichung Prison. These prisoners lived originally in the following places: 88 in Taichung Ting (including 42 Taichung, 1 Hulutun, 12 Changhua, 1 Yuanlin, 8 Shalu, 2 Erlin, 7 Peitou 北斗, 5 Lukang, 1 Tachia 大甲, and 6 in Tungshihchiao 東勢角, 15 in Nantou Ting (including 8 Nantou, 3 Tsaohsiehtun 草鞋墩, and 4 Pulishe 埔里社, 2 in Taipei, 4 in Hsinchu 新竹, 7 in Taoyuan 桃園, 3 in Chiayi 嘉義, and 1 in Tainan 臺南. Most of them were laborers.<sup>30</sup>

Another report was presented by Oono Ryouya in 1918. There were two groups of prisoners under examination. The first group consisted of 300 prisoners (of which 4 females) captured during the event of rebels (probably the Silaian 西來庵 event) in the south in 1915 and they were transferred from Tainan to Taipei Prison. Most of these prisoners suffered with scabies and eczema, or had edemata on the face and limbs, and apparently had symptoms of nutrition deficiency. They were sent directly to the health department of the prison. The Taiwan Government-general's Medical School conducted stool examinations with all of them in order to check the level of

<sup>28</sup> Kodama Tarou, 1924, p. 395.

<sup>29</sup> Namigawa Hiroshi, 1931, p. 1496.

<sup>30</sup> Ooi Tsukasa, 1915, pp. 819-820, 823.

hookworm infection. These prisoners came mostly from hillside villages in Tainan Ting and Akou Ting (阿猴廳, today's Pingtung). The youngest of them was 18 years old and the oldest 69. Among them 283 were farmers. The result of examinations showed that 271 (90.3% of the total) were infected with hookworm; and among them 255 were farmers (90.1% of the farmers). The second group was 916 ordinary prisoners at Taipei Prison; the stool examinations were conducted among them in 1916-1917.<sup>31</sup>

Table 5 lists the parasitic infection rates of prisoners. In 1915-1917, the infection rates of Al among Taiwanese at Taichung and Taipei Prisons were about the same, 65.8% and 66.4% respectively. These rates were higher than 45.4% found among Japanese at Taipei Prison. The infection rate of Tt among Taiwanese at Taichung Prison was 100%, but in Taipei Prison, the rates of Taiwanese and Japanese were rather close to each other, 66.1% and 67 % respectively. As for the infection rate of Ad, it was 73.3% for Taiwanese at Taichung Prison, higher than 59.3% for Taiwanese and 36.1% for Japanese at Taipei Prison.

Table 5: The Parasitic Infections of Prisoners in Taichung and Taipei Prisons

1915-1917		(% in parenthesis)				
Place of Prison	Taichung 1915	Taipei 1916-1917				
Prisoner	Taiwanese	Taiwanese				Japanese
		Male	Female	Youngster*	Total	
No. Examined	120	684	50	85	819	97
No. Infected	120 (100)	627(91.7)	48(96.0)	83 (97.6)	758(92.6)	86(88.6)
Al ( <i>Ascaris lumbricoides</i> )	79 (65.8)	430(62.8)	42(84.0)	72 (84.7)	544(66.4)	44(45.4)
Tt ( <i>Trichuris trichiura</i> )	120 (100)	434(63.4)	39(78.0)	69(81.1)	542(66.1)	65(67.0)
Ad ( <i>Ancylostoma duodenale</i> )	79 (73.3)	403(58.9)	36(72.0)	47(55.3)	486(59.3)	35(36.1)
Ad, Al and Tt		196(24.7)	25(50.0)	32(37.6)	253(30.9)	12(12.4)
Ad and Al		68 ( 9.9)	6(12.0)	8( 9.4)	82(10.0)	4( 4.1)
Ad and Tt		71(10.4)	4( 8.0)	5( 5.9)	80 ( 9.8)	9 ( 9.3)
Al and Tt		109(15.9)	9(18.0)	28(32.9)	146(17.8)	21 (21.6)
Ad only		68 ( 9.9)	1( 2.0)	2( 2.4)	71 ( 8.7)	10 (10.3)
Al only		57 ( 8.3)	2( 4.0)	4( 4.7)	63 ( 7.7)	7( 7.2)
Tt only		58 ( 8.5)	1( 2.0)	4( 4.7)	63 ( 7.7)	23(23.7)

\*Youngsters aged 14-18.

Source: Ooi Tsukasa, 1915, p. 820, Table 2; Oono Ryouya, 1918, pp. 112-113, data in three tables.

There was no statistics concerning single or multiple infections in Ooi's report, but Oono's report showed that both Taiwanese and Japanese prisoners at Taipei Prison had rather high rates of multiple infections. Those infected simultaneously with Ad, Al and Tt accounted for 30.9% among Taiwanese and 12.4% among Japanese. Those infected with Al and Tt accounted for 17.8% among Taiwanese and 21.6% among

<sup>31</sup> Oono Ryouya, 1918, "On the infection of *Ancylostoma duodenale* among prisoners at Taipei Prison with an appendix of survey on *Ascaris lumbricoides* and *Trichuris trichiura*," *JFMA*, No. 182-183, pp. 109-113.

Japanese. In the case of single infection, the infection rate of Tt among Japanese was 23.7%, much higher than 7.7% among Taiwanese. In addition, in Ooi's report, there were infection rates of other parasites: To 3.3%, Ev 1.7%, Ss 1.7%, Cs 1.7%, and unspecified parasites 1.7%, but these species were not included in Oono's report.

As for the infection with protozoa among prisoners, there was a report by Namikawa Hiroshi in 1936 with examinations of 429 male prisoners in Tainan Prison, including 23 Japanese, 1 Korean, and 405 Taiwanese. These Taiwanese came mostly from Tainan and Kaohsiung 高雄 prefectures. Their ages were from 20 to 57; 77% of them aged 20-40 and 21% aged above 40. The results showed that the infection rates were in the order of Eh 18%, En 14.1%, Gl 9%, Ec 6.25%, Ib 5.6%, and Df and Tricho only 0.65%. Moreover, Namikawa pointed out that among 181 prisoners infected with protozoa, there were 29 double infections, 8 triple infections, and 2 quadruple infections, altogether 39 cases (22%) were multiple infections.<sup>32</sup>

### 3. Soldiers

There were two reports concerning parasitic infection of soldiers, the one by Ikeda Zenzou in 1918 and the other by Kan Yoshio in 1934. These two reports had different focal points and difficult to compare, here only their main points are mentioned for reference.

Ikeda Zenzou conducted stool examinations with 321 soldiers newly enlisted in December 1916 to Taichung military station and the focal point was *Ancylostoma duodenale*. The results showed that the total infection rate of Ad was 15.9% and the infection rate varied among seven regiments. The Tsu 津 regiment had no soldier infected while the Kumamoto 熊本 regiment had 26.3% with the rates of other 5 regiments in between, Hachidai 八代 21.9%, Tojo 都城 20.4%, Hamamatsu 濱松 19.6%, Gifu 岐阜 13.6% and Nagoya 名古屋 5.6%. In addition, this report also mentioned that the infection rate of Ev was 12.5%, of Tt 21.18% and of Al 65.73%. These 321 soldiers were recruited from Japan and those infected with hookworm came mostly from Kyushu 九州 area.<sup>33</sup>

Kan Yoshio conducted examinations from April to November 1933 with 40 officers and soldiers at the Wireless Telegraph Station of Navy at Fengshan 鳳山 and the focal point was intestinal protozoa. These officers and soldiers were young men aged 20-30. The results found 5 persons (12.5%) were infected with Ec, 10 (25.0%) with En, 4 (10.0%) with Ib, and 2 (5.0%) with Gl.<sup>34</sup>

<sup>32</sup> Namikawa Hiroshi, 1936, "On human intestinal protozoa in Tainan, Formosa (An observation on the prisoners in Tainan)," *JFMA*, No. 381, pp. 2817-2819.

<sup>33</sup> Ikeda Zenzou, 1918, "On the infection of *Ancylostoma duodenale* among Japanese soldiers at military stations," *JFMA*, No. 182-183, pp. 107-109.

<sup>34</sup> Kan Yoshio, 1934, "The results of examinations on intestinal protozoa in southern Taiwan," *JFMA*, No. 350, pp. 823-831.

#### 4. Students

There were more reports concerning parasitic infections among students than the above three categories. In below the students will be discussed by classifying into elementary, middle, and vocational schools.

##### 4.1 Elementary School Children

Under the Japanese colonial rule, elementary schools in Taiwan were divided into two groups: the one for Japanese children and the other for Taiwanese children.<sup>35</sup> There were six reports concerning parasitic infection among school children; most of them dealt with Taiwanese but some of them also dealt with Japanese children.

Tanaka Seigo and Chen Tu-chin conducted stool examinations with both Japanese and Taiwanese school children in Yilan 宜蘭 in 1922. There were 303 Japanese (143 males and 160 females) and 1,296 Taiwanese (988 males and 308 females) received examinations.<sup>36</sup> Ooi Tsukasa undertook examinations from October to December 1925 with 168 Taiwanese school children at Hualienkang, and from February to May 1926 with 242 Japanese children at Yoshino Village.<sup>37</sup> Yokogawa Sadamu and Wakejima Osamu conducted examinations, from April 1929 to January 1931, with 1,820 Taiwanese children at 5 schools in Taipei prefecture, including 463 at Lungshan 龍山, 332 at Nankang 南港, 270 at Shihpai 石牌, 611 at Peitou 北投, and 139 at Kuantu 關渡.<sup>38</sup> Kan Yoshio undertook examinations in 1934 with 156 Taiwanese school children at Fengshan for the infection of protozoa.<sup>39</sup> Narihara Norio et al. undertook examinations, from October 1936 to February 1937, with 971 Japanese children at Shou (Su壽) elementary school and 1,363 Taiwanese children at Laosung 老松 elementary school located at the same district in Taipei city.<sup>40</sup> In July-August, 1939, Loo Wan-teh conducted examinations at Shihpai elementary school with 354 children for both helminth and protozoa; these children took santonin for expelling roundworm a month before.<sup>41</sup> Lastly, in 1943, Huang

<sup>35</sup> For establishment of Taiwanese elementary school, see Pei-hsuen Hsu, 2005, *Modern School of Colonial Taiwan* (Taipei: Yuanliu Publishing Company).

<sup>36</sup> Tanaka Seigo and Chen Tu-chin, 1922, "The results of examinations on intestinal parasites among Japanese and Taiwanese elementary school children in Yilan," *JFMA*, No. 225, pp. 641-642. Also see a report by *Taiwan Nichi Nichi Shinho*, 1922/06/11/3.

<sup>37</sup> Ooi Tsukasa, 1927, pp. 225-226.

<sup>38</sup> Yokogawa Sadamu and Wakejima Osamu, 1932, "A survey on parasitic infections among Taiwanese elementary school children especially with medical and biological observations of *Ascaris lumbricoides*," *JFMA*, No. 326, pp. 552-570 ; No. 327, pp. 654-687.

<sup>39</sup> Kan Yoshio, 1934, pp. 823-824.

<sup>40</sup> Narihara Norio, Yumoto Yoshika, Osaka Kiyoshi and Maeda Toshinori, 1938, "Intestinal Parasitic Infections of Japanese and Formosan Chinese Children in Taihoku (Taipei) City," *JFMA*, No. 403, pp. 1581-1606.

<sup>41</sup> Loo Wan-teh, 1940, "On the Results of a Facal Examination of Sekihai Elementary School Children in Hokuto District, Sitisei County, Taihoku Prefecture and the Efficacy of Santonin on Ascariasis," *JFMA*, No. 429, pp. 1975-1984.

Teng-yun conducted examinations with 85 students of agricultural school at Wantan 萬丹 and 3,610 children at 7 elementary schools in Tungkan 東港 district, including 565 at Shepi 社皮, 682 at Wantan, 242 at Hsinchuangtsu 新庄子, 390 at Hsinyuan 新園, 474 at Wulung 烏龍, 917 at Tungkan, and 255 at Liuchiu 琉球. It should be noted that Huang's statistics included the agricultural school students as there was no separate figures for them.<sup>42</sup>

Some of the aforementioned reports concentrated either with helminth or with protozoa, but some included both. Here, the statistics of helminth are listed in Table 6 and those of protozoa in Table 7.

Table 6 shows that in the cases in which both Japanese and Taiwanese children were examined, the infection rates among Taiwanese school children were higher than those among Japanese. In the case of Al infection, in 1922 in Yilan, Taiwanese had 93.8% infected while Japanese had 58.1%; in 1927 in Hualienkang, Taiwanese had 88.1% infected while Japanese had 87.2%; in 1938 in Taipei City, Taiwanese had 53.6% infected while Japanese had 22.6%. In the case of Tt, Taiwanese had 48.8%, 82.7% and 37.8% in the three years (places), while Japanese had 16.2%, 84.8% and 22.1% respectively. In the case of hookworm, Taiwanese had 8.3%, 51.8% and 2.2%, while Japanese had 3.6%, 29.6% and 1.0% respectively. Besides, the Taiwanese children at Hualienkang had 2.4% infected with To. As for the infection rates of Ev, lung fluke (*Paragonimus westermani*, Pw), *Metagonimus yokogawai* (My), *Hymenolepis diminuta* (Hd), and *Hymenolepis nana* (Hn), both Taiwanese and Japanese had rather low infection rate, mostly below 1%.

As for the cases in which only Taiwanese children were examined, in 1929-1931, the infection rates of Al among children at 5 schools in Taipei area ranged from 79.2% to 98.5%, while in 1939 the children at Shihpai had 80.7% and in 1943 the children at Tungkan had 93.5%, both within the range. It is notable that the Al infection rate of Shihpai school children reduced from 98.5% to 80.7% in about 10 years reflecting possibly the effect of taking expellant. In the case of Tt, the infection rates among children of 5 schools ranged from 60.2% to 93.2%, while the children at Shihpai had 72.6% and at Tungkan 91.4%, also within the range. However, the average infection rate of Ad among children of 5 schools in Taipei area was 41.1%, with the rate at each school varied as follows: Lungshan 6.4%, Peitou 26.9%, Kuantu 51.5%, shihpei 53.4% and Nankang 70.0%; except for Lungshan, these rates were much higher than 8.3% at Yilan and 8.1% at Tungkan. Comparatively, children of Laosung elementary school in Taipei City had only 2.2%. Yokogawa and Wakajima had specified the locations of these 5 elementary schools: Lungshan was located at a

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<sup>42</sup> Huang Teng-yun, 1943, "The results of stool examinations among elementary school children and agricultural school students in Tungkan district," *JFMA*, No. 454, p. 88.

zone where the health condition and living standard were comparatively lower than other zones in Taipei City, Nankang, Shihpai and Kuantu all located at Chihsing (七星) district where people engaged mostly in agriculture. Thus, it was clear that the rate was higher among those living in the rural area than those in the town area.<sup>43</sup> Moreover, in Taipei area there were a few children infected with lung fluke which was not found among children at other places.

Table 6: Infections of Helminth among School Children, 1922-1943 (% in parenthesis)

Author	Tanaka et al.		Ooi		Narihara et al.	
Time	1922		1927		1936-1937	
Place	Yilan		Hualienkang		Taipei City	
School	Japanese	Taiwanese	Japanese	Taiwanese	Shou (J)	Laosung (T)
No. Exam.	303	1296	243	168	971	1363
Al ( <i>Ascaris lumbricoides</i> )	176(58.1)	1216(93.8)	212 (87.2)	148 (88.1)	216 (22.3)	730 (53.6)
Tt ( <i>Trichuris trichiura</i> )	49 (16.2)	633 (48.8)	206 (84.8)	139 (82.7)	215 (22.1)	515 (37.8)
Ad ( <i>Ancylostoma duodenale</i> )	11 (3.6)	108 (8.3)	72(29.6)	87 (51.8)	10 (1.0)	30 (2.2)
Ev ( <i>Enterobius vermicularis</i> )	--	--	--	2 (1.2)	16 (1.7)	21(1.5)
Pw ( <i>Paragonimus westermani</i> )	--	--	--	--	1 (0.1)	2 (0.2)
To ( <i>Trichostrongylus orientalis</i> )	--	--	--	4 (2.4)	--	--
My ( <i>Metagonimus yokogawa</i> )	--	--	--	1 (0.6)	2 (0.2)	--
Hd ( <i>Hymenolepis diminuta</i> )	--	--	--	--	1 (0.1)	--
Hn	--	--	--	--	--	1 (0.1)

Author	Yokogawa et al.					Loo	Huang
Time	1929-1931					1939	1943**
Place	Taipei	Neihu	Peitou			Peitou	Tungkang
School	Lungshan	Nankang	Peitou	Kuantu	Shihpai	Shihpai	7 Schools
No. Examined.*	468	332	611	139	270	354	3610
Al ( <i>Ascaris lumbricoides</i> )	379 (81.0)	263 (79.2)	566 (92.6)	132 (95.0)	266 (98.5)	308 (87.0)	3376 (93.5)
Tt ( <i>Trichuris trichiura</i> )	103/171 (60.2)	198/317 (62.5)	464/561 (82.5)	124/134 (92.5)	219/234 (93.6)	257 (72.6)	3298 (91.4)
Ad ( <i>Ancylostoma duodenale</i> )	10/157 (6.4)	222/317 (70.0)	151/561 (26.9)	69/134 (51.5)	125/234 (53.4)	71 (20.1)	292 (8.1)
Ev ( <i>Enterobius vermicularis</i> )	1/157 (0.6)	1/317 (0.3)	4/561 (0.7)	0	1/234 (0.4)	--	19 (0.5)
Pw ( <i>Paragonimus westermani</i> )	--	4/317 (1.3)	--	--	1/234 (0.4)	1 (0.3)	--
My ( <i>Metagonimus yokogawa</i> )	--	--	--	--	--	--	23 (0.6)
Hd ( <i>Hymenolepis diminuta</i> )	--	--	1/561 (0.2)	--	--	--	--

\* In Yokogawa et al., this number was only for roundworm; for other parasites, the No. examined is listed under each item.

\*\* In Huang Teng-yun's report, there was no number of persons infected. The numbers listed here and are calculated with the number of persons examined and the reported infection rates.

Source: Tanaka Seigo and Chen Tu-chin, 1922, p. 642, Table 5; Ooi Tsukasa, 1927, pp. 229-230, Tables 1 and 2; Yokogawa Sadamu and Wakejima Osamu, 1932, p. 677, Table 56; Loo Wan-teh, 1940, p. 1977, Table 3; Narihara Norio, Yumoto Yoshika, Osaka Kiyoshi and Maeda Toshinori, 1938, p. 1589, Table 6; Huang Teng-yun, 1943, p. 88.

<sup>43</sup> Yokogawa Sadamu and Wakejima Osamu, 1932, pp. 24-25, 677-678.

In addition to cases listed in Table 6, the Education Department of Taichung Prefecture conducted examinations with children at 19 Japanese and Taiwanese elementary schools in 1928. The results showed that except for 2 Japanese elementary schools at Wushe and Nantou, 3 Taiwanese schools for girls Chiaoli 腳里, Tucheng 塗城, and Lukang, and 1 Taiwanese school for boys at Chunkungliao 軍功寮, children at the other 13 schools were 100% infected by parasites. Even 4 to 5 species were found for individual child. The Japanese school children had small fractions infected with Al and Ad, but they were 100% infected with Tt. The Taiwanese school children were infected mostly with Al, Ad, and Tt. Moreover, a few Taiwanese children were infected with Ss, but none Japanese child did. The infection rate of Tt among Taiwanese children at most schools was 60-70%, but only a few children at Lukang girls' school were infected; the reason was due to usage of well water.<sup>44</sup> In Tainan prefecture, comprehensive examinations of parasites with school children began in 1927. The first round included 17,000 school children at one part of Chiayi district and Hsingfeng 新豐 district and it was found that the infection rates ranged from 71% to 100%. The most common parasites were roundworm, whipworm and hookworm. In early 1929, the second round was conducted at schools in Tungshih 東石, another part of Chiayi, Touliu 斗六, and Peimen 北門 districts involving 21,300 children.<sup>45</sup>

Table 7 showed that the protozoan infection rates among school children at Fengshan in 1934 were in the order of Ec 39.7%, Gl 30.1%, Ib 23.7%, Eh 18.6%, and En 14.1%, all higher than those found among children in Taipei area and at Tungkang.

Table 7: The Infections of Protozoa among School Children, 1934-1943 (% in Parenthesis)

Author	Kan	Narihara et al.		Loo	Huang
Time	1934	1936/10-1937/2		1939	1943
Place	Fengshan	Taipei City		Shihpai	Tungkang
School	Taiwanese	Japanese	Taiwanese	Taiwanese	7 Taiwanese
No. Examined	156	971	1363	354	3610
<i>Entamoeba histolytica</i>	29 (18.6)	12 ( 1.2)	75 (5.5)	9 (2.5)	312 ( 8.6)
<i>Entamoeba coli</i>	62 (39.7)	33 ( 3.4)	113 (8.3)	39 (11.0)	393 (10.9)
<i>Endolimax nana</i>	22 (14.1)	42 ( 4.3)	166 (12.2)	6 (1.7)	475 (13.2)
<i>Iodamoeba bütschlii</i>	37 (23.7)	3 ( 0.3)	11 (0.8)	--	65 (1.8)
<i>Dientamoeba fragilis</i>	0	0	0	--	27 (0.8)
<i>Giardia intestinalis</i>	47 (30.1)	102(10.5)	213 (15.6)	50 (14.1)	263 (7.3)
<i>Chilomastix mesnili</i>	1 ( 0.6)	0	0	2 (0.6)	24 (0.7)
<i>Trichomonas hominis</i>	0	0	6 ( 0.4)	--	66 (1.8)

Source: Kan Yoshio, 1934, p. 825, Table 2; Narihara Norio, Yumoto Yoshika, Osaka Kiyoshi and Maeda Toshinori, 1938, p. 1592, Table 9; Loo Wan-teh, 1940, p. 1977, Table 3; Huang Teng-yun, 1943, p. 88.

The children at Laosung had the rates of Gl 15.6% and En 12.2%, the children at Shihpei had the rates of Gl 14.1% and Ec 11.0%, and the children at Tungkang had

<sup>44</sup> *Taiwan Nichi Nichi Shinho*, 1928/07/21/4.

<sup>45</sup> *Taiwan Nichi Nichi Shinho*, 1929/01/05/1.



the rates of En 13.2% and Ec 10.9%, and all above 10%, reflecting that protozoan infection in Taiwan could no longer be ignored in the 1930s-1940s.

It is notable that multiple parasitic infections were frequently found among school children. Kan pointed out that of the 128 Taiwanese children at Fengshan elementary school, 70 (54.6%) had single infection, 48 (37.5%) double infection, 8 (6.3%) triple infection, and 2 (1.6%) quadruple infection.<sup>46</sup> Narihara et al. reported that among Japanese children, 32.3% had single infection, 7.6% had double infection and only one girl had triple infection. The cases of double infection were mostly found with Al and Tt. As for Taiwanese school children, 42.2% had single infection, 24.3% had double infection, 1.5% had triple infection and 0.07% (only 1 person) had quadruple infection. The cases of double infection were mostly with Al and Tt; those of triple infection mostly with Ad, Al and Tt.<sup>47</sup> As for the infection of protozoa, of the 173 Japanese school children, 157 (90.8%) had single infection and only 16 (9.2%) had double infection. Of the 494 Taiwanese school children, 413 (83.6%) had single infection and 81 (16.4%) had double infection. For both Taiwanese and Japanese, the double infection cases were most frequently found with Ec and En followed by infected with Ec and Gl. In addition, among Taiwanese, the frequency of Eh found among double infection was also quite notable.<sup>48</sup>

Loo Wan-teh calculated multiple infections of helminth and showed that 17.8% were infected with single species, 42.7% with two species, and 10.1% with three species.<sup>49</sup> Huang Teng-yun counted multiple infections by combining helminthes and protozoa. He found in the case of double infection, 53.7% was infected with Al and Tt. In the case of triple infection, 6.0% were infected with Na, Al and Tt. In the case of quadruple infection, 3.95% were with Ad, Na, Al and Tt. The quintuple infections were mostly found with Al, Tt, Eh, Ec and En. The cases of infected with six species were mostly found with Ad, Na, Al, Tt, Eh, and En. In the cases of infected with seven species, Ec was added. Finally, in the case of infection with eight species, Gl was added.<sup>50</sup>

## 4.2 Middle School Students

In his 1915 report, Ooi also provided the results of examinations with 60 students at Taichung Middle School. Of these students, 55% came from Taichung and Nantou sub-prefectures, while others came from many places in Taiwan. The distribution was as follows: 6 from Taichung, 7 from Hulutun, 3 from Changhua, 2

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<sup>46</sup> Kan Yoshio, 1934, p. 828.

<sup>47</sup> Narihara Norio, Yumoto Yoshika, Osaka Kiyoshi and Maeda Toshinori, 1938, p. 1593.

<sup>48</sup> Narihara Norio, Yumoto Yoshika, Osaka Kiyoshi and Maeda Toshinori, 1938, p. 1598.

<sup>49</sup> Loo Wan-teh, 1940, p. 1978, table 5.

<sup>50</sup> Huang Teng-yun, 1943, p. 88.

from Yuanlin, 3 from Shalu, 3 from Peitou, 3 from Lukang, 1 from Tachia, 5 from Nantou, 1 from Tsaohsiehtun, 1 from Linchipu 林杞埔, 4 from Taipei, 3 from Hsinchu, 2 from Taoyuan, 9 from Chiayi, 3 from Tainan, and 4 from Akou.<sup>51</sup> In 1916, Ooi presented another report which included the result of examinations of 30 students of Taichung Middle School.<sup>52</sup>

As shown in Table 8, in 1915-1916, the infection rates of Al among students of Taichung Middle School were 80-90%, those of Tt 97-100%, and those of hookworm (combining the two kinds) 55-80%. Moreover, there were 2 persons (2%) infected with pinworm, 3 persons (3%) with To, and 4 persons (4%) with Cs.

Table 8: The Parasitic Infection of Students at Taichung Middle School, 1915-1916

	(% in parenthesis)	
Year	1915	1916
No. Examined	60	30
Al ( <i>Ascaris lumbricoides</i> )	48 (80.0)	27 (90.0)
Tt ( <i>Trichuris trichiura</i> )	58 (97.0)	30 (100)
Ev ( <i>Enterobius vermicularis</i> )	1 (1.7)	1 (3.3)
Ad ( <i>Ancylostoma duodenale</i> )	27 (45.0)	28 (70.0)
Na ( <i>Necator americanus</i> )	6 (10.0)	6 (15.0)
To ( <i>Trichostrongylus orientalis</i> )	1 (1.7)	2 (6.7)
Cs ( <i>Clonorchis sinensis</i> )	3 (5.0)	1 (3.3)

Source: Ooi Tsukasa, 1919, pp. 819-821, Tables 1-3; Ooi Tsukasa, 1916, pp.356-357.

#### 4.3 Vocational School Students

There are three reports concerning parasitic infection of vocational school students. The first report was presented in 1920 by Kojima Daiji and Ni Chiang-hai of the Taiwan Government-general's Medical School. They conducted examinations with 298 students in October 1919. Of these students, 268 were Taiwanese (included Chinese) and 30 were Japanese. The age of the Taiwanese student ranged 14-27 and that of the Japanese 18-30. The native places of the Taiwanese students were as follows: 25 from Taipei, 8 from Taoyuan, 13 from Hsinchu, 72 from Taichung, 11 from Nantou, 36 from Chiayi, 65 from Tainan, 17 from Akou, and 2 from Penghu (澎湖). And there were 17 from China.<sup>53</sup> The second report was present in 1925 Yamazaki Shigeru, who conducted examinations with 161 Taiwanese and Japanese students at the coeducated Private Commercial and Industrial School from February 6 to March 4, 1925.<sup>54</sup> The third report was presented by Morioka, Imaizumi, and Kao

<sup>51</sup> Ooi Tsukasa, 1915, p. 819-821.

<sup>52</sup> Ooi Tsukasa, 1916, "On the distribution of *Necator americanus* and *Trichostrongylus orientalis* in Taiwan," *JFMA*, No. 163-164, pp. 355-363.

<sup>53</sup> Kojima Daiji and Ni Chiang-hai, 1920, "The results of examinations on intestinal parasites with students at Medical School of Taiwan Government-general," *JFMA*, No. 206-207, pp. 117-120. Table 1 on page 118 listed the number of Taiwanese students examined as 268, but the total number listed in Table 3 on page 120 was 266.

<sup>54</sup> Yamazaki Shigeru, 1925, pp. 1129-1130.

in 1935 with examinations of 260 students at Taipei Medical School, of which 121 were Japanese and 139 were Taiwanese.<sup>55</sup> Since the third report was a lecture note with no details of statistics, here only the results of the first two are listed in Table 9.

Table 9: The Parasitic Infections of Vocational School Students, 1919-1925

(% in parenthesis)				
School	Medical School		Commercial and Industrial School	
Year	1919		1925	
Student	Taiwanese	Japanese	Taiwanese	Japanese
No. Examined	268	30	126	35
No. Infected	207 (77.2)	16 (53.3)	--	--
Al ( <i>Ascaris lumbricoides</i> )	123 (45.8)	15 (50.0)	67 (53.0)	19 (54.0)
Tt ( <i>Trichuris trichiura</i> )	148 (55.2)	14 (46.6)	103 (82.0)	27 (77.0)
Ev ( <i>Enterobius vermicularis</i> )	1 (0.37)	0	1 (0.8)	0
Ad ( <i>Ancylostoma duodenale</i> )	46 (17.2)	0	64 (51.0)	8 (23.0)
Tso ( <i>Taenia solium</i> )	1 (0.37)	0	0	0
To ( <i>Trichostrongylus orientalis</i> )	0	0	1 (0.8)	1 (3.0)
Cs ( <i>Clonorchis sinensis</i> )	0	0	1 (0.8)	4 (11.0)
Ad and Al	12 (4.5)	0	0	0
Al and Tt	69 (25.7)	4 (13.3)	0	0
Ad, Al and Tt	21 (7.8)	0	0	0

Source: Kojima Daiji and Ni Chiang-hai, 1920, p. 118, Table 1; Yamazaki Shigeru, 1925, p. 1130, Table 2.

Table 9 shows that the infection rates of Al among Taiwanese and Japanese students were rather close, Medical School students had 46% and 50% and Commercial and Industrial School students had 53% and 54% respectively. However, the infection rates of Tt and Ad were higher among Taiwanese students. The infection rates of Tt among Taiwanese students in the two schools were 55% and 82% and among Japanese students were 47% and 77% respectively. The infection rates of Ad among Taiwanese students in the two schools were 17% and 51% and among Japanese students were 0% and 23% respectively. Moreover, the infection of Cs was found only among students of the Commercial and Industrial School, Japanese had 11% and Taiwanese only 0.8%.

In their 1935 report, Morioka et al. pointed out that at the Taipei Medical School, the infection rates of Al among Taiwanese and Japanese were quite similar; but the rates of hookworm (Ad and Na together) among Japanese were 3 times higher than among Taiwanese; on the contrary, the infection rate of Tt was higher among Taiwanese than among Japanese. They also noted that there were 3 Japanese students infected with Cs before they came to Taiwan. Among the 3 students infected with *Metagonimus yokogawai* there was 1 Taiwanese and this reflected that the habit of eating Japanese food had gradually become popular. In addition, Morioka et al. also

<sup>55</sup> Morioka Kouichi, Imaizumi Kyouhei, and Kao Chi-tien, 1935, "The results of stool examinations among students of Taipei Medical School," *JFMA*, No. 369, pp. 2184-2185.

reported the result of examinations with protozoa. There were 95 students (36.5%) infected, of which Taiwanese accounted for 37.4% and Japanese 35.5%. They also noted that the infection rate of Eh among Taiwanese was 3 times higher than that of Japanese students.<sup>56</sup>

## 5. Inhabitants in General

The earliest report concerning parasitic infection among inhabitants in Taiwan was presented by Matsuo Minetarou and Yokogawa Sadamu in 1912. They conducted examinations from February 23 to March 6 in Hsinchu sub-prefecture with the assistance of staff at district offices and public and private medical doctors. The object of examinations included sputum of 838 Taiwanese and stool of 500 Taiwanese. The samples of sputum were collected from 50 males and 50 females aged 15 and above at each district and those of stool from 25 males and 25 females. The results were reported separately with lung fluke (Pw) and intestinal parasites.<sup>57</sup> Here, the infection rates of lung fluke are listed in Table 10 (see Map 2.1) and those of intestinal parasites in Table 11 (see Map 2.2-2.3).

Table 10: The Infections of Lung Fluke among Inhabitants of Hsinchu Sub-Prefecture, 1911

Place	No. Examined	No. Infected	Percentage
Hsinchu 新竹	95	5	5.26
Hsinpu 新埔	100	8	8.00
Shuchilin 樹杞林	82	13	15.85
Peipu 北埔	100	6	6.00
Nanchuang 南庄	73	23	31.51
Chungkang 中港	86	6	6.98
Miaoli 苗栗	95	7	7.37
Tahu 太湖	36	3	8.33
Sanchaho 三叉河	36	4	11.11
Tunghsiao 通霄	38	0	0
Houlung 後壠	97	29	29.90
Total	838	94	11.22

Source: Matsuo Minetarou and Yokogawa Sadamu, 1912, p. 384, Table 1.

Table 10 shows that in 1911, the total infection rate of lung fluke among inhabitants in Hsinchu sub-prefecture was 11.2%, with Nanchuang 31.5%, Houlung 29.9%, and Shuchilin 15.9% ranking on the top. Matsuo and Yokogawa pointed out that these districts were located along rivers with easy access to irrigation. They also

<sup>56</sup> Morioka Kouichi, Imaizumi Kyouhei, and Kao Chi-tien, 1935, p. 2185.

<sup>57</sup> Matsuo Minetarou and Yokogawa Sadamu, 1912, "The statistical results of examinations on intestinal parasites among Taiwanese in the Hsinchu area," *JFMA*, No. 114-115, pp. 382-387. Matsuo Minetarou was the Health Advisor of Hsinchu Ting at that time; his report on this investigation to the Prefect of Hsinchu was included in the *Official Documents of Taiwan Government-general*, Vol. 5450, No. 3, pp. 25-38.

reported that with age differentiation, the highest infection rate was 21.7% among those aged 10-20 and the next was 19.0% among those aged 21-30. In terms of occupational differentiation, students had 47.4% and merchants had 19%.<sup>58</sup>

It should be noted that Maxwell said that *Paragonimus westermanii* was first described by Patrick Manson (1844-1922) with a specimen from northern Taiwan. In some villages in central Taiwan, the large majority of the inhabitants, Chinese and especially aborigines, harbored this parasite.<sup>59</sup>

Table 11: The Infection Rates of Intestinal Parasites among Inhabitants in Hsinchu Sub-Prefecture, 1911 (% in parenthesis)

Place	Hsin-chu	Hsin-pu	Shuchi-lin	Peipu	Nan-Chuang	Chung-kang	Miaoli	Tahu	Sancha-ho	Tung-hsiao	Hou-lung	Total
No. Examined	54	40	51	50	36	50	36	61	34	53	35	500
No. Infected	54 (100)	35 (87)	51 (100)	49 (98)	26 (72)	48 (96)	34 (94)	54 (88)	28 (82)	50 (94)	35 (100)	464 (93)
Al ( <i>Ascaris lumbricoides</i> )	54 (100)	34 (85)	49 (96)	48 (96)	23 (64)	45 (90)	33 (92)	49 (80)	26 (76)	43 (81)	34 (97)	438 (88)
Tt ( <i>Trichuris trichiura</i> )	21 (39)	20 (50)	37 (73)	20 (40)	9 (25)	32 (64)	7 (19)	19 (31)	7 (21)	27 (51)	28 (80)	227 (45)
Ad ( <i>Ancylostoma duodenale</i> )	10 (19)	12 (30)	11 (22)	20 (40)	3 (8)	6 (12)	5 (14)	14 (23)	4 (12)	11 (21)	8 (23)	104 (21)
Ev ( <i>Enterobius vermicularis</i> )	2 (4)	0	0	0	0	0	0	0	0	2 (4)	2 (6)	6 (1)
Intestinal ell	1 (2)	1 (3)	1 (2)	0	0	0	4 (11)	0	0	0	0	7 (1)
Al only	26	11	12	17	15	14	19	24	18	12	4	172 (35)
Tt only	0	0	2	1	3	2	0	2	2	1	0	13 (3)
Ad only	0	1	0	0	0	0	1	3	0	5	1	11 (2)
Al and Tt	15	11	25	11	5	26	6	14	4	24	21	162 (32)
Al and Ad	5	3	2	12	2	2	3	8	3	4	2	46 (9)
Al and Ev	2	0	0	0	0	0	0	0	0	2	0	4 (0.8)
Al and Intestinal ell	0	0	0	0	0	0	4	0	0	0	0	4 (0.8)
Al, Tt and Ad	5	8	9	8	1	4	1	3	1	2	5	47 (9)
Al, Tt and Ev	0	0	0	0	0	0	0	0	0	0	2	2 (0.4)
Al, Ev, and Intestinal ell	1	1	1	0	0	0	0	0	0	0	0	3 (0.6)

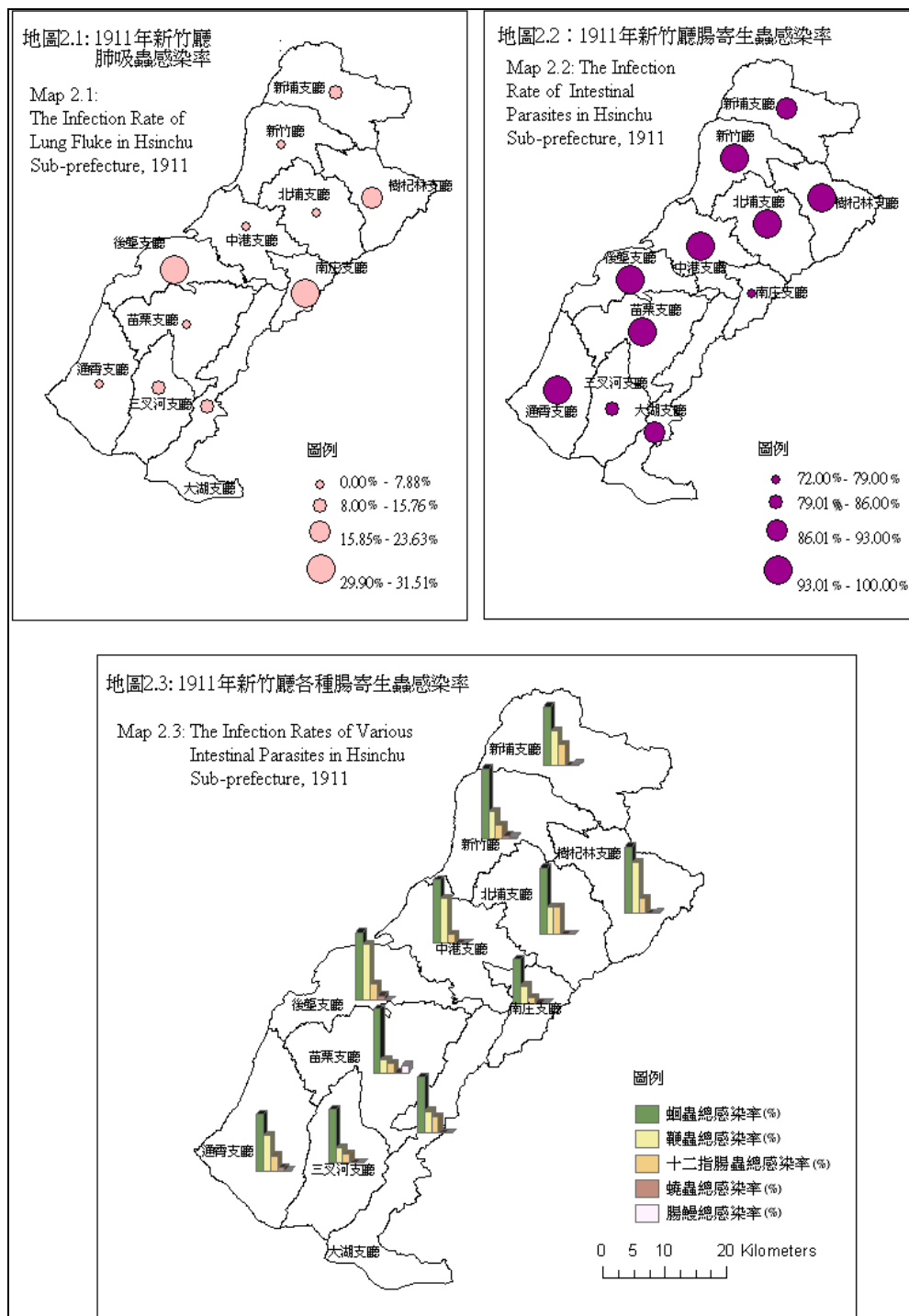
Source: Matsuo Minetarou and Yokogawa Sadamu, 1912, p. 383[387], Table 4.

Table 11 lists the statistics concerning infection of intestinal parasites among inhabitants of Hsinchu sub-prefecture in 1911. The total infection rate of intestinal parasites was 93%; specifically, Al 88%, Tt 45%, and Ad 21%. The highest infection rate was 100% found at Hsinchu, Shuchilin and Houlung and the lowest rate was 72% at Nanchuang. There was no significant difference between males and females as both had 92%. In terms of occupation, those engaged in restaurant business had the highest

<sup>58</sup> Matsuo Minetarou and Yokogawa Sadamu, 1912, p. 383, p. 385, p. 386.

<sup>59</sup> James Maxwell, 1929, p. 145.

rate at 100%, followed by agriculture 97%, laborers 96%, commerce 95%, miscellaneous 93%, and handicraft 92%.<sup>60</sup>



Map 2.1: The Infection Rate of Lung Fluke in Hsinchu Sub-prefecture, 1911

Map 2.2: The Infection Rate of Intestinal Parasites in Hsinchu Sub-prefecture, 1911

Map 2.3: The Infection Rate of Various Intestinal Parasites in Hsinchu Sub-prefecture, 1911

<sup>60</sup> Matsuo Minetarou and Yokogawa Sadamu, 1912, pp. 384-386.

In addition, many cases of multiple infections were discovered. In terms of single infection, there were 172 (34%) infected with Al, 13 (3%) with Tt, and 12 (2%) with Ad. In the cases of double infection, there were 162 (32%) infected with Al and Tt and 46 (9%) infected with Al and Ad. As for triple infection, there were 47 (9%) infected with Al, Tt and Ad. Moreover, there were a few cases infected with pinworm and intestinal ell-like worm, but they were not found in the cases of single infection. Both adult and larva of the ell-like worms were discovered, but it was not certain whether they were *Strongyloides stereoralis* (Bavay, 1876) or *Strongylus subtilis* (Loos, 1895).<sup>61</sup>

In 1927, Ooi, serving at the Hualienkang Hospital, presented a report on the parasitic infection among Japanese resided at colonist villages. He undertook examinations with Japanese inhabitants at Yoshino 吉野 village from February to May and at Toyota 豊田 and Hayata 林田 villages from September to October, 1926.<sup>62</sup> Among these three Japanese villages, Yoshino was established first around 1 li (1 Japanese league = 2.44 miles) southwest to Hualienkang. From February 1910 onward, several immigrations were recruited from Japan and the village was turned to the jurisdiction of Hualienkang by Taiwan Government-general in 1916. The inhabitants of Yoshino Village came from 21 counties outside of Hokkaido, with the largest number from Tokushima followed by Hiroshima, Fukuoka, Kagawa, Kumamoto, Saga, and Yamaguchi. At the end of 1925 there were 331 households with 1,768 persons at Yoshino Village. The Yoshino villagers mostly engaged in agriculture; the main crops were rice and sweet potato and the side lines were tobacco and other garden crops.

Toyota Village was established in April 1913. Its opening was more difficult than Yoshino because of geographical conditions. However, with appropriate arrangements by the authority, immigrations gradually arrived. At the end of 1925 there were 179 households with 911 persons at Toyota Village. The production of Toyota Village was similar to that of Yoshino.

The first immigrants of Hayata Village came in February 1914, just around the time when the railway connecting Hualienkang and Juishui 瑞穗 was completed. It was located 8 li south to Hualienkang. In the beginning, Hayata Village, similar to Toyota, was established at a wilderness grown with miscanthus reeds, at a juncture of plain woods and mountain woods, with wild animals swaggering around and very difficult to open up. Later, it was rather unstable because of epidemic diseases and natural calamities, but with tenacious encouragement of the authority and the efforts of villagers, the village developed gradually and the foundation was established.

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<sup>61</sup> Matsuo Minetarou and Yokogawa Sadamu, 1912, p. 383-384 [387-388].

<sup>62</sup> Ooi Tsukasa, 1927, pp. 225-226.

Immigrants to Hayata Village came from 13 counties in one prefecture with the largest number came from Fukuoka followed by Kumamoto, Saga, and Yamaguchi. At the end of 1925, there were 167 households with 689 persons. The production of Hataya was similar to the above two villages.<sup>63</sup>

In addition to the three Japanese villages, Ooi also undertook examinations with Okinawa fishermen resided at Milun Village 米崙庄 from April to May in 1925.<sup>64</sup>

Table 12 showed that in 1925, the parasitic infection rates of Japanese inhabitants at 3 colonist villages and Okinawa fishermen at Milun village were as high as 98%. Among various parasites, the infection rate of Tt was the highest; the average rate of the 3 village was 74.7% and that of Milun village 87.5%. The next highest was the infection rate of Al; the average rate of the 3 village was 58.5% and that of Milun village 45%. The third was the infection rate of Ad; the average rate of the 3 villages was 56% and that of Milun village 20%. In addition, the infection rates of To, Cs, My and *Heterophyes* were relatively small. Ooi pointed out that at the Japanese villages, the infection rate of malaria was also rather high, 50% at Yoshino, 21% at Toyota, 72% at Hayata, and the average was 48%.<sup>65</sup> The situation of coexisting ancylostomiasis and malaria at the same area was quite similar to that found with patients at the Red Cross Taipei Branch Hospital mentioned above.

Table 12: The Parasitic Infections among Japanese Inhabitants at Colonist Villages in Hualienkang Prefecture, 1926 (% in parenthesis)

Village	Yoshino	Toyota	Hayata	Total	Milun
No. Examined	270	210	236	716	40
No. Infected	266(98.5)	205(97.6)	233(98.7)	704(98.3)	39(97.5)
Tt ( <i>Trichuris trichiura</i> )	212(78.5)	145(69.1)	178(75.4)	535(74.7)	35(87.5)
Al ( <i>Ascaris lumbricoides</i> )	164(60.7)	122(58.1)	135(57.2)	419(58.5)	18(45.0)
Ev ( <i>Enterobius vermicularis</i> )	1(0.4)	1(0.5)	2(0.9)	4(0.6)	0
Ad ( <i>Ancylostoma duodenale</i> )	149(55.2)	113(53.8)	140(59.3)	402(56.2)	8(20.0)
To ( <i>Trichostrongylus orientalis</i> )	2(0.7)	4(1.9)	2(0.9)	8(1.1)	1(2.5)
Cs ( <i>Clonorchis sinensis</i> )	2(0.7)	1(0.5)	1(0.4)	4(0.6)	0
My ( <i>Metagonimus yokogawai</i> )	1(0.4)	1(0.5)	2(0.9)	4(0.6)	2(5.0)
<i>Heterophyes</i>	1(0.4)	0	0	1(0.1)	0
Tae ( <i>Cestodea, Taenia</i> sp.)	1(0.4)	0	0	1(0.1)	0

Source: Ooi Tsukasa, 1927, pp. 228-229, Table 1; p. 230, Table 2. The original tables listed the number of persons not infected; here it was re-calculated into the number infected.

The third report concerning parasitic infection among general inhabitants was presented in 1929 by Suzuki Sotoo, a technician at Taiwan Government-general and Central Research Institute. This report focused on rural area of Taichung prefecture, but also referred to similar topographical areas in other prefectures; it was a quite

<sup>63</sup> Ooi Tsukasa, 1927, p. 227.

<sup>64</sup> Ooi Tsukasa, 1927, p. 230.

<sup>65</sup> Ooi Tsukasa, 1927, p. 293.



comprehensive study on the parasitic infection of rural Taiwan at that time.<sup>66</sup>

Suzuki commented on living conditions in rural Taiwan to provide a background for understanding the parasitic infection. He said, the staple food of Taiwan villagers was rice, or rice mixed with pieces or strips of sweet potato, usually cooked into dry or gruel meal and the proportions of rice and sweet potato varied according to the level of family wealth. Except for fruit, Taiwanese usually did not eat raw food. However, they used polluted water to wash utensils and did not care whether there were touches of flies or cockroaches. Drinking water was usually rather muddy and it was never used after filtrating but only simply precipitated. At occasions of ceremonies, villagers might have pork, mutton, chicken, duck and goose, but in daily life they were used to have salt fish to go with coarse food. Vegetables were cooked with animal or vegetable oil and seasoned with salt, seldom with sugar or soy sauce.

Except for the day of ceremony, farmers were used to be barefoot all day long and they seldom took a bath. In the summer, they put a little warm water in a tray to wash the face, the body and the limb; in cold days, they almost did not wash. The toilet was usually shared with the neighbor; an earthen jar was laid down in a pit at open space around the house to serve for the purpose but there were no other devices around it and thus it was very easy to breed flies. People even could relieve the bowls at any time under the shadow or on the fields. Women would have a wooden pail for urine in the bedroom. Moreover, Taiwanese used to have their finger nails grown to very long and even boasted with the amount of filth harboring in them. They also liked to chew betel-nuts and threw up the juice at will; they used fingers to blow the nose and spread the snivel on the wall, on the post, or on the cloth.

Village houses were mostly Chinese style, roofed with tiles or thatches, lighting and ventilation were so poor that even in daytime it was dark and damp indoor. Around the house, there were cowshed, pigpen, and manure heap. And domestic animals and fowls were raised everywhere. What a spectacular of living together!

There was in general a deep superstition regarding diseases. Once getting ill, they believed it was a penalty of god or a plague of devil and thus they engaged in saying prayers and charting incarnations to seek for a cure. When prayers and incarnations were ineffective, they took Chinese medicine made of roots of herbs and barks of woods. Their concept of health was rather naïve. They did not believe that parasites could be infected through mouth and skin; they used polluted water to wash food and utensils, spread night soil as fertilizer, tilled with barefoot, and lived together with domestic animals and fowls. The prevalence of parasites was just a natural

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<sup>66</sup> Suzuki Sotou, 1929, "An investigation of the relationship between distribution of parasitic infection and age, sex, occupation, and topography at villages in rural Taiwan," *JFMA*, No. 291, pp. 535-560; No. 292, pp. 717-770.

outcome.<sup>67</sup>

Suzuki utilized the materials provided in the first to eighth *Health Examination Reports* completed during 1921-1927 and divided Taiwan's rural area into four types: the mountain villages, hillside villages, plain villages, and coastal villages. In below, these four types will be discussed in turn.

### 5.1 The Mountain Villages

The places surveyed among the mountain villages were as follows: Shengkengtsu 深坑仔 and Wanshunliao 萬順寮 of Shengkeng village 深坑庄 at Wenshan district 文山郡 in Taipei prefecture; Tanan 大湳 of Tatucheng 大肚城 at Puli town 埔里街 and Meitsuchiaio 梅子腳 at Puli village 埔里庄 in Nengkao district 能高郡; Luku 鹿谷, Hsinliao 新寮, and Chekuangliao 車軌寮 of Luku village 鹿谷庄 at Chushan district 竹山郡 in Taichung prefecture; Youtsuchai 柚仔宅, Shengkeng 深坑, Paimangpu 白芒埔, and Chutouchi 竹頭崎 of Chungpu village 中埔庄 at Chiayi district 嘉義郡 in Tainan prefecture.

Table 13 shows the parasitic infection rates among inhabitants at the mountain villages.

Table 13: The Parasitic Infections at the Mountain Villages, 1921-1927 (% in parenthesis)

Prefecture	Taipei	Taichung	Tainan	Total
No. Examined	1354	5627	2095	9076
No. Infected	1246 (92.0)	5441 (96.7)	1322 (63.1)	8009 (88.2)
Al ( <i>Ascaris lumbricoides</i> )	1156 (85.4)	5288 (94.0)	1049 (49.6)	7493 (82.5)
Tt ( <i>Trichuris trichiura</i> )	172 (12.7)	5370 (95.4)	477 (22.8)	6019 (66.3)
Ad ( <i>Ancylostoma duodenale</i> )	371 (27.4)	3425 (60.9)	153 ( 8.1)	3949 (43.7)
Tae ( <i>Cestodea</i> , <i>Taenia</i> sp.)	0	13 (0.23)	0	13 (0.14)
Ev ( <i>Enterobius vermicularis</i> )	0	5 (0.09)	0	5 (0.06)
Cs ( <i>Clonorchis sinensi</i> )	49 (3.6)	14 (0.25)	0	63 (0.69)
Ss ( <i>Strongyloides stercoralis</i> )	0	8 (0.14)	0	8 (0.09)
My ( <i>Metagonimus yokogawai</i> )	0	1 (0.02)	0	1 (0.01)
To ( <i>Trichostrongylus orientalis</i> )	0	0	3 (0.1)	3 (0.03)
Unspecified	2 (0.15)	0	48 (2.3)	50 (0.55)
Person-time	1750	14124	1730	17604
Person-time/No. Exam.	1.29	2.51	0.83	1.94

Source: Suzuki Sotoo, 1929, p. 553-554, Table 6. The original table listed the number of persons "not infected"; here the figures are converted into the number infected.

The total infection rates among the mountain villagers in three prefectures ranked as follows: Taichung 96.7%, Taipei 92.0% and Tainan 63.1%. Specifically, the highest rate was Al 82.5% followed by Tt 66.3% and Ad 43.7%. In Taipei prefecture, the infection rates ranked in the order of Al 85.4%, Ad 27.4% and Tt 12.7%. In Taichung prefecture, the order was Tt 95.4%, Al 94.0%, and Ad 60.9%.

<sup>67</sup> Suzuki Sotoo, 1929, pp. 540-542.

In Tainan prefecture, the order was Al 49.6%, Tt 22.8%, and Ad 8.1%. It is notable that in Taipei 3.6% were infected with Cs and in Taichung 0.25%. In addition, compared with the number of person-time and number examined, it is obvious that multiple infections were more frequently found in Taichung prefecture.

## 5.2 The Hillside Villages

The places surveyed among the hillside villages were as follows: Paishihchiao 白石腳, Tachieh 大結, Tangwei 湯圍, and Chiaohsi 礁溪 of Chiaohsi village 礁溪庄 at Yilan district 宜蘭郡 in Taipei prefecture; Nanchuang 南庄 at Chunan district 竹南郡 in Hsinchu prefecture; Fenyuan 芬園, Shekou 社口, and Hsienchuang 縣庄 of Fenyuan village 芬園庄 at Changhua district 彰化郡 in Taichung prefecture; Fenchihu 糞箕湖 and Muchiliao 木屐寮 of Paiho village 白河庄 at Hsinying district 新營郡 in Tainan prefecture.

Table 14 shows that at the hillside villages the total infection rates were in the order of Taipei 97.6%, Taichung 96.9%, Tainan 72% and Hsinchu 61.5%. Specifically, Taipei had 94.8% infected with Al, 44.3% with Tt, and 27.5% with Ad; Taichung had 96.1% with Tt, 92.5% with Al and 62.8% with Ad; Tainan had 64.5% with Al, 22.5% with Tt and 10.5% with Ad; Hsinchu had 56.3% with Al, 15.2% with Tt and 0.08% with Ad. It is notable that the infection rate of Cs was 2% in Hsinchu prefecture. Compared with the number of person-time and number examined, multiple infections were also more frequently found in Taichung prefecture.

Table 14: The Parasitic Infections at the Hillside Villages, 1921-1927 (% in parenthesis)

Prefecture	Taipei	Hsinchu	Taichung	Tainan	Total
No. Examined	1663	1195	3896	1688	8442
No. Infected	1623(97.6)	735(61.5)	3774(96.9)	1215(72.0)	7347(87.0)
Al ( <i>Ascaris lumbricoides</i> )	1576(94.8)	673(56.3)	3605(92.5)	1089(64.5)	6943(82.2)
Tt ( <i>Trichuris trichiura</i> )	737(44.3)	182(15.2)	3745(96.1)	379(22.5)	5043(59.7)
Ad ( <i>Ancylostoma duodenale</i> )	458(27.5)	1(0.08)	2446(62.8)	177(10.5)	3082(36.5)
Tae ( <i>Cestoidea</i> , <i>Taenia</i> sp.)	0	0	53(1.36)	0	53(0.63)
Ev ( <i>Enterobius vermicularis</i> )	4(0.24)	0	5(0.13)	0	9(0.11)
Cs ( <i>Clonorchis sinensis</i> )	0	25(2.09)	7(0.18)	0	32(0.38)
Ss ( <i>Strongyloides stercoralis</i> )	0	0	3(0.08)	0	3(0.04)
My ( <i>Metagonimus yokogawai</i> )	0	0	1(0.03)	0	1(0.01)
To ( <i>Trichostrongylus orientalis</i> )	4(0.24)	0	0	0	4(0.05)
<i>Diphyllobothriidae</i>	0	9(0.75)	0	0	9(0.11)
Unspecified	0	0	0	6(0.36)	6(0.07)
Person-time	2779	890	9865	1651	15185
Person-time/No. Exam.	1.67	0.74	2.53	0.98	1.80

Source: Suzuki Sotoo, 1929, pp. 724-725, Table 12.

## 5.3 The Plain Villages

The places surveyed among the plain villages were as follows: Loutsutso 樓子厝, Hsichien 溪墘, and Chunglu 中路 of Luchou village 鷺洲庄 at Hsinchuang

district 新莊郡 in Taipei prefecture; Peimenwai 北門外 and Luntzu 崙子 of Hsinchu town 新竹街 at Hsinchu district 新竹郡 in Hsinchu prefecture; Liushunan 柳樹南 of Wufeng village 霧峰庄 at Tatun district 大屯郡; Tungpeitou 東北斗 and Hsipeitou 西北斗 of Peitou town 北斗街 at Peitou district 北斗郡 in Taichung prefecture; Hsinhua village 新化庄 and Hsinshih village 新市庄 at Hsinhua district 新化郡 in Tainan prefecture; Linlo 麟洛 of Changhsing village 長興庄 at Pintung district 屏東郡 in Kaohsiung prefecture.

Table 15 shows that the highest parasitic infection rate among inhabitants of the plain villages was 96.8% in Taichung, followed by 94.4% in Taipei, 72.1% in Tainan, 54.8% in Hsinchu, and 53.1% in Kaohsiung prefectures. As for the three main species, the rates in Taichung were Tt 95.2%, Al 92.8%, and Ad 57.6%; those in Taipei were Al 88.5%, Tt 50.7%, and Ad 26.0%; those in Tainan were Al 63.9%, Tt 44.2%, and Ad 8.6%; those in Hsinchu were Al 51.2%, Tt 12.3%, and Ad 0.05%; and those in Kaohsiung were Al 42.2%, Ad 13.5%, and Tt 6.7%. Besides, it is notable that in Taichung prefecture, the infection rate of tapeworm was 1.5% and that of Cs 0.6%. Compared the number of person-time and number examined, Taichung also had a higher multiple infection rate than other prefectures.

Table 15: The Parasitic Infections at the Plain Villages, 1921-1927 (% in parenthesis)

Prefecture	Taipei	Hsinchu	Taichung	Tainan	Kaohsiung	Total
No. Examined	2680	2003	2808	5312	2292	15095
No. Infected	2531(94.4)	1097(54.8)	2718(96.8)	3828(72.1)	1216(53.1)	11390(75.5)
Al ( <i>Ascaris lumbricoide</i> )	2372(88.5)	1025(51.2)	2607(92.8)	3392(63.9)	967(42.2)	10363(68.7)
Tt ( <i>Trichuris trichiura</i> )	1359(50.7)	247(12.3)	2674(95.2)	2348(44.2)	154(6.7)	6782(44.9)
Ad ( <i>Ancylostoma duodenale</i> )	697(26.0)	1(0.05)	1616(57.6)	459(8.6)	309(13.5)	3082(20.4)
Tae ( <i>Cestoidea</i> , <i>Taenia</i> sp.)	0	0	43(1.5)	0	0	43(0.28)
Ev ( <i>Enterobius vermicularis</i> )	0	0	4(0.14)	0	0	4(0.03)
Cs ( <i>Clonorchis sinensis</i> )	0	0	17(0.61)	0	0	17(0.11)
Ss ( <i>Strongyloides stercoralis</i> )	6(0.22)	0	7(0.25)	0	0	13(0.09)
My ( <i>Metagonimus yokogawai</i> )	7(0.26)	0	0	0	0	7(0.05)
Unspecified	0	0	0	121(2.28)	0	121(0.80)
Person-time	4441	1273	6968	6320	1430	20432
Person-time/No. Exam.	1.66	0.64	2.48	1.19	0.62	1.35

Source: Suzuki Sotoo, 1929, pp. 736-738, Table 18.

#### 5.4 The Costal Villages

The places surveyed among the coastal villages were as follows: Chinpaoli 金包里, Shuiwei 水尾, Tienhsintzu 田心子, Luntzuting 崙子頂, and Kuishantzu 龜山子 of Chinshan village 金山庄 at Keelung district 基隆郡 in Taipei prefecture; Chungchuang 中庄, Nanchuang 南庄, Sankuaitso 三塊厝, Tungshihwei 東勢尾, and Fuhsing 福興 of Ta-an village 大安庄 at Tachia district 大甲郡 in Taichung prefecture; Chihkan 赤崁 of Mito village 彌陀庄 at Kangshan district 岡山郡 in Kaohsiung prefecture.

Table 16 shows that the highest parasitic infection rate among inhabitants of the coastal village was 94.4% in Taichung prefecture, followed by 83.2% in Kaoshiung and 65.1% in Taipei. As for three main species, Taichung had Tt 92.8%, Al 90.8% and Ad 53.9%; Taipei had Al 55.6%, Tt 13.5%, and Ad 6%; Kaoshiung had Al 74.5%, Tt 19.4% and Ad 17.5%. In addition, Taichung had 0.8% with tapeworm and 0.1% with pinworm, while Taipei had 0.3% with unspecified variety.

Table 16 : The Parasitic Infections at the Coastal Villages, 1921-1927 (% in parenthesis)

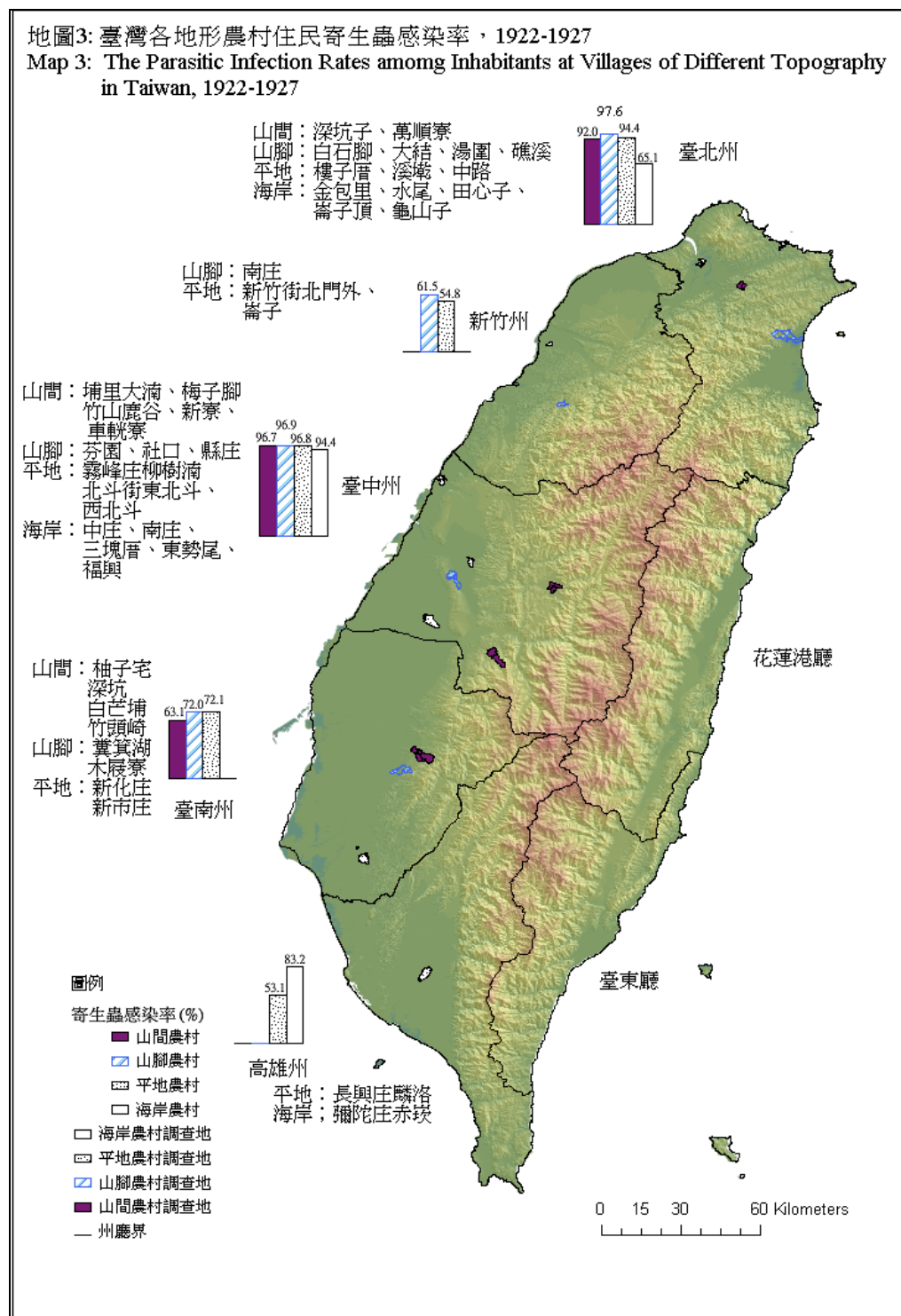
Prefecture	Taipei	Taichung	Kaoshiung	Total
No. Examined	2129	2512	2411	7052
No. Infected	1386(65.1)	2371(94.4)	2005(83.2)	5762(81.7)
Al ( <i>Ascaris lumbricoides</i> )	1184(55.6)	2281(90.4)	1796(74.5)	5261(74.6)
Tt ( <i>Trichuris trichiura</i> )	287(13.5)	2332(92.8)	468(19.4)	3087(43.8)
Ad ( <i>Ancylostoma duodenal</i> )	128(6.0)	1353(53.9)	421(17.5)	1902(27.0)
Tae ( <i>Cestoidea, Taenia</i> sp.)	0	19(0.76)	0	19(0.27)
Ev ( <i>Enterobius vermicularis</i> )	0	3(0.12)	0	3(0.04)
Unspecified	6(0.28)	0	0	6(0.09)
Person-time	1605	5988	2685	10278
Person-time/No. Exam.	0.75	2.38	1.11	1.46

Source: Suzuki Sotoo), 1929, pp. 747-748, Table 24.

The above 4 tables together demonstrate that the highest parasitic infection rate was found among rural inhabitants in Taichung prefecture and the next in Taipei prefecture. Taichung prefecture had four types of villages under surveyed; the infection rate at the mountain villages was 96.7%, at the hillside 96.9%, at the plain 96.8%, at the coast 94.4%, and the average was 96.2%. Taipei prefecture also had four types, with the rate at the mountain villages 92.0%, at the hillside 97.6%, at the plain 94.4%, at the coast 65.1%, and the average at 87.3%. Tainan prefecture had three types of villages, with the rate at the mountain village 63.1%, at the hillside 72.0%, at the plain 72.1%, and the average at 69%. Kaoshiung prefecture had two types of villages, with the rate at the plain villages 53.1%, at the coast 83.2% and the average at 68.2%. Hsinchu prefecture had two types of villages with the rate at the hillside villages 61.5%, at the plain 54.8%, and the average at 58.2% (see Map 3).

When the total infection rate of each type of village was compared, the highest rate was 88.2% found at the mountain villages, followed by 87.0% at the hillside, 81.7% at the coast, and 75.5% at the plain. In terms of three major parasites, the infection rate of Al was 82.5% at the mountain, 82.2% at the hillside, 68.7% at the plain, and 74.6% at the coastal villages. The infection rate of Tt was 66.3% at the mountain, 59.7% at the hillside, 44.9% at the plain, and 43.8 at the coastal villages. The infection rate of Ad was 43.7% at the mountain, 36.5% at the hillside, 20.4% at the plain, and 27.0% at the coastal villages. In addition, it is notable that cases of infection with Cs were found at the mountain villages (total 0.7%, with 3.6% in Taipei

and 0.3% in Taichung), at the hillside villages (total 0.4%, with 2.1% in Hsinchu and 0.2% in Taichung), and at the plain villages (total 0.1%, with 0.6% at Taichung).



Map 3: The Parasitic Infection Rates among Inhabitants at Villages of Different Topography in Taiwan, 1922-1927

In addition, from August 18, 1940 to July 2, 1942 Huang Teng-yun conducted examinations with inhabitants of Wantan district 萬丹庄 (in today's Pintung County).

There were 16,619 persons (82% of the district), 8,482 males and 8,137 females, received examinations. Most of the people engaged in agriculture. The results of examinations showed that 96.5% were infected with various parasites. Of the helminth, the infection rates were in the order of Al 96.0%, Tt 87.7%, Ev 0.8%, My 0.2%, To 0.09%, Cs 0.07%, Ss 0.04%, and *Fasciolopsis buski* (Fb) 0.03%. Among the protozoa, the infections rates were En 13.3%, Ec 9.4%, Eh 7.6%, Gl 5.5%, Trico 2.7%, Ib 2.3%, Cm 0.9% and Df 0.5%. Moreover, multiple infections were quite prevalent. Of all infections, there were 7.5% single infection, 48.5 % double infections, 20.5% triple infections, 14.3% quadruple infections, 6.2% quintuple infections, 1.9% infected with six species, 1.1% with seven species, and 0.2% with eight species.<sup>68</sup> In short, this investigation during the war time revealed that the parasitic infections were still quite prevalent.

As for protozoan infections among rural inhabitants, a report concerning was presented in 1933 by Wakajima Osamu and Kao Chi-tien of the Taipei Medical School. In the winter of 1932, the authors participated in the task of expelling hookworm and roundworm conducted by the Health Division of the Taipei Prefecture at Shulin Village 樹林庄 of Haishan District 海山郡 and they took this opportunity to investigate the infection of protozoa with the Shulin villagers. Those accepted examination were inhabitants came originally from Fukien 福建. Among the 139 persons examined, 61 were male and 78 females. Most of them engaged in farming; although a few of them were officials or engaged in small-sized commerce and industry, they all lived in the village and thus it was appropriate to consider all of them as farmers.<sup>69</sup>

Table 17 shows that in 1932, the infection rates of protozoa among the Shulin villagers were in the following order: Ec 13.7%, Eh 11.5%, En 2.9%, Gl 2.16% and Ib 1.44%. For the first two species, the rates of females were slightly higher those of males. In terms of age, those aged 16-50 had higher infection rates for the first two species. It is notable that no case of multiple infections was discovered.<sup>70</sup>

If compared with the aforementioned infection rates of protozoa found among the patients of Taipei Hospital in 1924 and 1931, the navy at Fengshan in 1931, and the Taiwanese elementary school children at Fengshan in 1934, Taipei in 1938, and Tungkang in 1943, it is notable that the rate of Shulin farmers was higher than that of the Taiwanese elementary school children in Taipei, lower than that of the Taiwanese

<sup>68</sup> Huang Teng-yun, 1947, "Investigation on the Human Parasites among the Inhabitants in Wan-tan district, Kao-hsiung Prefecture, South Formosa," *JFMA*, 46: 4, pp. 119-132; see statistics in p. 123, Table 6 and p. 126, Table 12.

<sup>69</sup> Wakejima Osamu and Kao Chi-tien, 1933, "The intestinal protozoa infection among Taiwanese farmers in northern Taiwan with an emphasis on those infected with *Entamoeba histolytica*," *JFMA*, No. 340, pp. 1034-1038.

<sup>70</sup> Wakejima Osamu and Kao Chi-tien, 1933, p. 1035.

elementary school children at Fengshan. However, the elementary school children all had a higher rate of *Endolimax nana*.

Table 17: The Infection of Protozoa among Farmers of Shulin Village at Haishan District in Taipei Prefecture, 1932 (% in parenthesis)

	Male	Female	Age 10-15	Age 16-50	Age 51+	Total
No. Examined	61	78	59	72	8	139
Eh ( <i>Entamoeba histolytica</i> )	6 (9.84)	10 (12.82)	6 (10.17)	9 (12.50)	1 (12.50)	16 (11.51)
Ec ( <i>Entamoeba coli</i> )	7 (11.48)	12 (15.38)	7 (11.86)	11 (15.28)	1 (12.50)	19 (13.67)
En ( <i>Endolimax nana</i> )	2 (3.28)	2 (2.56)	3 (5.08)	1 (1.39)	0	4 (2.88)
Ib ( <i>Iodamoeba bütschlii</i> )	1 (1.64)	1 (1.28)	0	2 (2.78)	0	2 (1.44)
Gl ( <i>Giardia lamblia</i> )	2 (3.28)	1 (1.28)	1 (1.69)	2 (2.78)	0	3 (2.16)

Source: Wakejima Osamu and Kao Chi-tien, 1933, p. 1035, Table 1.

It should be mentioned here that Kawai Nariumi, Nagayoshi Kousuke, and Kao Chih-tien of the Taipei Medical School conducted an examination for protozoa with personnel employed by the Health Division of Taipei City from December 5, 1933 to January 16, 1934. They examined 616 healthy men at the prime age, including Japanese and Taiwanese, employed to engage in pumping up night soil, collecting garbage, cleaning sewerage, and other works at 7 offices of Wanhua 萬華, Simen 西門, Nanmen 南門, Tungmen 東門, Chengnei 城內, Peimen 北門 and Tacheng 大成.<sup>71</sup> Table 18 shows that in 1933-34, the infection rate of protozoa among the employees of the Health Division of the Taipei City was around 40%, this was the highest rate found for the protozoa in Taiwan. Kawai et al. pointed out, because these people engaged daily in the work of contacting with dirty objects, they had more opportunity to be infected.<sup>72</sup>

Table 18: The Infection of Protozoa among the Employees of the Health Division of Taipei City, 1933-1934 (% in Parenthesis)

Examinee	Total	Taiwanese	Japanese	Urban	Rural
No. Examined	616	498	118	410	206
No. Infected	253(41.08)	206(41.36)	47(39.83)	167(40.73)	86(41.74)
Eh ( <i>Entamoeba histolytica</i> )	103(16.72)	90(18.07)	13(11.01)	66(16.09)	37(17.96)
Ec ( <i>Entamoeba coli</i> )	70(11.36)	55(11.04)	15(12.71)	47(11.46)	23(11.16)
En ( <i>Endolimax nana</i> )	103(16.72)	83(16.66)	20(16.95)	68(16.56)	35(16.99)
Ib ( <i>Iodamoeba bütschlii</i> )	9(1.46)	7(1.41)	2(1.69)	3(0.73)	6(2.91)
Gl ( <i>Giardia lamblia</i> )	38(6.16)	34(6.83)	4(3.39)	26(6.34)	12(5.82)
Tricho ( <i>Trichomonas hominis</i> )	17(2.75)	10(2.01)	7(5.93)	13(3.17)	4(1.94)

Source: Kawai Nariumi, Nagayoshi Kousuke and Kao Chi-tien, 1934, pp. 1151-1155.

<sup>71</sup> Kawai Nariumi, Nagayoshi Kousuke and Kao Chi-tien, 1934, "On intestinal parasitic protozoa in the Taipei area," *JFMA*, No. 353, pp. 1149-1158.

<sup>72</sup> Kawai Nariumi, Nagayoshi Kousuke and Kao Chi-tien, 1934, p. 1154.



## 6. Aborigines

There were four reports concerning the parasitic infection among aborigines in Taiwan. Presented below are the main points of these reports.

In Ooi's 1927 report, the examinations conducted among the aborigines in Hualienkang included two parts. The first part related to the examination with 104 students at the Agricultural Supplementary School in Hualienkang. These students were sons of "acculturated aborigines" living at the plain area. They lived in the dormitory of the school and aged around 20. The results of their examinations were as follows: The total parasitic infection rate was 88.4% and specifically, Al 77.8%, Ad 55.8%, and Ev 1.8%. The second part related to the aborigines of Ikatosan village at Taroko 太魯閣.<sup>73</sup> There were 77 persons received examinations, of them 50.7% were infected with Tt and 20.7% with Al. The infection rate of Tt was close to that found with Japanese and Taiwanese living around Hualienkang, but the low infection rate of Al among the aborigines was rather a surprise. With careful investigation, it was found that the mountain aborigines did not use night soil as fertilizer and they adopted crop rotation. As it was well known, the infection of *Ascaris lumbricoides* was usually through the mouth due to eating soiled vegetables. Those infected with Al were mostly young people; they might be infected due to unclean habits. As for the infection rate of Ad, it was as high as 75.3%. And this might be related to the habit of relieving the bowls at will outside the house and used to be half-naked and barefoot; with unclean living conditions, there were a lot of opportunities to be infected with hookworm through the mouth and the skin. One case was found infected with *Metagonimus yokogawai* and this was perhaps related to eating fresh-water trout captured from the nearby Iwattan River 三棧溪.<sup>74</sup>

Yokogawa, Kobayashi and Kao conducted stool examinations with more than 2,000 aborigines living in Hsinchu prefecture from December 1927 to April 1928 and found the infections as follows: Al 94.5%, Ad 12%, Na 2.9%, and *Taenia saginata* (Tsa) 10.3%. Moreover, there were 3 cases infected with *Capillaria hepatica*. After investigating carefully the residence of these three cases, it was found that they ate raw meat of rat and the liver of the house rat was infected with *Capillaria hepatica*.<sup>75</sup>

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<sup>73</sup> Ikatosan was an old name of the village, which is now located at Chiamin 佳民, Hsiulin Hsiang 秀林鄉 in Hualien County. See Wei Hwei-lin and Wang Jen-ying, 1966, *A survey of population growth and migration patterns among Formosan aborigines* (Taipei: Department of Archaeology and Anthropology, National Taiwan University), p. 80. Ooi pronounced the name of this village slightly different as Ikadosan (イカドサン), see Ooi Tsukasa, 1927, p. 226.

<sup>74</sup> Ooi Tsukasa, 1927, pp. 230-231. As for the discovery of a new parasite with the fresh-water trout as the second host, see Yokogawa Sadamu, 1912, "The fresh-water trout as the second intermediate host of a new parasite and the establishment of a new category of this new parasite," *JFMA*, No. 122, pp. 1055-1068; and 1913, "The fresh-water trout as the second intermediate host of a new parasite and the establishment of a new category of this new parasite (continuation)," *JFMA*, No. 123, pp. 1-26.

<sup>75</sup> Yokogawa Sadamu, Kobayashi Hidekazu, and Kao Chi-tien, 1928, "The results of stool

Yokogawa and Kobayashi in another brief report pointed out that the aborigines living Tahsi district (大溪郡, in Today's Taoyuan County) in Hsinchu prefecture used to eat raw meat of deer, therefore, there were more cases of infection with *Taenia saginata*. The authors went to the aboriginal village in the summer of 1928 to help expelling the parasites with more than one hundred aborigines.<sup>76</sup>

In his 1929 research report, Yokogawa said that in 1927 he and Dr. Nishikiori discovered a cat infected with Brazilian hookworm (*Ancylostoma braziliense*) at an aboriginal village. Later, Yokogawa conducted stool examinations with 204 aborigines at the village of Chutung district 竹東郡 where this particular cat was found. The results demonstrated that 67 persons were infected with hookworm. He further applied the stool collected to do experiment with a cat and after 54 days the anatomy of its body proved that one of the hookworm found in the small intestine was *Ancylostoma braziliense*. As *Ancylostoma braziliense* was a zoonotic parasite found in the dog, cat and human and was discovered in India, Malay, and the Philippines, how it was introduced into the mountain area of Taiwan was an interesting question to be inquired further.<sup>77</sup>

In addition to investigations concerning parasitic infection mentioned above, it should be noted that the Japanese colonial authority initiated a task of expelling the parasites among school children in 1924 and later it was extended to general inhabitants. Here related reports covered by the *Taiwan Daily News* (*Taiwan Nichi Nichi Shinho*) are listed in Appendix 2 in order to get a glimpse of its process and effect. Briefly speaking, the task of expelling parasites started with school children at Japanese and Taiwanese elementary schools at Fengshan district at the end of 1924. In 1927-1928, the same task was carried out at elementary schools in Tainan city, Chiayi city, Haishan district and Keelung city. From 1932 on, the task was extended to inhabitants aged 3-55 in Tainan prefecture. It seems that the effect was quite good as it was reported in 1939 that about 700,000 persons in Tainan prefecture had taken *digenia simplex* since 1932; the expelling rate was 76% in 1937 and 49% in 1938. During the war time in 1942, a plan of expelling was still proposed in Tainan. Further studies are required for evaluating the effectiveness of expelling parasites in Taiwan during the Japanese colonial period.

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examinations among the aborigines in Shinchiku (Hsinchu) prefecture," *JFMA*, No. 283, p. 1194. This parasite was called "ヘパチコーラ", perhaps with omission or error.

<sup>76</sup> Yokogawa Sadamu and Kobayashi Hidekazu, 1928, "The results of expelling hookworm among the aborigines at Taikei (Tahsi) district in Shinchiku (Hsinchu) prefecture," *JFMA*, No. 283, p. 1194. Related report appeared in *Taiwan Nichi Nichi Shinho*, 1928/08/20/2; there were 170 persons receiving expellant.

<sup>77</sup> Yokogawa Sadamu, 1929, "The parasitic infection of *Ancylostoma braziliense* among aborigines and cats at the aboriginal area in Taiwan," *JFMA*, No. 290, pp. 457-462. Related report appeared in *Taiwan Nichi Nichi Shinho*, 1928/02/15/9.

## II. Period since Taiwan Restoration

First of all, it should be noted that there are two papers which provide general review of parasitic infections in Taiwan at different stage. In 1965, Hsieh Hsien-chen (1924-2000), an eminent parasitologist, presented a paper to discuss soil-transmitted helminthic infections in Taiwan. He collected infection rates obtained by surveys during the Japanese colonial period and Hsieh himself and other scholars in 1956-1963, and showed them on three maps respectively for hookworm (*Ad* and *Na*), *Ascaris lumbricoides*, and *Trichuris trichiura*. He also enlisted the rates of *Strongyloides stercoralis* and *Trichostrongylus orientalis*. The infection rates of various species differed, however, in the early 1960s the highest rate was still around 80%. Hsieh pointed out that from the viewpoint of public health, hookworm and *Ascaris* required special attention.<sup>78</sup>

In 2001, Yeh Ta-chuan et al. presented a review for the changing status of parasitic infection in Taiwan since the mid-twentieth century. In brief, malaria was eradicated by 1965 and lymphatic filariasis in the 1980s. The infection rate of soil-transmitted intestinal nematodes among school children was reduced from 70% in the 1950s to 2% in the 1990s. The infection of roundworm, whipworm, and hookworm was under control by the end of the twentieth century, but enterobiasis was still quite popular among school children. Food-borne parasitic zoonosis such as clonorchiasis and taeniasis are confined to some ethnic groups, whereas angiostrongyliasis is associated with the rainy season. The protozoal infections with *Giardia lamblia* and *Cryptosporidium parvum* are not rare, but their prevalence is difficult to assess because of lacking epidemiological surveys. Among patients with human immunodeficiency virus (HIV) infections in Taiwan, the leading parasitic pathogens are *Pneumocystis carinii*, *Entamoeba histolytica*, and *Toxoplasma gondii*. In addition, a relatively common parasitic infection rate among the Southeast Asian workers employed in Taiwan had already caught the attention and a long-term study showed that the overall parasitic infection rate of these workers was 10.3%.<sup>79</sup>

In the second half of the twentieth century, surveys on parasitic infections in Taiwan were mostly conducted among school children, local inhabitants and aborigines. This paper lists the infection rates of 4 helminthes and 3 protozoas in Appendix 3 and 4 in order to observe changes through time and space. Generally, the cases of a same place with surveys at different times are rather rare. For example, at

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<sup>78</sup> Hsieh Hsien-chen, 1965, "The Incidence and Intensity of Common Soil-transmitted Helminthic Infections in Taiwan," *JFMA*, 64:4, pp. 222-238.

<sup>79</sup> Yeh Ta-chuan, Lin Pey-ru, Chen Eng-rin, and Shaio Men-fang, 2001, "Current status of human parasitic infections in Taiwan," *Journal of Microbiology, Immunology and Infection*, 34:3, pp. 155-160.

Shihpai district in Taipei city (previously belonged to Taipei Prefecture and Taipei County) there were 4 surveys: the first by Yokogawa et al. in 1929-31, the second by Loo in 1939, the third by Huang and Chiu in 1959-1960,<sup>80</sup> and the fourth by Yu and Chiu in 1975.<sup>81</sup> These four surveys showed that in the case of Al, the infection rates were 98.5%, 87.0%, 65.2%, and 7.4% respectively, apparently in decline. In the case of Ev, the infection rate was usually very small before 1945, however, due to adopting Scotch-tape swab method the rate was 40.7% in 1960 and 55.5% in 1975; an increase on the contrary. This was because pyrantel pamoate (Combantrin) was more effective for expelling roundworm (Al).<sup>82</sup> In 1980, the infection rates of Al, Tt, and Hw among school children at five districts in Taipei City had decline to 2.3%, 1.8% and 0.05% respectively; reflecting the effect of parasitic controlling since 1972; but this report did not include pinworm.<sup>83</sup> Because most of the places only had one survey, it is perhaps better to put together surveys of different places in the same county to try to observe changes through time. This will be showed below.

## 1. Taipei County

In July-August, 1949, Huang Wen-hsien et al. conducted survey at 4 villages of aborigines at Wulai (Urai烏來) area. There were 634 persons, 84% of the total populations at the 4 villages, received stool examinations.<sup>84</sup> In October 1954, Jolliffe and Tung investigated the parasitic infections among school children in Taipei area in order to study nutritional conditions. Those received examinations in Taipei County were 219 children from Luchou 蘆洲, 204 from Yingko 鶯歌 and 105 from Hsinchuang 新莊, the original paper pronounced it as Heng-Zing, judging from place names in Taipei County, Hsinchuang is perhaps the best guess), as well as 98 children from Naihu 內湖 in today's Taipei City.<sup>85</sup> In 1961, Kuntz et al. presented a paper on surveys covering 7 locations in 5 counties, and among the examinees were 256 inhabitants from Shihmen district 石門鄉. However, the time of the survey was not clearly stated in the paper and the best guess was around 1960.<sup>86</sup>

<sup>80</sup> Huang Wen-hsien and Chiu Jui-kuang, 1961, "Resurvey of the Incidence of Intestinal Helminthic Infections among School Children in a Rural Area in Northern Taiwan," *JFMA*, 60:2, pp. 216-226.

<sup>81</sup> Yu Jen-chieh and Chiu Jui-kuang, 1976, "Present Status of Intestinal Parasitic Infections among Shih-pai Primary School Children in Taipei, Taiwan, with an Evaluation of Pyrantel Pamoate in Treatment," *JFMA*, 75: 11, pp. 639-646.

<sup>82</sup> Yu Jen-chieh and Chiu Jui-kuang, 1976, p. 644.

<sup>83</sup> Wei Teng-hsien, Li Chung-hsiang, Wu Kang-wen, Huang Ching-feng, and Chan Tien-sheng, 1981, "A Report on Parasitic Control at Five Districts in Taipei City in 1980," *Public Health* (《公共衛生》), 8: 1, pp. 107-113.

<sup>84</sup> Huang Wen-shien, Loo Wan-teh, Hsieh Hsien-chen, and Wu Chen-lan, 1952, "Parasitological Investigations on the Aborigines in Taipei Prefecture, Formosa," *JFMA*, 51: 3, pp. 96-118.

<sup>85</sup> Norman Jolliffe and Ta-cheng Tung, 1956, "Nutrition Status survey of the Civilian Population of Formosa," *Metabolism*, 5, p. 319, Table 7.

<sup>86</sup> Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, "Protozoan and Helminth Parasites in Peoples of Taiwan," *JFMA*, 60: 9, pp. 809-824.

Table 19 lists the helminthic infections rates found in Taipei County. During 1949-1960, the total helminthic infection rates were 73-96%, with that among the inhabitants in Wulai area ranked the highest. In 1949, the infection rates at Wulai were in the order of Al 81.7%, Hw 66.1%, Tt 63.4%, Tsa 20.5%, and To, Ss and Ev below 1%. In 1954, the infection rates among children at Luchou were in the order of Al 74.9%, Tt 68.5%, Hw 46.6%, and Ev 0.9%; at Yingko, the rates were Al 59.8%, Tt 25.5%, Hw 18.6%, and Ev 0.5%; and at Hsinchuang, the rates were Hw 50.5%, Al 43.8%, Tt 4.8%, and Ev 1.9%. Around 1960, the infection rates among the Shihmen inhabitants were Hw 79%, Al 59%, Tt 29%, Pw 6% and Ev 1%. It is notable that the infection rate of pinworm was mostly around 1% in the above surveys, however, using the Scotch-tape swab method, the Ev infection rate in 1957 was 62.3% at Shengken 深坑 and 72.4% at Chingmei 景美 and 54.3% at Mucha 木柵, the last two places were still belonging to Taipei County at that time.<sup>87</sup> In 1985, the rate among school children at Juifang 瑞芳 was 33.9%.<sup>88</sup>

Table 19: The Infections of Helminthes among Inhabitants and School Children in Taipei County, 1949-1960 (% in Parenthesis)

Place	Wulai	Luchou	Yingko	Hsinchuang	Shihmen
Examinee	Inhabitants	S children	S children	S children	Inhabitants
Time	1949/7-8	1954/10	1954/10	1954/10	1960
No. Examined	634	219	204	105	256
No. Infected	608(95.9)	209(95.4)	148(72.6)	77(73.3)	(94)
Al ( <i>Ascaris lumbricoide</i> )	518(81.7)	164(74.8)	122(59.8)	46(43.8)	(51)
Hw (hookworm)	419(66.1)	102(46.6)	38(18.6)	53(50.5)	(79)
Tt ( <i>Trichuris trichiura</i> )	402(63.4)	150(68.5)	52(25.5)	5(4.8)	(29)
Ev ( <i>Enterobius vermicularis</i> )	2(0.3)	2(0.5)	1(0.5)	2(1.9)	(1)
To ( <i>Trichostrongylus orientalis</i> )	4(0.6)	--	--	--	--
Ss ( <i>Strongyloides stercoralis</i> )	4(0.6)	--	--	--	--
Pw ( <i>Paragonimus westermani</i> )	--	--	--	--	(6)
Tsa ( <i>Taenia saginata</i> )	130(20.5)	--	--	--	--

Source : Huang Wen-hsien, Loo Wan-teh, Hsieh Hsien-chen, and Wu Chen-lan, 1952, p. 99, Table 1; p. 101, Table 2. Norman Jolliffe and Tung Ta-cheng, 1956, p. 319, Table 7. Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 815, Table 1

As for the infections of protozoa, the data were available in surveys of 1949 and 1960. At Wulai area, the infections were in the order of Ec 19.4%, Trico 8.5%, Eh 5.7%, En 4.1%, Gl 2.2%, Bc 0.8%, and Ib 0.6%.<sup>89</sup> At Shihmen, the rates were Gl 10%, Ec and En 9% each, and Eh 3%.<sup>90</sup> The multiple infections were also found at

<sup>87</sup> Lin Yuan-tang, 1962, "Observations on Enterobiasis, I. Observation on *Enterobius vermicularis* infection among school children of Chin-mei, Sheng-ken and Mu-cha primary schools in Taipei county, Taiwan," *JFMA*, 61: 2, p. 155, Table 1.

<sup>88</sup> Chung W.C., Lu J. L. and Chang K. C., 1986, "Survey of Enterobius and Head Louse Infection among Children of Jui-fang Primary School, Jui-fang district, Taipei County," *Journal of Taipei Medical College* (《北醫學報》), 15, p. 139, Table 2.

<sup>89</sup> Huang Wen-hsien, Loo Wan-teh, Hsieh Hsien-chen, and Wu Chen-lan, 1952, p. 101, Table 2.

<sup>90</sup> Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 815, Table 1.

Wulai area; there were 11.0% single infection, 25.4% double infections, 33.1% triple infections, 18.4% quadruple infections and 7.6% quintuple infections.<sup>91</sup>

## 2. Hsinchu County

The parasitic surveys in Hsinchu County were mostly conducted at the mountain area. In 1968-1969, Chung Wen-cheng et al. conducted survey at Wufeng district 五峯鄉 and focused on *Taenia Saginata*. Among 302 persons received examinations, 111 (36.8%) were found infected; the infection rate increased with age and reached the highest 64.7% at ages 31-40.<sup>92</sup> From July to October 1967, Wen Yung-fu conducted stool examinations with inhabitants at low mountain area at 3 villages in Chienshih district 尖石鄉. There were 239 aborigines and 224 Han Taiwanese received stool examinations; 417 aborigines and 262 Han Taiwanese received intradermal test for lung worm; and 221 aboriginal children and 163 Han Taiwanese children received Scotch-tape swab examination for pinworm.<sup>93</sup> In 1978-1979, Wu Yu-yeh and Lü Sen-chi conducted examinations with 346 students at Chienshih Middle School and 600 children at Chienshih Elementary School.<sup>94</sup> In July 197, Chang Kok-chung et al. conducted survey at Yufeng 玉峯 and Hsiuluan 秀巒 villages at the remote mountain area in Chienshih district with 481 Atayal aborigines.<sup>95</sup> And from March to July 1979, Chung Wen-cheng et al. also conducted survey at the same two villages with 770 aborigines.<sup>96</sup>

Table 20 shows that in the lower mountain area of Chienshih district, the total helminthic infection rate among the aborigines was 96.2%, with the order of Al 82.4%, Tt 68.9%, Hw 22.2%, Tae 7.2%, Pw 4.3%, and Ev 17.7% among children; the total helminthic infection rate among Han Taiwanese was 88.0%, with Al 79.5%, Tt 56.3%, Hw 17.9%, and Ev 61.4% among children. In 1978-79, the middle school students had a total helminthic infection rate of 75.7%, with various species ranked in the order of Tt 59.5%, Al 43.1%, Hw 4.9%, Tae 2.0%; the total protozoan infection rate was

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<sup>91</sup> Huang Wen-hsien, Loo Wan-teh, Hsieh Hsien-chen, and Wu Chen-lan, 1952, p. 103, Table 3.

<sup>92</sup> Chung Wen-cheng and Liu Jui-chung, 1971, "Survey and Treatment of *Taenia Saginata* with Atabrine in Aborigines in Wufeng District, Hsinchu County, Taiwan," *Chinese Journal of Microbiology*, 4, p. 46. Tables I and II.

<sup>93</sup> Wen Yung-fu, 1969, "A Survey on Helminthic Infections among Aborigines in Chien-shih district of Hsin-chu County, Taiwan," *JFMA*, 68: 9, pp. 445-450. See p. 446, Table 1.

<sup>94</sup> Wu Y. Y. and Lü S. C., 1979, "A Survey on protozoan and helminthic infections among middle and primary school children at Chien-shih district, Hsin-chu county, Taiwan," *Chinese Journal of Microbiology*, 12:1, p. 113.

<sup>95</sup> Chang Kok-chung, Sun Yun-lai, and Chiu Jui-kuang, 1973, "A Survey on Parasitic Infections among Aborigines in Remote Mountain Area of Chien-shih District, Hsinchu County, Taiwan," *JFMA*, 72:5, p. 299, Table 2; p. 301, Table 4.

<sup>96</sup> Chung W. C., Fan P. C. and Chiu H. M., 1985, "Survey of Helminthic Infections and Treatment of *Taenia* Species Infection among the Aborigines in Chien-shih District, Hsin-chu County, Northern Taiwan," *Chinese Journal of Microbiological Immunology* (《中華微免雜誌》), 18, p. 96 and p. 98, Table 1.

16.8%, with the order of Gl 10.1%, Ec 4.3%, Eh 1.4%, and En 0.6%. The elementary school children had a total helminthic infection rate of 81.0%, with Tt 75.5%, Al 37.3%, Hw 11.3%, Tae 1.2%, and Pw and Cs 0.02% each; the total protozoan infection rate among children was 18.2%, with Gl 12.3%, Ec 5.5%, Eh 1.7%, and En 0.02%. In addition, the Ev infection rate of children was 47.3%.

Table 20: The Parasitic Infections among Inhabitants and Students at Chienshih Rural Township in Hsinchu County, 1967-1979 (% in Parenthesis)

Place	Yihsing, Chialo, Chinping		Middle School	Elementary School	Yufeng, Hsiuluan	
Time	1967/7-10		1978-79	1978-79	1971/7	1979/3-7
No. Examined	Aborigines 239	Chinese 224	346	600	481	770
No. Infected	229(96.2)	197(88.0)	H (75.7) P (16.8)	H (81.0) P (18.2)	H 448(93.1) P 137(28.5)	616(80.0)
Al ( <i>Ascaris lumbricoides</i> )	197(82.4)	178(79.5)	(43.1)	(37.3)	427(88.8)	594(77.1)
Tt ( <i>Trichuris trichiura</i> )	164(68.9)	126(56.3)	(59.5)	(75.5)	189(39.3)	222(28.8)
Hw (hookworm)	53(22.2)	40(17.9)	(4.9)	(11.3)	13(2.7)	1(0.3)
Tae ( <i>Cestoidea, Taenia</i> sp.)	17(7.2)*	--	(2.0)	(1.2)	45(9.4)	142(18.4)
Ev ( <i>Enterobius vermicularis</i> ) *	39/221 (17.7)	101/163 (61.4)	--	(47.3)	--	12(1.6)
Pw ( <i>Paragonimus westermani</i> )	10(4.3)	--	--	(0.02)	--	--
Cs ( <i>Clonorchis sinensis</i> )	--	--	--	(0.02)	--	--
Hd ( <i>Hymenolepis diminuta</i> )	--	--	--	--	4(0.8)	1(0.3)
Hn ( <i>Hymenolepis nana</i> )	--	--	--	--	--	1(0.3)
Ech ( <i>Echinostoma</i> sp.)	--	--	--	--	3(0.6)	--
Gl ( <i>Giardia lamblia</i> )	--	--	(10.1)	(12.3)	41(8.5)	--
Ec ( <i>Entamoeba coli</i> )	--	--	(4.3)	(5.5)	74(15.4)	--
Eh ( <i>Entamoeba histolytica</i> )	--	--	(1.4)	(1.7)	36(7.5)	--
En ( <i>Endolimax nana</i> )	--	--	(0.6)	(0.02)	15(3.1)	--
Ib ( <i>Iodamoeba bütschlii</i> )	--	--	--	--	3(0.6)	--
Bc ( <i>Balantidium coli</i> )	--	--	--	--	2(0.4)	--
Cm ( <i>Chilomastix mesnili</i> )	--	--	--	--	1(0.2)	--

\* Examination with Scotch- *Ascaris lumbricoides* tape perianal swab method.

Source: Wen Yung-fu, 1969, p. 446, Table 1. Wu Y. Y. and Lü S. C., 1979, p. 113. Chang Kok-chung, Sun Yun-lai, and Chiu Jui-kuang, 1973, p. 299, Table 2; p. 301, Table 4. Chung W. C., Fan P. C., Chiu H. M., 1985, p. 98, Table 1.

In the remote mountain area of Chienshih district, the total helminthic infection rate was 93.1% in 1971, with Al 88.8%, Tt 39.3%, Tsa 9.4%, Hw 2.7%, Hd 0.8%, and *Echinostoma* sp. (Ech) 0.6%. The total protozoan infection rate was 28.5%, with Ec 15.4%, Gl 8.5%, Eh 7.5%, En 3.1%, Ib 0.6%, Bc 0.4%, and Cm 0.2%. In 1979, The total helminthic infection rate was 80.0%, with Al 77.1%, Tt 28.8%, Tsa 18.4%, Ev 1.6%, and Hw, Hn and Hd each had 0.1%.

Compared the results of two surveys each in the lower and remote mountain areas of Chienshih district, it is notable that in 1979 the helminthic infection rate was still rather high but was already lower than in 1967-1971. This was related to the

parasitic controlling program initiated in 1972 by the government.<sup>97</sup>

It should be noted here that in 2001, Fan Ping-chin et al reported that the tapeworm found in Taiwan was different from classical *Taenia saginata* and it was given a new name of *Taenia saginata asiatica* in 1995. They summarized the results of examinations conducted during 1971-1992 with 27,359 at 88 villages of 14 mountain districts in 10 counties and counted 3,104 persons (11% of the total) were infected with this parasite. Counted by each county, Taipei had 62 persons (8%), Taoyuan had 212 persons (10%), Hsinchu had 467 persons (12%), Yilan had 1,298 persons (16%), Nantou had 310 persons (6%), Chiayi had 3 persons (0.4%), Kaohsiung had 56 persons (9%), Pingtung had 10 persons (4%), Taitung had 319 persons (11%), Hualien had 367 persons (13%).<sup>98</sup> It is notable that the infection of *Taenia saginata asiatica* in Hsinchu was only lower than that in Yilan and Hualien counties.

### 3. Yilan County

Regarding the parasitic infections among inhabitants in Yilan County, the earlier surveys focused on school children at Kuishan Island 龜山島. There are three reports: Kuntz and Wells examined 80 children in 1959-62;<sup>99</sup> Chung and Cross examined 158 children in 1975;<sup>100</sup> and Chung Wen-cheng examined 62 children in 1977.<sup>101</sup> In addition to Kuishan Island, Kuntz and wells also examined 204 children and 115 adults at Toucheng 頭城, 147 Taiwanese children and 116 aboriginal children at Nanao 南澳. In 1978-1979, Fan Ping-chin's team adopted Formalin-ether concentration method to examine intestinal parasites with 1,767 students at four middle schools at Chuangwei 壯圍, Toucheng, Yuanshan 員山 and Chiaohsi 礁溪, and used the Scotch-tape perianal swab method to examine pinworm with 2,329 children.<sup>102</sup> In January and February 1980, Fan Ping-chin' team used the same methods to examine 1,074 students at Nanao for intestinal parasites, and 1,051

<sup>97</sup> Chung W. C., Fan P. C. and Chiu H. M., 1985, p. 99.

<sup>98</sup> Fan Ping-chin, Chung Wen-cheng, and Chen Eng-rin, 2001, "Parasitic Infections among the Aborigines in Taiwan with Special Emphasis on *Taeniasis Asiatica*," *Kaohsiung Journal of Medical Science*, 17: 1, p. 2, p. 7, Table 4.

<sup>99</sup> Robert E. Kuntz and William H. Wells, 1967, "Parasites in School Children of I-lan and Peng-hu Hsiens; and Adults in I-lan and Chang-hua Hsiens, Taiwan," *JFMA*, 66: 6, pp. 300-307.

<sup>100</sup> Chung Pyung-rim and John H. Cross, 1975, "Prevalence of Intestinal parasites in Children on a Taiwan Offshore Island Determined by the Use of Several Diagnostic Methods," *JFMA*, 74:6, pp. 411-418.

<sup>101</sup> Chung Wen-cheng, 1977, "Report on Survey on Parasitic Infection at Kuishan Island, Yilan County, Taiwan," *Biological Science* (《生物科學》), 11, pp. 47-54.

<sup>102</sup> Fan P. C., David Chao, Liu H. Y., Lee K. M., Cheng F. Y. Wang K. H. and Lee S. H., 1980, "Comparative Studies on Prevalence of Common Intestinal Nematode Parasites in the Tape-water and Non-tape-water Supported Areas in Taiwan, Part I. Prevalence and Chemotherapy of Common Intestinal Nematode Parasites among Junior High School Students in Ilan County, Northern Taiwan," *National Science Council Monthly* (《科學發展月刊》), 8: 12, pp. 1168-1179.



children at Nanao and 200 children at Chuangwei for pinworm.<sup>103</sup> From April 1981 to March 1983, Fan Ping-chin's team conducted survey and treatment of parasites at Nanao and Tatung 大同 districts.<sup>104</sup>

Table 21.1: The Parasitic Infections among School Children at Kuishan Island, Yilan County, 1959-1977 (% in Parenthesis)

Helminth			
Year	1959-62	1975	1977
No. Examined	80	158	62
Al ( <i>Ascaris lumbricoides</i> )	(93)	76(48)	(41.9)
Tt ( <i>Trichuris trichiura</i> )	(100)	157(99)	(75.8)
Hw (hookworm)	(0)	22(14)	(25.8)
Ev ( <i>Enterobius vermicularis</i> )	(1)	20(13)	(16.3)
Ev ( <i>Enterobius vermicularis</i> )*	--	--	(58.3)*
Hn ( <i>Hymenolepis nana</i> )	(4)	30(19)	(11.3)
Hd ( <i>Hymenolepis diminuta</i> )	(0)	(0)	(3.2)
Tae ( <i>Taenia saginata</i> )	(1)	(0)	(1.6)
<i>Didymozoon</i> -like egg		(41)	
Protozoa			
Year	1959-62	1975	1977
No. Examined	80	158	62
Eh ( <i>Entamoeba histolytica</i> )	(23)	29(18)	(4.8)
Eha ( <i>Entamoeba hartmanni</i> )	(15)	28(18)	(14.5)
Ec ( <i>Entamoeba coli</i> )	(30)	62(39)	(46.8)
En ( <i>Endolimax nana</i> )	(9)	23(15)	(8.1)
Df ( <i>Dientamoeba fragile</i> )	(3)	5(3)	(0)
Ib ( <i>Iodamoeba bütschlii</i> )	(0)	4(3)	(0)
Cm ( <i>Chilomastix mesnili</i> )	(5)	(0)	(1.6)
Gl ( <i>Giardia lamblia</i> )	(9)	50(32)	(30.7)
Tricho ( <i>Trichomonas hominis</i> )	(0)	32(20)	(1.6)
Enba ( <i>Enbdomonas intestinali</i> )	(0)	(0)	(1.6)
Bc ( <i>Balantidium coli</i> )	(0)	(0)	(1.6)
<i>Isospora</i>	(0)	1(0.6)	(0)

\* Examination with Scotch-tape perianal swab method. The number examined was 132.

Source: R. E. Kuntz and W. H. Wells, 1967, p. 304, Table 1. Chung Pyung-rim and John H. Cross, 1975, p. 415, Table 4. Chung Wen-cheng, 1977, p. 50, Table 1; p.53, Table 5.

<sup>103</sup> Fan P. C., David Chao, Liu H. Y., Lee K. M., Cheng F. Y. Wang K. H. and Wu C. C., 1981, "Comparative Studies on Prevalence of Common Intestinal Nematode Parasites in the Tape-water and Non-tape-water Supported Areas in Taiwan, Part II. Prevalence of Common Intestinal Parasites among Children in the Remote Area of Taiwan and Determination of the Minimum Effective Dose of New Broad Spectrum Anthelmintics against the Common Intestinal Parasites," *National Science Council Monthly* (《科學發展月刊》), 9:2, pp. 159-175.

<sup>104</sup> Fan P. C., Chung W. C., Chan C. H., Lee K. M., Wang C. C. and Wu C. C. , 1982, "A Pilot Control Study of Common Intestinal Parasites and Head Louse among Aboriginal Children in Taiwan, ROC, Part I. Prevalence and Chemotherapy of Parasitic Infections among Aboriginal Children in Nan-ao and Ta-tung districts, Ilan County, Northern Taiwan," *National Science Council Monthly* (《科學發展月刊》), 10: 9, pp. 773-798 ; Fan P. C., Chung W. C., Chan C. H., Cheng F. Y., Chen Y. A., and Hsu, M. C., 1984, "A Pilot Control Study of Common Intestinal Parasites and Head Louse among Aboriginal Children in Taiwan, ROC, Part II. The 2<sup>nd</sup> Year Survey and Treatment of Intestinal Helminths and Head Louse Infections among Aboriginal Children in Ta-tung and Nan-ao districts, Ilan county, Northern Taiwan," *National Science Council Monthly* (《科學發展月刊》), 11: 12-3, pp. 1511-1535.

Table 21.1 shows that during 1960-1977, the parasitic infections among school children at Kuishan Island had changed substantially; the rate of Al declined from 93% to 41.9%; that of Tt from 100% to 75.8%; but that of Hw increased from 0 to 25.8% and that of Ev from 1% to 16.3%; using the Scotch-tape swab method the infection rate of Ev in 1977 was 58.3%. Of the protozoa, the rate of Eh declined from 23% to 4.8%, but that of Eha and En declined only slightly; on the contrary, the infection rates of Ec and Gl increased a lot; Ec from 30% to 46.8% and Gl from 9% to 31%. For other species, the infection rate was mostly around 1% or none at all. Moreover, the survey in 1975 discovered 41% infected with *Didymozoon*-like egg.

Table 21.2 shows that around 1960, the total helminthic infection rate among students at Toucheng middle school was 98% and among the adults 90%. Specifically, both the students and adults had 70% infected with Al and 68% with Tt; but the students had 25% infected with Hw while the adults 36%; the students had 1% infected with tapeworm and the adults 2%. At Nanao, both the aboriginal and Han Taiwanese children had 100% infected with parasites; with Al 93% and 99% respectively, Tt both 90%, Hw 29% and 50% respectively; showing higher rates among the aborigines. In addition, the aborigines had 13% infected with tapeworm. In 1978-1979, the total infection rate among students in Yilan was 42%, with Al 14.5%, Tt 32.9%, and Hw 3.9%; much lower than those rates in 1960. However, using the Scotch-tape swab method, the infection of Ev was 41.9%; much higher than 9% with other method. It is also notable that the surveys in 1978-79 found that the parasitic infection rates were not closely related with the supply of tape-water.<sup>105</sup> In February 1980, the survey at Nanao found that the total infection rate was 60.9%, with Tt 45.3%, Al 39.9%, Hw 10.6%, Tae 2.4%, and Hn 0.5%. Using the Scotch-tape swab method, the results showed the positive rate was 25% among 1,051 children at Nanao and 49% among 200 children at Chuangwei; demonstrating that enterobiasis was more prevalent among children at the plain than at the mountain area.<sup>106</sup>

As for surveys conducted at Nanao and Tatung districts during 1981-1983, Table 21.1 listed the results before treatment (1981/5), after the first treatment (1982/6) and after the fourth treatment (1983/1). In the case of Nanao, the total infection rate declined from 79% to 24%, with Al from 53% to 0.6%, Tt from 57% to 21%, Hw from 16% to 0, and Ev from 4% to 1.2%. In the case of Tatung, the total infection rate declined from 83% to 25%, with Al from 64% to 1.5%, Tt from 66% to 24%, Hw from 7% to 0.3%, and Ev from 8% to 1.8%. The magnitude of decline was quite substantial. Moreover, the result of using the Scotch-tape swab method to examine tapeworm also found a decline in infection rate; at Nanao from 2% to 0.9% and at

<sup>105</sup> Fan P. C. et al., 1980, pp. 1170-1171.

<sup>106</sup> Fan P. C. et al., 1981, p. 163 and p. 164, Table 5.

Tatung, from 5% to 0.4%. Using the Test-tube filter-paper cultivation method to examine *S. stercoralis*, it was found that the infection rate decline from 6 % to 2.4% at Nanao but increased from 3% to 5.3% at Tatung.

Table 21.2: The Parasitic Infections among Student and Inhabitants in Yilan County, 1960-1983 (% in Parenthesis)

Place	Toucheng		Yilan	Nanao		
Examinee	Middle S	Adults	4 Middle S	Han Children	Aboriginal Children	4 ES & 1 MS
Year	1959-62	1959-62	1978-79	1959-1962	1959-1962	1980/2
N. Examined	204	115	1767	147	116	1074
N. Infected	(98)	104(90)	742(42.0)	(100)	(100)	654(60.9)
Al ( <i>Ascaris lumbricoides</i> )	(70)	(68)	256(14.5)	(93)	(99)	428(39.9)
Tt ( <i>Trichuris trichiura</i> )	(70)	(68)	580(32.9)	(90)	(90)	487(45.3)
Hw (hookworm)	(25)	(36)	70(3.9)	(29)	(50)	114(10.6)
Ev ( <i>Enterobius vermicularis</i> )	(1)	(1)	9(0.5)	0	0	
Ev ( <i>Enterobius vermicularis</i> ) **	--	--	977/2329 (42)	--	--	263/1051(25)
Hn ( <i>Hymenolepis nana</i> )	0	--	--	0	--	5(0.5)
Tae ( <i>Cestoidea, Taenia</i> sp.)	(1)	(2)	--	0	(13)	26(2.4)

Place	Nanao			Tatung		
Examinee	8 ES	5 ES	5 ES	8 ES & 1 MS	5 ES & 1 MS	5 ES & 1 MS
Year	1981/5	1982/6	1983/1	1981/5	1982/6	1983/1
N. Examined	470	233	160	464	290	335
N. Infected	369(79)	71(31.8)	35(24.2)	384(83)	140(48.3)	85(25.4)
Al ( <i>Ascaris lumbricoides</i> )	249(53)	18(7.7)	1(0.6)	298(64)	61(21.0)	5(1.5)
Tt ( <i>Trichuris trichiura</i> )	268(57)	58(24.9)	34(21.3)	305(66)	103(35.5)	79(23.6)
Hw (hookworm)	14(3)	0	0	9(2)	0	1(0.3)
Hw (hookworm)*	73/459(16)	2/311(0.6)	0/205(0)	39/578(7)	2/351(0.6)	1/396(0.3)
Ss ( <i>Strongyloides stercoralis</i> )*	27/459(6)	5/311(0.9)	5/205(2.4)	15/578(3)	1/351(0.3)	21/396(5.3)
Ev ( <i>Enterobius vermicularis</i> )**	104/738 (14)	13/586 (2.2)	6/499 (1.2)a	55/668 (8)	18/647 (2.8)	12/668 (1.8)b
Hn ( <i>Hymenolepis nana</i> )	9 (2)	2(0.9)	0	9(2)	1(0.3)	3(0.9)
Tae ( <i>Cestoidea, Taenia</i> sp.)	--	1(0.3)	0	--	1(0.3)	2(0.6)
Tae ( <i>Cestoidea, Taenia</i> sp.)**	11 (2)	11/1233 (0.9)	3/1167 (0.3)	23 (5)	8/647 (1.2)	3/668 (0.4)

\* Examination with Test-tube filter-paper cultivation method.

\*\*Examination with Scotch-tape perianal swab method.

a. 8 elementary schools. B. 8 elementary schools and 1 middle school.

Source: R. E. Kuntz and W. H. Wells, 1967, 304-305 · Tables 1-2. Fan P. C. *et al.*, 1980, p.1170, Table 1; p. 1171, Table 2. Fan P. C. *et al.*, 1981, p. 164, Table 5; p. 165, Table 7. Fan P. C. *et al.*, 1982, p.778, Table 1. Fan P. C. *et al.*, 1984, p. 1514, Table 1; p. 517, Table 4; p. 1520, Table 7; p. 1522, Table 9.

As for the infection rate of protozoa, it was only available in the survey around 1960. The infection rates among student of Toucheng middle school were Ec 9%, Eh and En each 6%, Eha 3%, Cm and Gl each 2%, Df and Ib each 1%. Among the adults at Toucheng, the infection rates were Eh and Ec each 8%, En 7%, Eha 4%, Df, Gl, and Cm each 2%. Among the Taiwanese children at Nanao, the infection rates were Ec 12%, Eha 7%, and En 2%; among the aboriginal children, the infection rates were Ec

18%, Eha and En each 10%, Gl 7%, Eh 3%, and Ib 1%.<sup>107</sup> These rates indicated that *E. coli* had a higher rate than other species; the aborigines had a higher rate than the Taiwanese, and the students and a higher rate than the adults.

#### 4. Miaoli County

Miaoli County was an area with high infection rate of *Clonorchis sinensis* and there were several surveys on parasites among school children and inhabitants. Kuntz et al. included Sanwan 三灣鄉 in their 1961 report.<sup>108</sup> Lü Sen-chi conducted survey in December 1966 at Taian 泰安鄉 and Nanchuang 南庄. There were 1,749 aboriginal school children received stool examinations and 2,066 examined for pinworm with the Scotch-tape perianal swab method.<sup>109</sup> Chou Chun-hsiung and Huang Wen-hsien conducted examinations in July 1967 with 2,028 school children at four elementary schools at Hsihu 西湖鄉, of them 1,722 received stool examinations and 1,997 received intradermal tests for paragonimiasis.<sup>110</sup> Chou Chun-hsiung and Kao Chi-tien conducted examinations in December 1968 at Sanwan for 2,095 school children.<sup>111</sup> From December 1977 to May 1978, Ong Hsiou-jeng and Lü Sen-chi conducted stool examinations with public servants, teachers, and students at Miaoli Township 苗栗鎮. The people examined included 1,304 elementary school children, 112 junior high school students, 101 senior high school students, and 681 public servants and teachers.<sup>112</sup> In July and August 1983, Lu Jin-lang, Chung Wen-cheng and Chang Ke-chieng conducted survey at Taian district, those received stool examinations were 242 inhabitants including adults, junior high school students and elementary school children. In addition, 254 children from 7 schools received examinations for pinworm with the Scotch-tape swab method.<sup>113</sup>

Table 22 shows the results related to Miaoli County. Around 1960, the parasitic infection rate for inhabitants at Sanwan was 89%, while in 1967 the rate for school children at Hsihu was 58.7%, and in 1977-1978, the infection rate was much lower at Miaoli Township. Among the four groups of people examined at Miaoli Township, the highest infection rate was 57.4% for public servants and teachers, followed by 14.9%

<sup>107</sup> Robert E. Kuntz and William H. Wells, 1967, pp. 304-305.

<sup>108</sup> Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 811, p. 815.

<sup>109</sup> Lü Sen-chi, 1968, "A Survey on Helminthic and Protozoan Infections among Aboriginal School Children in Miao-li County, Taiwan," *JFMA*, 67: 4, pp. 120-133.

<sup>110</sup> Chou Chun-hsiung and Huang Wen-hsien, 1970, "The helminthic parasitic infections among elementary school children at Hsi-hu district in Miao-li county," *JFMA*, 69: 9, pp. 484-485.

<sup>111</sup> Chou Chun-hsiung and Kao Chi-tien, 1972, "Paragonimus and Intestinal Helminthic Infection among School Children in San-wan District of Miaoli County, Taiwan," *JFMA*, 71:8, pp. 525-529.

<sup>112</sup> Ong Shiu-jeng and Lü Sen-chi, 1979, "Protozoan and Helminthic Infections among the Government Workers and Students of Miao-li District in Miao-li County: A Highly Endemic Area of Clonorchiasis in Taiwan," *Chinese Journal of Microbiology*, 12:1, pp. 13-20.

<sup>113</sup> Lu Jin-lang, Chung Wen-cheng, and Chang Ke-chien, 1987, "Prevalence of Parasitic Infections among Aborigines in Tai-an District, Miao-li County, Taiwan," *Journal of Taipei Medical College*, 16, pp. 119-129.

for senior high school students, 14.1% for elementary school children, and 11.6% for junior high school students. In 1966, the henminthic infection rate of aboriginal children at Taian and Nanchuang was 90.6%. In 1983, the infection rate among aborigines at Taian was still as high as 72.3%.

Table 22: The Parasitic Infections among Inhabitants in Miaoli County, 1960-1983  
(% in parenthesis)

Place	Sanwan		Hsihu	Miaoli Township				Taian & Nanhuang	Taian
Year	1960	1968	1967	1977-78				1966/12	1983/7-8
Examinee	GP	ESC	ESC	ESC	JHS	SHS	PS&T	Abo. ESC	Aborigine
No. Examined	269	2095	1722	1304	112	101	681	1749	242
N. Infected	(89)*	1290 (61.6)	1010 (58.7)	184 (14.1)	13 (11.6)	15 (14.9)	391 (57.4)	H 1584(90.6) P 288(16.5)	175 (72.3)
Cs ( <i>Clonorchis sinensis</i> )	(1)	0	0	41 (3.1)	8 (7.1)	8 (7.9)	379 (55.7)	1 (0.1)	23 (9.5)
Al ( <i>Ascaris lumbricoides</i> )	(47)	856 (40.9)	709 (41.2)	24 (1.8)	1 (0.9)	1 (1.0)	2 (0.3)	1416 (81.0)	64 (26.4)
Tt ( <i>Trichuris trichiura</i> )	(59)	313 (14.9)	299 (17.4)	61 (4.7)	0	1 (1.0)	5 (0.7)	882 (50.4)	106 (43.8)
Hw (hookworm)	(48)	579 (27.6)	343 (19.9)	16 (1.2)	1 (0.9)	0	10 (1.5)	552 (31.6)	50 (20.7)
Ev ( <i>Enterobius ermicularis</i> )	--	--	--	--	--	--	--	1126 (54.5)**	--
Ss ( <i>Strongyloides tercoralis</i> )	--	--	--	2 (0.2)	0	0	0	3 (0.2)	2 (0.8)
Pw ( <i>Paragonimus westermani</i> )	(7)	(2.2)***	--	--	--	--	--	9 (0.5)	2 (0.8)
Hn ( <i>Hymenolepis nana</i> )	--	--	--	--	--	--	--	--	2 (0.8)
Hd ( <i>Hymenolepis diminuta</i> )	(1)	--	--	--	--	--	--	--	--
Ech ( <i>Echinostoma</i> sp.)	(1)	--	--	--	--	--	--	--	--
My ( <i>Metagonimus yokogawai</i> )	(1)	--	--	--	--	--	--	--	--
Gl ( <i>Giardia lamblia</i> )	(5)	--	--	45(3.5)	3 (2.7)	7 (6.9)	5 (0.7)	89 (5.1)	12 (5.0)
Eh ( <i>Entamoeba histolytic</i> )	(2)	--	--	0	0	0	1 (0.1)	27 (1.5)	--
Ec ( <i>Entamoeba coli</i> )	(5)	--	--	1 (0.1)	0	0	1 (0.1)	159 (9.1)	11 (4.5)
En ( <i>Endolimax nana</i> )	(5)	--	--	2(0.2)	0	0	--	64 (3.7)	--
Ib ( <i>Iodamoeba bütschlii</i> )	--	--	--	--	--	--	--	15 (0.9)	1 (0.4)
<i>Isospora</i>	--	--	--	--	--	--	--	--	2 (0.8)

GP: General Population. ESC: elementary school children; JHS: junior high school students;

SHS: senior high school students; PS&T: public servants and teachers.

\* Calculated from the original percentage of "Stool with neither".

Source: Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 815, Table 1. Chou Chun-hsiung and Kao Chi-tien, 1972, p. 527, Table 2. Chou Chun-hsiung and Huang Wen-hsien, 1970, p. 485, Table 1. Ong Shiou-jeng and Lü Sen-chi, 1979, pp. 15-16, Tables 1-4. Lü Sen-chi, 1968, p. 122, Table 1; p. 126, Table 3. Lu Jin-lang, Chung Wen-cheng and Chang Ke-chien, 1987, p. 120, Table 1; p. 122, Table 4.

The villagers at Sanwan were mostly Hakka, but their infection rate of Cs was only 1% in 1966, while in 1977-1978 at Miaoli, the rate of Cs was the highest counted 55.7%, 7.9% and 7.1% respectively for public servants and teachers, senior high school, and junior high school students. Those infected with Cs were mostly Hakka and Cantonese who had a custom of eating raw fish ("yu-sheng" 魚生) and raw fish gruel ("yu-sheng-chou" 魚生粥).<sup>114</sup> It is notable that in 1983, the aborigines at Taian

<sup>114</sup> Ong Hsiou-jeng and Lü Sen-chi, 1979, p. 16.

had 9.5% infected with Cs with the rate for the adult counted for 26.4%.<sup>115</sup>

In addition to Cs, the infection rates among villagers at Sanwan were Tt 59%, Hw 48%, Al 47%, and 5% each for Ec, En and Gl. Moreover, that there were 7% of villagers at Sanwan infected with Pw and 1% each with My, Hd, and *Echinostoma*.<sup>116</sup> These four species were not found among inhabitants of Miaoli Township. For the elementary school children at Miaoli Township, the infection rates were Tt 4.7%, Gl 3.5%, Cs 3.1%, En 0.2%, and Ec 0.1%. It is notable that the infection rate of *Giardia lamblia* among junior high school students was 2.7% and among senior high school student 6.9%, both ranking the second highest among the two groups. Among the public servants and teachers, in addition to the high infection rate of Cs, there was 1.5% infected with hookworm and this was perhaps due to the fact that their families were engaging in agriculture and they had opportunities to work in the field and contact with the origin of infection. Moreover, there was 0.1% infected with Eh and 0.1% with Ec.

As for the aborigines at Taian, besides Cs, there were Tt 43.8%, Al 26.4%, Hw 20.7%, Gl 5%, Ec 4.5%, and 0.8% each for Ss, Pw, Hn, and *Isospora* as well as Ib 0.4%. Moreover, at Taian, there were 96 cases (54.9%) single infection, 62 (35.4%) double infections, 14 (8.0%) triple infections, 2 (1.1%) quadruple infections and 1 (0.6%) quintuple infections.<sup>117</sup>

## 5. Nantou County

In Nantou County, the Sun Moon Lake area was known with high infection rate of *Clonorchis sinensis*. In 1966, Kuntz presented a brief report regarding the intestinal parasitic infection among inhabitants of Huafanshe 花番社 at the Sun Moon Lake area.<sup>118</sup> In February and July 1969, Clarke, Khaw, and Cross conducted stool examinations at Huafanshe and Peitan 北潭 around the Sun Moon Lake. At Huafanshe, those accepted examinations were 156 persons in February and 253 persons in July, with 73 persons received both examinations. At Peitan, the examination was conducted only in July with 56 persons. This survey confirmed further that Sun Moon Lake area was endemic with *Clonorchis sinensis*.<sup>119</sup> In October 1971, Cross et al. presented a report on a survey aimed at tracing 2 cases of *Macranthorhynchus hirudinaceus* found in April 1967. The survey was conducted at

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<sup>115</sup> Lu Jin-lang, Chung Wen-cheng, and Chang Ke-chieng, 1987, pp. 121 · 125 ·

<sup>116</sup> Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 815, Table 1.

<sup>117</sup> Lu Jin-lang, Chung Wen-cheng, and Chang Ke-chieng, 1987, p. 122, Table 3.

<sup>118</sup> Robert E. Kuntz, 1966, "Intestinal Parasites in People of Taiwan: A cursory survey of Hua-fan-she Village (Sun Moon Lake, Nan-tou Hsien): A New Locality for endemic *Clonorchiasis*," *Formosan Science*, 20:2, pp. 63-68.

<sup>119</sup> Michael D. Clarke, O. K. Khaw, and J. H. Cross, 1971, "Clonorchiasis in Sun Moon Lake Area," *Chinese Journal of Microbiology*, No. 4, pp. 50-60.

four villages of Atayal aborigines at Jenai district 仁愛鄉 with 438 persons aged 2-71, of them 223 males and 215 females.<sup>120</sup> From August 1971 to February 1972 a team of the China Medical College conducted survey at Hsinyi district 信義鄉 in Nantou County.<sup>121</sup> In addition, in August 1973, Chiu Jui-kuang et al. conducted examinations at Tannan 潭南 village at Hsinyi district with 417 Atayal aborigines, of them 224 males and 193 females.<sup>122</sup> Here the results of these surveys are listed in Table 23.

Table 23: The Parasitic Infections among Inhabitants in Nantou County, 1966-1972  
(% in the parenthesis)

Place	Huafanshe				Peitan	4 v. Jenai	Hsinyi	Tannan
Year	1966	1969/2	1969/7	1969/2-7	1969/7	1971	1971-72	1973/8
No. Examined	62	156	253	73	56	438	153	417
No. Infected	(97)*	153 (98.1)	243 (96.1)	72 (98.6)	51 (91.1)	(97)	113 (73.9)	H 399(95.7) P 66(15.8)
Cs ( <i>Clonorchis sinensis</i> )	(39)	81 (51.9)	111 (43.9)	43 (58.9)	6 (10.7)	2 (0.5)	3 (2.0)	12 (2.9)
Tt ( <i>Trichuris trichiura</i> )	(60)	128 (82.1)	201 (79.5)	68 (93.2)	45 (80.4)	(67)	63 (41.2)	307 (73.6)
Al ( <i>Ascaris lumbricoides</i> )	(90)	122 (78.2)	175 (69.2)	63 (86.3)	40 (71.4)	(81)	98 (64.1)	339 (81.3)
Hw (hookworm)	(36)	62 (39.7)	49 (19.4)	31 (42.5)	15 (26.8)	(2)	16 (10.5)	129 (30.9)
Ev ( <i>Enterobius vermicularis</i> )	0	2 (1.3)	0	1 (1.4)	0	--	1 (0.6)	--
Ss ( <i>Strongyloides stercoralis</i> )	(3)	--	--	--	--	--	--	2 (0.5)
Tsa ( <i>Taenia saginata</i> )	--	--	--	--	--	(6)	3 (2.0)	1 (0.2)
Tso ( <i>Taenia solium</i> )	--	--	--	--	--	--	--	1 (0.2)
Gl ( <i>Giardia lamblia</i> )	(10)	8(5.1)	11(4.4)	7 (9.6)	0	(11)	--	18 (4.3)
Ec ( <i>Entamoeba coli</i> )	(3)	10(6.4)	5 (2.0)	4 (5.5)	3 (5.4)	(24)	--	38 (8.4)
Ib ( <i>Iodamoeba bütschli</i> )	(3)	--	--	--	--	(1)	--	--
Eh ( <i>Entamoeba histolytica</i> )	0	0	2 (0.8)	0	1 (1.8)	(8)	--	13 (3.1)
Eha ( <i>Entamoeba hartmanni</i> )	--	1 (0.6)	0	1 (1.4)	0	(10)	--	--
En ( <i>Endolimax nana</i> )	--	--	--	--	--	(9)	--	11 (2.6)

\* Calculated from the percentage listed in original table as "Stools with neither".

Source: Robert E. Kuntz, 1966, p. 65, Table I. Michael D. Clarke, O. K. Khaw, and J. H. Cross, 1971, p. 52, Table I, p. 53, Table II. J. H. Cross, K. D. Murrell, and M. D. Cates, 1971, p. 117, Table 1; p. 118. The Medical Team of the China Medical College, 1972, p. 53, calculated with figures listed in Table 1. Chiu Jui-kuang, Chiu Ping-chou, and Tseng Po-tsun, 1979, pp. 156-157, Tables 1-2.

Table 23 shows that the total parasitic infection rate in 1966 at Huafanshe was 97% and in 1969, it was 98% at Huafanshe and 91% at Peitan. In terms of helminthes, at Huafanshe in 1966, the highest infection rate was Al 90%, followed by Tt 60%, Cs 39%, Hw 36%, and Ss 3%. In 1969 at Huafanshe, Tt had the highest infection rate

<sup>120</sup> J. H. Cross, K. D. Murrell, and M. D. Cates, 1971, "Survey for Intestinal Parasites in Aborigines in Nantou County, Central Taiwan, with a Report of two Spurious Infections of *Macranthorhynchus hirudinaceus*," *Chinese Journal of Microbiology*, 4, pp. 116-122.

<sup>121</sup> The Medical Team of the China Medical College, 1972, "A Survey of Intestinal Helminthic Infection among Aborigines," *China Medical College Annual Bulletin*, Vol. 3, pp. 53-55.

<sup>122</sup> Chiu Jui-kuang, Chiu Ping-chou, and Tseng Po-tsun, 1979, "Prevalence of Intestinal Parasitic Infections among Inhabitants of Tan-nan Village, Nantou County, Taiwan," *Chinese Journal of Microbiology*, 12, pp. 155-160.

(82.1% in February, 79.5% in July, and 93.2% for both), followed by Al (78.2%, 69.2% and 86.3% respectively), Cs (51.9%, 43.9% and 58.9% respectively), Hw (39.7%, 19.4% and 42.5% respectively), and Ev (around 1%). It was noted that among those examined in February 1969, the infection rate of Cs among the Tsou aborigines (58%) was higher than that found among Chinese (40%) and Bunun and Hakka (39%). The higher rate of Tsou people was related to their habit of eating raw fish.<sup>123</sup> At Peitan, the infection rate of Tt 80.4% was also the highest, followed by Al 71.4%, Hw 26.8%, and Cs 10.7%. The 1971 reports on 4 villages at Jenai district showed that the helminthic infections among Atayal aborigines were in the following order: Al 81%, Tt 67%, Tas 6% and Hw 2%; those below 1% were Cs and *Dicrocoelium* sp., each had 2 cases; Hn and Hd each had 1 case. Moreover, at the four villages, there were 80% with multiple infections.<sup>124</sup> In 1971-72, the infection rates among the aborigines at Hsinyi district were in the order of Al 64.1%, Tt 41.2%, Hw 10.5%, Cs 2%, Tas 2% and Ev 0.6%. In August 1973, the infection rates among the aborigines at Tannan village were Al 81.3%, Tt 73.6%, Hw 30.9%, Cs 2.9%, and there were 3 cases (0.7%) for Hd, 2 cases (0.5%) for Ss, and 1 case (0.2%) each for Tso and Tsa. Tannan village was located south to Sun Moon Lake and the infection rate of Cs among its inhabitants was much lower than Huafanshe and Peitan. There was no pond and lake in the village, but the inhabitants confirmed that they ate the fish delivered to the village from Sun Moon Lake.<sup>125</sup>

In terms of protozoa, at Huafanshe in 1966, there were Gl 10%, Ec and Ib 3% each. In 1969, the infection rates were Gl (5.1%, 4.4% and 9.6% respectively) and Ec (6.4%, 2.0% and 5.5% respectively), while Eh and Eha were both around 1%. At Peitan, the infection rates were Ec 5.4% and Eh 1.8%. In 1971, the aborigines at 4 villages in Jenai district were infected with Ec 24%, Gl 11%, Eha 10%, En 9%, Eh 8%, and Ib 1%. In August 1973, the infection rates among the aborigines at Tannan village were in the order Ec 8.4%, Gl 4.3%, Eh 3.1%, and En 2.6%. In short, the protozoa infection rates were in general higher in Jenai district.

## 6. Changhua and Tainan Counties

In the aforementioned report of Kuntz et al. in 1961, there were results of survey with 263 inhabitants at Puyen district 埔鹽鄉, 246 at Peishihwei village 北勢尾, Changhua County, and 329 at Paweng village 八翁村 at Liuying district 柳營鄉 in

<sup>123</sup> Michael D. Clarke, O. K. Khaw, and J. H. Cross, 1971, pp. 53, 55, 57, 60. The aborigines living around Sun Moon Lake has been re-named as Thao (邵), to be distinguished from Tsou (曹 or 鄒). Thus there is a possibility to reconsider the name of aborigines mentioned in Clarke et al.'s paper. For history and culture of Thao, see <http://www.sinica.edu.tw/~pingpu/01/soalian/title.htm>.

<sup>124</sup> J. H. Cross, K. D. Murrell, and M. D. Cates, 1971, p. 117-118.

<sup>125</sup> Chiu Jui-kuang, Chiu Ping-chou, and Tseng Po-tsun, 1979, p. 157.



Tainan County (the original paper put it in Yunlin County by mistake).<sup>126</sup> In addition, in the 1967 report by Kuntz et al. there were results of survey conducted during 1959-1962 with 50 inhabitants at Liutzukou 柳子溝 and 114 at Peishihli 北勢里.<sup>127</sup> The data of these five locations in two counties were all around 1960, thus listed together in Table 24.

Table 24: The Parasitic Infections among Inhabitants in Changhua and Tainan Counties, around 1960 (% in Parenthesis)

Place	Changhua				Tainan
	Liutzukou	Peishihli	Puyen	Peishihwei	Paweng
N. Examined	50	114	263	246	329
Infection Rate (%)	(100)	(100)	(99)	(99)	(99)
Al ( <i>Ascaris lumbricoides</i> )	(74)	(81)	(92)	(90)	(83)
Hw (hookworm)	(86)	(64)	(38)	(50)	(34)
Tt ( <i>Trichuris trichiura</i> )	(82)	(84)	(94)	(99)	(93)
Ev ( <i>Enterobius vermicularis</i> )	0	0	--	(2)	(1)
Cs ( <i>Clonorchis sinensis</i> )	(2)	0	--	(1)	(4)
To ( <i>Trichostrongylus orientalis</i> )	(1)	0	(1)	(1)	--
Hd ( <i>Hymenolepis diminuta</i> )	--	--	--	--	(1)
My ( <i>Metagonimus yokogawai</i> )	--	--	--	--	(1)
Hetro ( <i>Heterophyes</i> )	(2)	0	--	--	--
Fb ( <i>Fasciolopsis buski</i> )	--	--	--	--	(24)
Eh ( <i>Entamoeba histolytica</i> )	(10)	(4)	(20)	(17)	(29)
Eha ( <i>Entamoeba hartmanni</i> )	(14)	(10)	--	--	--
Ec ( <i>Entamoeba coli</i> )	(20)	(24)	(37)	(22)	(39)
En ( <i>Endolimax nana</i> )	(2)	(4)	(25)	(20)	(37)
Ib ( <i>Iodamoeba bütschlii</i> )	(2)	(1)	(8)	(1)	(3)
Df ( <i>Dientamoeba fragilis</i> )	(0)	(4)	--	--	--
Cm ( <i>Chilomastix mesnili</i> )	(2)	(1)	(3)	(1)	(4)
Gl ( <i>Giardia lamblia</i> )	(10)	(8)	(3)	(8)	(8)
Bc ( <i>Balantidium coli</i> )	--	--	--	(1)	--

Source: R. E. Kuntz and W. H. Wells, 1967, p. 305, Table 2. R. E. Kuntz, J. C. Burke, S. Lin, and R. H. Watten, 1961, p. 815, Table 1.

Table 24 shows that around 1960, at the five locations in Changhua and Tainan counties the total parasitic infection rates were as high as 99-100%. In the case of helminthic infections, at Liutzukou, the rates were Hw 86%, Tt 82% and Al 74%; at Peishihli, the rates were Tt 84%, Al 81%, and Hw 64%; at Puyen, the rates were Tt 94%, Al 92%, and Hw 38%; at Peishihwei, the rates were Tt 99%, Al 90%, and Hw 50%; and at Paweng, the rates were Tt 93%, Al 83%, and Hw 34%. In short, except for Liutzukou where the highest rate was that of hookworm, at the other four locations, the highest rate was that of whipworm. It was rather special that inhabitants at Paweng had 24% infected with *Fasciolopsis buski* (Fb). As for the infection rate of Cs, there was 1% at Peishihwei, 2% at Liutzukou, and 4% at Paweng. The former two rates had no other comparable data, while the last one was slightly higher than 2.14%

<sup>126</sup> R. E. Kuntz, J. C. Burke, S. Lin and R. H. Watten, 1961, pp. 811-812.

<sup>127</sup> R. E. Kuntz and W. H. Wells, 1967, p. 305, Table 2.

found by Hsieh Hsien-chen with 280 inhabitants at Liuying in July 1958.<sup>128</sup> Moreover, the infection rate of Ev at Peishihwei was 2% and at Paweng 1%; the infection rate of To at Liutzukou, Puyen, and Peishihwei was 1% each; Liutzukou also had 2% infected with *Heterophyes* (Hetero), Paweng had 1% each infected with My and Hd.

In terms of protozoa, at Liutzukou, the infection rates were Ec 20%, Eha 14%, Eh and Gl 10% each, and En and Ib 2% each. At Peishihli, the rates were Ec 24%, Eha 10%, Gl 8%, Eh, En, and Df 4% each, and Ib and Cm 1% each. At Puyen, Peishihwei, and Paweng, the highest rate was Ec, respectively with 37%, 22%, and 39%; the next was En, respectively with 25%, 20% and 37%; the third was Eh, respectively with 20%, 17% and 29%. Moreover, Puyen had Ib 8%, Peishihwei and Paweng had Gl 8%; Puyen also had Cm and Gl 3% each, Peishihwei had Ib, Cm, and Bc 1% each, and Paweng had Ib 3% and Cm 4%. Compared with other places, the protozoan infections at these five locations were relatively higher.

## 7. Kaohsiung County

In southern Taiwan, the endemic area of *Clonorchis sinensis* was in Kaohsiung County. In his 1959 report, Hsieh Hsien-chen mentioned that examinations with 514 inhabitants in September 1956 at Meinung Township 美濃鎮 found 22.37% infected with Cs.<sup>129</sup> In August 1958, Hsieh Hsien-chen et al. conducted survey with 828 aborigines at Maolin district 茂林鄉.<sup>130</sup> In the 1961 report by Kuntz et al., there were results of examinations with 297 inhabitants at Shanlin district 杉林鄉 and 337 at Meinung Township.<sup>131</sup> In 1965, Huang Wen-heien et al. presented a brief report concerning the result of examinations with 744 people at Meinung from July to August 1960.<sup>132</sup> In the 1980s, Eng-rin Chen and Chuan-min Yen presented three papers concerning *Clonorchis sinensis* and other parasites. These three studies all took skin test before stool examinations. Included in one of their 1985 report were the results of examinations with 86 school children and 19 teachers at Meinung elementary school and 60 patients at the Department of Parasitology of the Kaohsiung Medical School.<sup>133</sup> In 1987-88, they conducted survey with 714 school children at

<sup>128</sup> Hsieh Hsien-chen, 1959, "Outline of Parasitic Zoonoses in Taiwan," *Formosan Science*, 13, p. 100.

<sup>129</sup> Hsieh Hsien-chen, 1959, "Outline of Parasitic Zoonoses in Taiwan," *Formosan Science*, No. 13, pp. 90-109.

<sup>130</sup> Hsieh H. C., Shih C. C., and Yuan J. C., 1958, "Survey reports of intestinal parasites among the aborigines in Mao-lin district in southern Taiwan," *JFMA*, Vol. 57, pp. 908-909.

<sup>131</sup> Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 815, Table 1.

<sup>132</sup> Huang, W.H., Chiu, J.K., Lin, T.M. and Kao, C.T., and Tsai, W. P., 1965, "Intestinal helminthic infections among the inhabitants of Meinung district in Kaohsiung county: a high endemic area of clonorchiasis in Taiwan," *JFMA*, 64:12, pp. 795-796.

<sup>133</sup> Chen Eng-rin and Yen Chuan-min, 1985a, "Human Clonorchiasis Survey on Taiwan and Its Immunodiagnostic Technics," *Chinese Journal of Microbiological Immunology*, 18, pp. 202-209. This paper is a result of National Science Council's research project in 1982-83.

Liukuei district 六龜鄉, 2,141 employees of the Petroleum Company, and 153 patients at the Kaohsiung Medical School.<sup>134</sup> From September to December 1999, Lee June-der et al. conducted survey at Taoyuan district 桃源鄉 with a sample of 316 children from 3 elementary schools, of them 305 received stool examination for intestinal parasites and 302 for pinworm with the Scotch-tape swab method.<sup>135</sup>

Table 25: The Parasitic Infection among School children and Inhabitants in Kaohsiung County, 1960-1999 (% in parenthesis)

Place	Maolin	Shanlin	Meinung				Liukuei	Petro. Co.	Med. School Patient	Taoyuan
Examinee	Abo.	GP	GP	GP	ESC	EST	ESC			ESC
Year	1958	1960	1960	1960	1982-3	1982-3	1987-8	1987-8	1987-8	1999
No. Examined	828	297	337	744	86	19	714	2141	153	305
Al ( <i>Ascaris lumbricoides</i> )	(68.4)	(43)	(45)	(47.2)	0	0	36(5.0)	0	0	4 (1.3)
Tt ( <i>Trichuris trichiura</i> )	(17.2)	(58)	(74)	(43.3)	0	0	26(3.6)	3 (0.1)	0	13(4.3)
Hw (hookworm)	(10.4)	(49)	(54)	(40.2)	0	0	4 (0.6)	0	1 (0.7)	2 (0.7)
Ev ( <i>Enterobius vermicularis</i> )*	(8.9)a	(1)	(1)	(38.7)b	--	--	--	--	--	76(25.2)c
Cs ( <i>Clonorchis sinensis</i> )	--	(8)	(34)	(10.2)	45(52.3)	14(73.7)	2 (0.3)	59(2.8)	70(45.8)	--
Fb ( <i>Fasciolopsis buski</i> )	--	(1)	--	--	--	--	--	--	--	--
My ( <i>Metagonimus yokogawai</i> )	--	--	(2)	--	--	--	--	--	--	--
Hn ( <i>Hymenolepis nana</i> )	(0.2)	--	--	--	0	0	1 (0.1)	0	0	2 (0.7)
Tsa ( <i>Taenia saginata</i> )	(0.5)	--	--	--	0	0	0	0	1 (0.7)	--
Al & Tt	--	--	--	--	0	0	12( 1.7)	0	0	--
Tt & Cs	--	--	--	--	7 (8.1)	0	0	0	0	--
Ec ( <i>Entamoeba coli</i> )	(2.2)	--	--	--	0	0	5 (0.7)	0	0	29 (9.5)
Gl ( <i>Giardia lamblia</i> )	(1.7)	--	--	--	--	--	--	--	--	7 (2.3)
Tricho ( <i>Trichomonas hominis</i> )	(1.3)									
Bla ( <i>Blastocystis hominis</i> )	--	--	--	--	--	--	--	--	--	3 (1.0)

\* Examination with Scotch-tape perianal swab method.

The number examined: a. 599 children; b. 1,892 children; c. 302 children.

Source: Hsieh H. C., Shih C. C., and Yuan J. C., 1958, p. 909. Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 815, Table 1. Huang, W. H., Chiu, J. K., Lin, T. M., and Kao, C. T., 1965, p. 795. Chen Eng-rin and Yen Chuan-min, 1985a, p. 205, Table 2. Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 541, Table 2. Lee June-der, Wang Jiun-jye, Chung Lee-yii, Chang E. E., Lai Li-chen, Chen Eng-rin, and Yen Chuan-min, 2000, p. 454, Table 2; p.455, Table 5.

Table 25 shows that in 1958, the parasitic infection rates among the aborigines at Maolin were in the order of Al 68.4%, Tt 17.2%, Hw 10.4%, Ev 8.9%, Ec 2.2%, Gl

<sup>134</sup> Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, "Human Clonorchiasis in New Endemic Areas of Taiwan," *Kaohsiung Journal of Medical Science*, 4:10, pp. 538-546.

This paper is a result of National Science Council's research project in 1987-88.

<sup>135</sup> Lee June-der, Wang Jiun-jye, Chung Lee-yii, Chung Eddy Essen, Lai Li-chen, Chen Enng-rin and Yen Chuan-min, 2000, "A survey on the Intestinal Parasites of the School Children in Kaohsiung County," *Kaohsiung Journal of Medical Science*, 16, pp. 452-458.

1.7%, and other species about 1%. Around 1960, at Shanlin and Meinung, the parasitic infection rates were still rather high with Al 43-47%, Tt 43-74%, Hw 40-54%, Ev 1-39%, and Cs 8-34%. Moreover, there were Fb 1% at Shanlin and My 2% at Meinung. In the 1980s, among children at Meinung elementary school the rate of Cs was 52.3% and another 8.1% simultaneously infected with Tt and Cs; among the teachers, the infection rate of Cs was 73.7%. But among the school children at Liukuei, the infection rate of Cs was only 0.3% which was lower than Al 5.0%, Tt 3.6%, Hw 0.6%, and the double infection of Al and Tt 1.7%. The employees of the Petroleum Company had 2.8% infected with Cs in addition to Tt 0.1%. However, the patients at the Parasitology Department of the Kaohsiung Medical School had 45.8% infected with Cs. In 1999, the highest infection rate among school children at Taoyuan was Ev 25.2%, followed by Ec 9.5%, Tt 4.3%, Gl 2.3%, while Al, Hw, Hn, and *Blastocystis hominis* (Bla) all around 1%. Moreover, among the school children at Taoyuan, there were 45 cases (15%) of single infection, 4 (1%) double infections, 1 case each for triple and quintuple infections.<sup>136</sup> It is notable that using the same method of examination, in 1960 the infection rate of Ev was 38.7% among the inhabitants of Meinung, thus the infection rate of 25.2% among school children at Taoyuan in 1999 was comparatively lower.

## 8. Pingtung County

In 1971 Durfee and Tsai conducted a survey with 127 aborigines at Santimen.<sup>137</sup> In July 1979, Fan Ping-chin et al conducted survey at 5 elementary school at Manchou district 滿州鄉 with 1,193 children, most of them were aborigines of Paiwan tribe 排灣族.<sup>138</sup> In the 1980s, Chen Eng-rin and Yen Chuan-min presented three reports on surveys in Kaohsiung, Pingtung, Taitung, Hualien and Penghu counties, those related to Pingtung will be discuss here. In their first report the examinations were conducted with 226 elementary school children and 441 inhabitants aged above 20 at two rural districts, Wutai 霧臺鄉 and Santi 三地鄉.<sup>139</sup> Included in the second report was the results of examination with 96 children at 12 elementary schools; these children had replied to questionnaire as having eaten raw fish flake.<sup>140</sup> In the third report, the examinees included 379 school children at

<sup>136</sup> See Lee Juin-der et al., 2000, p. 453, Table 1.

<sup>137</sup> P. T. Durfee and C. S. Tsai, 1972, "Intestinal Parasites among Aborigines at Santimen, Southern Taiwan," *JFMA*, 71: 12, pp. 724-726.

<sup>138</sup> Fan P. C. et al., 1981, p. 160.

<sup>139</sup> Chen Eng-rin and Yen Chuan-min, 1985b, "Study on Survey, Immunodiagnosis and Treatment of Human Clonorchiasis in Southern Taiwan," *JFMA*, 84:5, pp. 529-535. This report was a result of y the National Science Council's research project in 1983-84.

<sup>140</sup> Chen Eng-rin and Yen Chuan-min, 1985a, "Human Clonorchiasis Survey on Taiwan and Its Immunodiagnostic Technics," *Chinese Journal of Microbiological Immunology*, 18, pp. 202-209. This report was a result of the project supported by the National Science council in 1982-83.

Laiyi district 來義鄉, 677 villagers at Chuwei village 竹圍村 in Neipu district 內埔鄉, 843 villagers at Toulun village 頭崙村 in Chutien district 竹田鄉, and 806 villagers at Hsintien village 新田村 in Linlo district 麟洛鄉.<sup>141</sup>

Table 26.1 shows the results of examinations among school children. In 1980, the parasitic infection rates of school children at Manchou were in the order of Tt 55.8% and Al 33%. Moreover, using the Test-tube filter-paper cultivation method to examine hookworm the rate was 37.9% and using the Scotch-tape swab method to examine pinworm, the rate was 28.3%; these examinations are not available in other surveys. In 1982-1983, the infection rates of the children at 12 elementary schools were Tt 28.1%, Al 5.2%, and Cs 9.4%. In terms of double infections, 36.5% had infected with Tt and Al, 6.3% with Cs and Tt, and 2.1% with Tt and Hw. Moreover, there were 2.1% infected simultaneously with Al, Tt and Cs. Among the school children at Wutai, the infection rates were Al 16.7% and Tt 20%, but no other parasites were found. As for the school children at Santi, the infection rates were Al 61.3%, Tt 36.8%, and Ec 9.4%. Comparatively, the infection rates of the school children at Laiyi were lower but with more varieties; their infection rates were Tt 9.5%, Al 1.6%, Hn 1.1%, Gl 0.3%, and Ec 0.5%, in addition to 0.8% infected with Al and Tt simultaneously.

Table 26.1: The Parasitic Infections among School Children in Pintung County, 1980-1988 (% in parenthesis)

Place	Manchou	12 ES	Wutai	Santi	Laiyi
Year	1980/7	1982-83	1983-84	1983-84	1987-88
N. Examined	1193	96	90	106	379
Al ( <i>Ascaris lumbricoides</i> )	394(33.0)	5(5.2)	15 (16.7)	65 (61.3)	6 (1.6)
Tt ( <i>Trichuris trichiura</i> )	666(55.8)	27 (28.1)	18 (20.0)	39 (36.8)	36 (9.5)
Hw (hookworm)*	452(37.9)	--	--	--	--
Ev ( <i>Enterobius vermicularis</i> )**	287(28.3)**	--	--	--	--
Cs ( <i>Clonorchis sinensis</i> )	--	9 (9.4)	0	0	0
Hn ( <i>Hymenolepis nana</i> )	--	0	0	0	4 (1.1)
Al & Tt	--	35 (36.5)	0	0	3 (0.8)
Al & Cs	--	2 (2.1)	0	0	0
Tt & Hw	--	2 (2.1)	0	0	0
Ts & Cs	--	6 (6.3)	0	0	0
Al, Tt & Cs	--	2 (2.1)	0	0	0
Ec ( <i>Entamoeba col</i> )	--	0	0	10 (9.4)	2 (0.5)
Gl ( <i>Giardia lamblia</i> )	--	0	0	0	1 (0.3)

\* Examination with Test-tube filter-paper cultivation method.

\*\* Examination with Scotch-tape perianal swab method; the number examined was 1013.

Source: Fan P. C. *et al.*, 1981, p. 165, Table 7 ; p. 164, Table 5. Chen Eng-rin and Yen Chuan-min, 1985a, p. 205. Table 2. Chen Eng-rin and Yen Chuan-min), 1985b, p. 531. Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 541, Table 2.

Table 26.2 shows that in 1971, the aborigines at Santimen had the infection rates

<sup>141</sup> Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, "Human Clonorchiasis in New Endemic Areas of Taiwan," *Kaohsiung Journal of Medical Science*, 4:10, pp. 538-546. This report was a result of the project supported by the National Science Council in 1987-88.

of Tt 64%, Al 63%, Hw and Ec 20.4% each, Gl 7.1%, En 3.9%, and Eh 3.2%. In 1987-1988, the infection rate of Cs was higher than other parasites among inhabitants at Chuwei, Luntou, and Hsintien villages; the three villages had respectively 8.7%, 10.0%, and 20.1% with a total rate of 13.1%. Next to Cs was the infection rate of Hw, the three villages had 3.7%, 1.0%, and 1.1% respectively with a total rate of 1.8%. Finally, the rate of Tt was 0.8%, 0.2%, and 0.4% respectively with a total rate of 0.4%. In terms of double infections, Chuwei village had 13 persons (1.9%) infected with Cs and Hw; Luntou village had 1 person (0.1%) each infected with Cs and Hw, with Cs and Tt, and with Hw and Tt; while the number (rate) of the above three combinations at Hsintien village were 9 persons (1.1%), 5 persons (0.6%), and 2 persons (0.3%) respectively. It is notable that the inhabitants of these three villages are mostly Hakka people and they favored raw fish as it was also found at other well-known endemic areas of *Clonorchis sinensis*.<sup>142</sup>

Table 26.2: The Parasitic Infections of Villagers in Pingtung County, 1971-1988

(% in parenthesis)					
Place	Santimen	Chuwei	Toulun	Hsintien	3V. Total
Year	1971	1987-88	1987-88	1987-88	1987-88
No. Examined	127	677	843	806	2326
Cs ( <i>Clonorchis sinensis</i> )	--	59 (8.7)	84 (10.0)	162 (20.1)	305 (13.1)
Hw (hookworm)	26(20.4)	25 (3.7)	8 (1.0)	9 (1.1)	42 (1.8)
Tt ( <i>Trichuris trichiura</i> )	81(64.0)	5 (0.8)	2 (0.2)	3 (0.4)	10 (0.4)
Al ( <i>Ascaris lumbricoides</i> )	80(63.0)	--	--	--	--
Cs & Hw	--	13 (1.9)	1 (0.1)	9 (1.1)	23 (1.0)
Cs & Tt	--	0	1 (0.1)	5 (0.6)	6 (0.3)
Hw & Tt	--	0	1 (0.1)	2 (0.1)	3 (0.1)
Ec ( <i>Entamoeba coli</i> )	26(20.4)	--	--	--	--
Gl ( <i>Giardia lamblia</i> )	9 (7.1)	--	--	--	--
En ( <i>Endolimax nana</i> )	5 (3.9)	--	--	--	--
Eh ( <i>Entamoeba histolytica</i> )	7 (3.2)	--	--	--	--

Source: P. T. Durfee and C. S. Tsai, 1972, p. 725, Table 1. Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 543, Table 5.

## 9. Hualien County

Concerning parasitic infections among the school children in Hualien County, Chiu and Kao conducted a survey from October 6 to November 5, 1958 with 2,951 children from the plain area and 258 children from the mountain area.<sup>143</sup> In one of their 1985 report, Chen and Yen conducted stool examinations with 34 elementary school children at Chian district 吉安鄉.<sup>144</sup> In the 1988 report, those accepted stool examinations included 437 elementary school children at Hsiulin district 秀林鄉.<sup>145</sup>

Table 27 shows the parasitic infections among school children in Hualien

<sup>142</sup> Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 542.

<sup>143</sup> Chiu, Jui-kuang and Kao Chi-tien, 1959, "The Incidence of Intestinal Parasites among The Elementary School Children in Hualien Prefecture, Taiwan," *JFMA*, 58:3, pp. 101-116.

<sup>144</sup> Chen Eng-rin and Yen Chuan-min, 1985a, p. 204.

<sup>145</sup> Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 541.

County. In 1958, no matter living in the plain or in the mountain areas, the highest parasitic infection rate among school children was Al (84.6% in the plain and 90.7% in the mountain), followed by Tt (71.3% and 65.5% respectively) and Hw (27.0% and 57.4% respectively), while other helminthic infection rates were quite small, Ev (0.6% and 0.8% respectively), Tsa (0.6% and 1.9% respectively), and Ss (0.1% and 0.4% respectively). Besides, at the plain area there was 0.1% infected with *Fasciolopsis buski* (Fb). In 1958, the examinations also included protozoa, of which the notable infection rates were those of Ec (4.3% in the plain and 9.1% in the mountain), Gl (5.1% and 3.6%), Eh (1.7% and 3.6%), and En (1.3% and 4.4%). Moreover, in the plain area, there were 2 children (0.07%) infected with Ib, and 1 (0.04%) with Tricho. In 1982-83, at Chian district, the infection rates were Al 8.8% and Tt 17.6%. In addition, there was 1 child (2.9%) infected with Cs and 3 children (8.8%) simultaneously infected with Al and Tt. In 1987-88, at Hsiulin district, the infection rates were Al 12.4%, Tt 24.3% with whipworm, and Tsa 0.9%. Moreover, there were cases of multiple infections: 114 (26.1%) infected with Al and Tt, 1 (0.2%) with Tt and Tsa, and 1 (0.2%) with Al, Tt and Tsa. Compared the helminthic infection rates in 1958 and the 1980s, there was apparently a substantial decline.

Table 27: The Parasitic Infections among School Children in Hualien County,  
1958 and the 1980s (% in parenthesis)

Place	Plan Area*	Mountain Area**	Chian	Hsiulin
Year	1958	1958	1982-83	1987-88
No. Examined	Helminth 2951 Protozoa 2769	Helminth 258 Protozoa 253	34	437
Al ( <i>Ascaris lumbricoides</i> )	2497(84.6)	234(90.7)	3(8.8)	54 (12.4)
Tt ( <i>Trichuris trichiura</i> )	2105(71.3)	169(65.5)	6 (17.6)	106(24.3)
Hw (hookworm)	798(27.0)	148(57.4)	--	--
Ev ( <i>Enterobius vermicularis</i> )	18(0.6)	2(0.8)	--	--
Cs ( <i>Clonorchis sinensis</i> )	--	--	1 (2.9)	--
Tsa ( <i>Taenia saginata</i> )	--	--	--	4 (0.9)
Hn ( <i>Hymenolepis nana</i> )	18(0.6)	5(1.9)	--	--
Fb ( <i>Fasciolopsis buski</i> )	4(0.1)	--	--	--
Ss ( <i>Strongyloides stercoralis</i> )	3(0.1)	1(0.4)	--	--
Eh ( <i>Entamoeba histolytica</i> )	47(1.7)	9(3.6)	--	--
Ec ( <i>Entamoeba coli</i> )	120(4.3)	23(9.1)	--	--
En ( <i>Endolimax nana</i> )	37(1.3)	11(4.4)	--	--
Ib ( <i>Iodamoeba bütschlii</i> )	2(0.07)	--	--	--
Gl ( <i>Giardia lamblia</i> )	142(5.1)	9(3.6)	--	--
Tricho ( <i>Trichomonas hominis</i> )	1(0.04)	--	--	--

\*Including Fenglin and Yuli urban townships and Hsincheng, Chian, Shoufeng, Kuangfu, Fengpin, Juisui, and Fuli rural townships.

\*\*Including Hsiulin, Wamjung, and Chohsi rural townships.

Source: Chiu Jui-kuang and Kao Chi-tien, 1959, p. 103, Table 1; p. 104, Table 2. Chen Eng-rin and Yen Chuan-min, 1985a, p. 205, Table 2. Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, 541, Table 2.

## 10. Taitung County

An earlier survey on parasitic infections among school children in Taitung

County was conducted by Huang Wen-hsien, Chiu Jui-kuang, and Kao Chi-tien from September to November 1956 with 564 children from Luyeh district 鹿野鄉, 539 from Chengkung Township 成功鎮, 375 from Tungho district 東河鄉 and 228 from Tawu district 大武鄉.<sup>146</sup> In one of their 1985 report of Chen Eng-rin and Yen Chuan-min, the results of stool examinations with 549 children at 5 elementary schools at Tungho district were included.<sup>147</sup> And the results of stool examinations with 341 elementary school children at Tawu district were included in the 1988 report by Yen et al.<sup>148</sup> It is notable that there were several surveys conducted on Lanyu 蘭嶼, Orchid Island. The results of the following surveys are used in this paper: Kuntz et al. conducted examinations with 325 inhabitants in March 1965;<sup>149</sup> Huang Wen-hsien et al. conducted survey in May 1965 with 419 school children with the Scotch-tape swab method and with 376 children for stool examinations;<sup>150</sup> in 1968-1969, John F. Bergner et al. examined 929 inhabitants;<sup>151</sup> in August 1980, Yu Jen-chieh et al. conducted stool examinations with 313 inhabitants and with 219 school children using the Scotch-tape swab method;<sup>152</sup> and in 1993, Tjung Jin-jin et al. conducted surveys and treatments with school children; in the first time 335 samples were collected and in the second time 303, but only 196 samples were included in their analysis.<sup>153</sup>

Table 28.1 shows the parasitic infections among school children in Taitung County. In 1956, at Luyeh, Chengkung, Tungho, and Tawu, the highest infection rate among helminthes was Al at 82.8%, 74.6%, 68.0% and 57.9% respectively; followed by Tt at 50.4%, 64.8%, 54.9% and 43.9%; Hw at 33.0%, 27.3%, 28.5% and 17.5%; and Hn at 3.2%, 8.7%, 10.1% and 12.3% respectively. As for the infection rates of Tsa, Ev and Ss, they were all below 1%. Among protozoa, the notable infection rates are those of Ec, 6.7%, 12.6%, 10.7% and 11.0% respectively; Gl, 5.1%, 6.9%, 11.5% and 4.4%; and Eh, 1.8%, 3.2%, 5.1% and 4.8% respectively. As for En, Ib and Bc, the infection rates were all rather small. In 1982-83, the parasitic infection rates among school children at Tungho and Tawu had already reduced

<sup>146</sup> Huang, W. H, Chiu J. K, and Kao C. T, 1957, "The Incidence of Intestinal Parasites among the Elementary School Children in Taitung Prefecture, Taiwan," *JFMA*, 56:6, pp 264-284.

<sup>147</sup> Chen Eng-rin and Yen Chuan-min, 1985a, pp. 204-205.

<sup>148</sup> Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 539, p. 541.

<sup>149</sup> R. E. Kutzs and D. K. Lawless, 1966, "Intestinal parasites of people of Taiwan. Intestinal parasites of aborigines (Yami) of Lan-Yu (Orchid Island)," *JFMA*, 65: 6, pp. 287-293.

<sup>150</sup> Huang W.H., Chen H. H., Kao C.T., and Tsai W. P., 1966, "The incidence of helminthic infections among aborigine school children on Lan-Yu Island of Taitung County, Taiwan," *JFMA*, 65: 6, pp. 397-405.

<sup>151</sup> John G. Bergner and D. M. McCroddan, 1973, "A Team Approach to a Disease Survey on an Aboriginal Island (Orchid Island, Taiwan). I. Protozoa and helminth parasites of the Yami aborigines," *Chinese Journal of Microbiology*, 6, pp. 164-172.

<sup>152</sup> Yu Jen-chieh and Kao Che-yen, 1982, "Present Status of Intestinal Parasitic Infections and Head Louse Infection among Aborigines of Lan-Yu (Orchid Island), Taiwan," *JFMA*, 81, pp. 408-413.

<sup>153</sup> Tjung Jin-jin, Chen Shyang-fa, Lay Yeh-pi and Lai Mei-shu, 1993, "The Prevalence and Treatment of Intestinal Parasitic Infection among Children on Lan-yu Island," *Chinese Journal of Family Medicine* (《中華家醫誌》), 3: 3, pp. 123-130.



substantially with Al 10.6% and 15.5% respectively and Tt 7.5% and 1.2% respectively. There was no infection of protozoa at Tungho and only 0.3% at Tawu infected with *Entamoeba coli*.

As for multiple infections, the 1956 report did not provide details for each locality, but the total figures revealed that there were 453 persons (28.7%) infected simultaneously with Al and Tt; 126 (8.0%) with Al and Ad; 64 (4.1%) with Ad and Tt; 36 (2.3%) with Al and Hn; and 32 (2.0%) with Al, Tt, and Hn. Other triple and quadruple infection combinations were all below 1%.<sup>154</sup> In 1982-83, double infections were found among 26 persons (4.7%) with Al and Tt, 2(0.4%) with Tt and Ad, and 1 (0.2%) with Al and Hn. In 1987-88, there was 1 person (0.3%) infected with both Al and Tt.

Table 28.1: The Parasitic Infections among School Children in Taitung County, 1956 and the 1980s (% in parenthesis)

Place	Luyeh	Chengkung	Tungho		Tawu	
Year	1956	1956	1956	1982-83	1956	1987-88
No. Examined	564	539	375	549	228	341
Al ( <i>Ascaris lumbricoides</i> )	467 (82.8)	402 (74.6)	255 (68.0)	58 (10.6)	132 (57.9)	53 (15.5)
Tt ( <i>Trichuris trichiura</i> )	284 (50.4)	349 (64.8)	206 (54.9)	41 (7.5)	206 (54.9)	4 (1.2)
Hw (hookworm)	186 (33.0)	147 (27.3)	107 (28.5)	--	40 (17.5)	--
Hn ( <i>Hymenolepis nana</i> )	18 (3.2)	47 (8.7)	38 (10.1)	--	28 (12.3)	--
Tsa ( <i>Taenia saginata</i> )	--	1 (0.2)	--	0	--	0
Ev ( <i>Enterobius vermicularis</i> )	3 (0.5)	2 (0.4)	--	--	--	--
Ss ( <i>Strongyloides stercoralis</i> )	--	1 (0.2)	1 (0.3)	--	--	--
Eh ( <i>Entamoeba histolytica</i> )	10 (1.8)	17 (3.2)	19 (5.1)	--	11 (4.8)	--
Ec ( <i>Entamoeba coli</i> )	38 (6.7)	68 (12.6)	40 (10.7)	0	25 (11.0)	1 (0.3)
En ( <i>Endolimax nana</i> )	3 (0.5)	19 (3.5)	14 (3.7)	--	3 (1.3)	--
Ib ( <i>Iodamoeba bütschlii</i> )	--	1 (0.2)	1 (0.3)	--	--	--
Gl ( <i>Giardia lamblia</i> )	29 (5.1)	37 (6.9)	43 (11.5)	--	10 (4.4)	--
Bc ( <i>Balantidium coli</i> )	1 (0.2)	--	--	--	--	--

Source: Huang, W.H., Chiu, J.K., and Kao, C.T., 1957, p. 265, Table 1; p. 266, Table 2. Chen Eng-rin and Yen Chuan-mi, 1985a, p. 205, Table 2. Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 541, Table 2.

It should be noted that Huang Wen-hsien *et al.* pointed out that except for the infection rate of Al, the 1956 survey revealed an increase of infections for various species compared with the rates found in 1926-1930; the health authority should pay

<sup>154</sup> Huang, W.H., Chiu, J.K., and Kao, C.T., 1957, p. 274, Table 7.

attentions to this fact.<sup>155</sup> Compared with the results in the 1980s, the parasitic infection rates among school children in Taitung County showed that there was a great change during the 1950s-1980s. The highest infection rate had reduced from above 80% to around 10%.

Table 28.2: The Parasitic Infections among School Children and Inhabitants at Lanyu (Orchid Island), Taitung county, 1965-1996 (% in parenthesis)

Year	1965/3#	1968-69	1980/8	1965/5	1991/11a	1992/4b
Examinee	Aborigines	Aborigines	Aborigines	Children	Children	Children
No. Examined	325	929	313	376	196	196
Al ( <i>Ascaris lumbricoides</i> )	(77.0)	755(81.3)	(52.7)	285(75.8)	75(38.3)	14(7.1)
Tt ( <i>Trichuris trichiura</i> )	(17.8)	429(46.2)	(23.3)	138(36.7)	21(10.7)	20(10.2)
Hw (hookworm)	(32.6)	313(33.7)	(13.1)	103(27.4)	2(1.0)	0
Ev ( <i>Enterobius vermicularis</i> )	(0.8)	13(1.4)	(3.5)	215/419(51.3)*	1(0.5)	8(4.1)
Tae ( <i>Cestoidea, Taenia</i> sp.)	(8.6)	53(5.7)	(3.5)	44(11.7)	2(1.0)	4(2.0)
Tsa ( <i>Taenia saginata</i> )	--	24(2.6)	--	1(0.2)	--	--
Dip ( <i>Diphyllobothriidae</i> )	(1.0)	--	--	--	--	--
Hd ( <i>Hymenolepis diminuta</i> )	(0.2)	--	--	--	--	--
<i>Dicrocoelium dendriticum</i>	--	13(1.4)	(1.0)	223(59.3)	1(0.5)	36(18.4)
Hetero ( <i>Heterophyes</i> )	(0.4)	--	--	--	--	--
Ss ( <i>Strongyloides stercoralis</i> )	(1.8)	41(4.4)	(1.9)	8 (2.1)	--	--
Nip ( <i>Nippostrongylus</i> species)	--	2(0.1)				
Cap ( <i>Capillaria hepatica</i> )	--	1(0.1)	--	--	--	--
Eh ( <i>Entamoeba histolytica</i> )	(9.8)	42(4.5)	(1.3)	--	--	--
Eha ( <i>Entamoeba hartmanni</i> )	(10.0)	24(2.6)	--	--	--	--
Ec ( <i>Entamoeba coli</i> )	(2.6)	57(6.1)	(2.7)	--	--	--
En ( <i>Endolimax nana</i> )	(14.8)	28(3.0)	(1.0)	--	--	--
Df ( <i>Dientamoeba fragilis</i> )	(5.6)	--	--	--	--	--
Ib ( <i>Iodamoeba bütschlii</i> )	--	1(0.1)	--	--	--	--
Gl ( <i>Giardia lamblia</i> )	(4.8)	32(3.4)	(6.7)	--	--	--
Cm ( <i>Chilomastix mesnili</i> )	--	2(0.2)	--	--	--	--
Bc ( <i>Balantidium coli</i> )	(3.6)	1(0.1)	--	--	--	--
Eh & Eha	(2.4)	5(0.5)				

\* Examination with Scotch-tape perianal swab method.

a. Before treatment. b. After treatment.

# The average calculated with rates of five age groups.

Source: Huang Wen-hsien, Chen Huei-Hsiung, Kao Chih-tien and Tsai-wen-po, 1966, p. 399, Table 1. John F. Bergner, Jr., D. M. McCroddan, O. K. Khaw, and Jack Devlin, 1973, p. 166, Table 2. Yu Jen-chieh and Kao Che-yen, 1982, p. 409, Table 1. Tjung Jin-jin, Chen Shyang-fa, Lay Yeh-pi and Lai Mei-shu, 1993, p. 125, Table 1.

Listed in Table 28.2 are the infections among aboriginal school children and inhabitants on Lanyu. In the case of children, the infection rates in 1965 were in the order of Al 75.8%, Tt 36.7%, Hw 27.4%, Tae 11.7%, Ss 2.1%, and Hn 0.2%. Moreover, using the Scotch-tape swab method, the infection rate of Ev was 51.3%. A special case was that 59.3% were found to be infected with *Dicrocoelium dendriticum*. The infection rates among children before treatment in 1991 were in the order of Al 38.3%, Tt 10.7%, Hw and Tae 1% each, and *Dicrocoelium dendriticum* 0.5%. Those after treatment in 1992 were *Dicrocoelium dendriticum* 18.4%, Tt 10.2%, Al 7.1%, Ev 4.1%, and Tae 2.0%. The reason why the infection rate of *Dicrocoelium dendriticum* increased instead of declined after the treatment was related to the season of

<sup>155</sup> Huang W.H., Chiu J.K., and Kao C.T., 1957, p. 279; for the statistics of 1926-1930, see p. 277, Table 9

flying-fish. On Lanyu, during the season of flying-fish from March to May, the inhabitants used to dry the fish they captured on the open space and thus the fish was very easily soiled by excrements of pigs and goats. By eating the soiled fish afterwards, the inhabitants were infected with *Dicrocoelium dendriticum* but these were considered as “spurious” infections.<sup>156</sup> In the case of inhabitants, the results of three surveys in 1965, 1968 and 1980 showed that of the infection rates of helminthes were as follows: Al 77.0%, 81.3%, and 52.7%; Tt 17.8%, 42.6% and 23.3%; Hw 32.6%, 33.7% and 13.1%, Tae 8.6%, 5.7% and 3.5%, Ss 1.8%, 4.4%, and 1.9%; in general there was a decline. Moreover, in 1965, there was 1% infected with *Diphyllobothriidae* (Dip), 0.4% with Hetro and 0.2% with Hd. In 1968, there was 1.4% infected with *Dicrocoelium dendriticum*, 0.2% with *Nippostrongylus* and 0.1% with *Capillaria* species. In 1980, there was 1% with *Dicrocoelium dendriticum*.

Among the protozoa, the infection rates in the three surveys were not in the same order. In 1965, the order was En 14.8%, Eha 10.0%, Eh 9.8%, Df 5.6%, Gl 4.8%, Bc 3.6%, Ec 2.6%, Tricho 0.6%, and *Entermonas hominis* 0.4%; moreover, there was 2.4% infected both with Eh and Eha. In 1968-69, the infection rates were in the order of Ec 6.1%, Eh 4.5%, Gl 3.4%, En 3.0%, Eha 2.6%, Cm 0.2%, Ib and Bc 0.1% each; and 0.5% with both Eh and Eha. All rates were lower than those in 1965. In 1980, the rates were in the order of Gl 6.7%, Ec 2.7%, Eh 1.3%, En 1.0%; the rate of Gl was higher than before but that other species was already lower.

## 11. Penghu County

An earlier survey among school children in Penghu County was done by Kuntz and Wells in 1959-62; there were 807 children on the Penghu Island and 48 on the Chipei Hsu 吉貝嶼 received examinations. The results showed that the parasitic infections among children on Penghu Island was 100%; among helminthes the infection rates were in the order of Tt 96%, Al 83%, Hw 13%, and Ev, Ss and Hn 1% each; among protozoa, the order was Ec 46%, Eha 23%, En 13%, Ib 10%, Eh 8%, Gl 7%, and Cm 2%. Among the children on Chipei Hsu, the helminthic infections were Tt 100%, Al 98%, and Hw 6%; the protozoan infections were Ec 19%, Eh and Eha 17% each, Gl 6%, En 3%, Ib and Cm 1% each.<sup>157</sup> In addition, in 1987-1988, Yen Chuan-min and his team conducted intradermal tests with 1,652 school children and found 7 of them (0.4%) were positive to the test for Clonorchiasis. Of those received intradermal tests, 780 received stool examinations and the results showed that only 7 children (0.9%) were infected with Tt, and 3 children (0.4%) with Al.<sup>158</sup> Compared with the rates in 1960, the parasitic infections in Penghu County had reduced a lot.

<sup>156</sup> Tjung Jin-jin, Chen Shyang-fa, Lay Yeh-pi and Lai Mei-shu, 1993, p. 128.

<sup>157</sup> R. E. Kuntz and W. H. Wells, 1967, p. 304, Table 1.

<sup>158</sup> Yen Chuan-min, Chen Eng-rin, Fang Ay-huey, and Chung Tieh-chi, 1988, p. 539, p. 541, Table 2.

In short, the above review reveals that in the second half of the twentieth century, there were few parasitic surveys in Taoyuan, Taichung, Yunlin and Chiayi counties and it is difficult to do comparative observation.<sup>159</sup> With the data more or less comparable, in the late 1950s and early 1960s, in Taipei, Hsinchu, Yilan, Miaoli, Nantou, Changhua, Tainan, Kaohsiung, Pingtung, Taitung, Hualien and Penghu Counties, the parasitic infection rates were as high as 80-90%. In the 1980s, the parasitic infection rates of school children and inhabitants in Miaoli, Kaohsiung, Pingtung, Taitung, and Hualien Counties were still quite considerable. At some places in Miaoli, Nantou, Kaohsiung, and Pingtung Counties, the infection with *Clonorchis sinensis* had become a new focal point of attention. Here, it should be mentioned that *Clonorchis sinensis* is a zoonotic parasite with snail as the first and fish as the second intermediate hosts; its infestation in Taiwan was related to the promotion of multiple-production farms for raising fish and domestic animals during the 1960s-1970s; further study was required for this implication.<sup>160</sup>

Finally, it should be noted that there was no mention of Japanese blood fluke (*Schistosoma japonicum*) and blood filaria (*Wuchereria bancrofti* or *Filaria bancrofti*) in the above investigations on parasites in different times and places. Concerning *Schistosoma japonicum* in Taiwan, Takeue Kouichi, a veterinarian of the Bureau of Production, discovered in 1914 that this parasite was found in the body of pig, dog, goat, and cattle at the slaughterhouse of Peitou town 北斗街 in Taichung sub-prefecture, as well as 8 inhabitants at villages of Hsiaopuhsin 小埔心庄, Lienchiaotso 連交厝庄, and Luntzu 崙仔庄 were found infected. It was said that *schistosomiasis japonica* was endemic at that area. This discovery was considered by Yokogawa Sadamu as “an alarm bell for Taiwan’s medical circles”.<sup>161</sup> In the next year, Yokogawa presented a paper to discuss the intermediate host of *Schistosoma japonicum* in Taiwan, a snail known as *Blanafordia formosana*.<sup>162</sup> In 1922, Suemori Susumu, a student of Yokogawa, presented an article to discuss the growth of Taiwan

<sup>159</sup> Survey related to Chiayi, see Loo W. T. and Huang C. Y., 1956, “On the results of a faecal examination of the people in Tsu-wei Li, Chia-yi City,” *JFMA*, Vol. 55, p.p. 246-247. This survey examined 117 persons and the total infection rate was 100%, of which hookworm 89.2%. Survey related to Yunlin, see Chung W.C., Lu, J. L., Fan P. C., Wng C. R., Liu W. K., and Liu H. C., 1986, “Prevention of *Enterobius* and Survey of Head Louse among Primary School Children in Kuo-hu district, Yun-lin County,” *Journal of Taipei Medical College* (《北醫學報》), Vol. 15, pp. 147-166. The first examination in January 1984 with 2,314 children found 47.1% infected with Ev; the second examination in July with 1,569 children found 34.5% infected with Ev.

<sup>160</sup> See for example, Wang Jiunn-shiow et al., 1980, “Studies on the Control of Zoonotic Clonorchiasis (1) An Epidemiological Survey in Several Areas of Taiwan,” *National Science Council Monthly*, 8:2, pp. 113-122.

<sup>161</sup> Takeue Kouichi, 1914, “On *Schistosoma japonicum* in Taiwan,” *JFMA*, No. 137, pp. 183-201. Yokogawa’s comment appeared on p. 197. Takeue’s report was also included in the *Official Documents of Taiwan Government-general*, Vol. 5879, No. 21, pp. 308-315.

<sup>162</sup> Yokogawa Sadamu, 1915, “On *Schistosomiasis japonica* in Taiwan with an emphasis on its intermediate host,” *JFMA*, No. 149, pp. 178-183.

strain of *Schistosoma japonicum* in the body of its end host, using rabbits, rats, dogs, cats, pigs, and monkeys as experimental animals.<sup>163</sup> As a matter of fact, there was no further report concerning epidemiological survey on *Schistosoma japonicum* in Taiwan until the end of Japanese colonial period. And Maxwell said that in Taiwan, infections of *Schistosoma japonicum* were only reported for animals and not for humans.<sup>164</sup> It is notable that in 1959, Hsien Hsien-chen reminded the medical circle to pay attention to the possibility of increasing infestation of *Schistosoma japonicum* following the migration of people from Mainland China.<sup>165</sup> Kuntz et al. pointed out in their 1961 report that their survey found 2 persons passed eggs of *Schistosoma japonicum* with stools. One was a 63 year old male from the mainland China and the other was a 74 year old woman who was born and lived in Changhua county. They considered these two cases as “spurious” infections.<sup>166</sup>

As for *Filaria bancrofti*, Maxwell said that it was also found in the western coast of Taiwan.<sup>167</sup> By 1930, except for a few reports on individual patients, there was no epidemiological survey related to *Filaria bancrofti* in Taiwan.<sup>168</sup> In the 1930s, some epidemiological surveys were carried out. In 1935-1936, Ichimura Hiroshi, a surgeon of the army stationed in Taiwan, conducted a survey with 55 Taiwanese normal school students, but after careful pathological and blood examinations, he did not find any filarial infection among these students.<sup>169</sup> In November 1936, Tanaka Shigeo, a Surgeon Lieutenant, conducted blood examinations with 229 Taiwanese employees at the Harbor of Makung 馬公 and found that 99 (43.2%) of them were infected with microfilaria. Since only 4 among those examined were from outside of Penghu islands, it was assumed that infestation of *Wuchereria bancrofti* was quite dense in Pescadores.<sup>170</sup>

Consequently, Yokogawa and his team conducted an epidemiological survey in 1938. They found that 71 (10.6%) of 671 children at the First Taiwanese Elementary School, 47 (8.3%) of 564 children at the Second Taiwanese Elementary School, 61 (10.8%) of 563 inhabitants at Husi 湖西 village, 35 (11.5%) of 304 inhabitants at Kangti 港底 village, 25 (7.9%) of 340 inhabitants at Watung 瓦硐 village, and 5

<sup>163</sup> Suemori Susumu, 1922, “On the Growth of Taiwan strain of *Schistosoma japonicum* in the body of the end host,” *JFMA*, No. 220, pp. 1-17.

<sup>164</sup> James Maxwell, 1929, p. 165.

<sup>165</sup> Hsieh Hsien-chen, 1959, p. 102.

<sup>166</sup> Robert E. Kuntz, James C. Burke, S. Lin and Raymond H. Watten, 1961, p. 821.

<sup>167</sup> James Maxwell, 1929, p. 149.

<sup>168</sup> Konto Yoshiichi and Hara Youzo, 1919, “A Taiwanese case of filarial chyluria,” *JFMA*, No. 200, pp. 688-689. Sukanema Mitsuo, 1927, “*Wuchereria bancrofti*? A discovery in an abnormal tumor,” *JFMA*, No. 262, pp. 82-87. Fujisaki Toshitsuku, 1928, “An abnormal case of filariasis,” *JFMA*, No. 283, pp. 1188-1193.

<sup>169</sup> Ichimura Hiroshi, 1936, “Observations on the infection of filaria,” *JFMA*, No. 277, pp. 798.

<sup>170</sup> Tanaka Shigeo, 1937, “Investigations and Clinical Observations on Microfilaria among Formosan Chinese on Boko Islands (Pescadores),” *JFMA*, No. 389, pp. 1815-1825.

(2.3%) of 401 inhabitants at Hochieh 合界 village were infected with *Wuchereria bancrofti*. By grouping with villages where those received examinations came from, the rates were as follows: Hungmucheng 紅木埕 19.0%, Shuangtoukua 雙頭掛 17.3%, Huoshaoping 火燒坪 12.5%, Shihchuan 石泉 11.7%, Hsiwei 西衛 10.4%, Makung 馬公 10.1%, Kangti 港底 9.4%, Wenao 文澳 9.4%, Houchutan 後屈潭 6.3%, Chienliao 前寮 6.3%, Tungwei 東衛 5.8%, Huhsi 湖西 5.5%, Wukan 烏坎 5.5%, Tsaiyuan 菜園 5.1%, and Chaichiaoyu 宅腳嶼 4.1%. Yokogawa et al. also pointed out that the variation of infection rates at different places in Pescadores was related to the strength of monsoon; at places where the monsoon was weak, the mosquitoes flourished and the infection rate was higher, and on the contrary, at places where the monsoon was strong, the infection rate was lower.<sup>171</sup> Finally, in 1939, Huang Teng-yun conducted a survey at Wantan and Hsiaoliuchiu 小琉球 in Pintung and found no positive carriers of filaria among 5,267 inhabitants who received blood examinations.<sup>172</sup>

After the Second World War, Fan Ping-chin devoted most significant efforts in the survey research on *Filaria bancrofti* in Taiwan area. According to Fan's retrospection, he discovered for the first time in 1951 at the National Defence Medical School a female nurse student infected with blood filaria, and she came from Fuhsingli 福興里 of Kangshn Township 岡山鎮 in Kaohsiung county. Thus, in 1952, he undertook a survey at Fuhsingli and the nearby Shihtanli 石潭里, Houhsiehli 後協里, and Weijenli 維仁里 and found that the infection rates were 2.9-8.3%. At the same time, he also found that at Jente district 仁德鄉 in Tainan County and Fengshan Township in Kaohsiung county, the infection rates were 0.4-1.2%. During 1958-1962, the Taiwan Provincial Malaria Research Institute, with supports of the U. S. Security Agency and the U. S. Aid, conducted a four-year survey on filariasis at 150 rural and urban townships in 15 counties. With a sample of 1,000 inhabitants at each township, the total number examined amounted to 178,421 persons. Of them, positive reaction was found with 2,670 persons and the average infection rate was 1.5%. This survey proved that 23 rural and urban townships at 5 countries in the southwest coast on Taiwan was an area infested with *Filaria bancrofti*. This area included Mailiao 麥寮 in Yunlin County; Lutsao 鹿草 and Yichu 義竹 in Chiayi County; Shanhua 善化, Hsinhua 新化, Sikang 西港, Yungkang 永康, Kuijen 歸仁, Kuanmiao 關廟, and Matou 麻豆 in Tainan County; Kangshan, Tzukuran 梓官, Tashe 大社, Mituo 彌陀, Yungan 永安, Hunei 湖內, Luchu 路竹, Yenchao 燕巢,

<sup>171</sup> Yokogawa Sadamu, Kobayashi Hidekazu, Yumoto Yoshika, Osaka Kiyoshi, Ro Mantoku, and Yokogawa Muneo, 1939, "Epidemiological Investigations on *Wuchereria bancrofti* on Boko Islands (Pescadores)," *JFMA*, No. 415, pp. 1452-1466.

<sup>172</sup> Huang Teng-yun, 1939, "An epidemiological survey of *Filaria bancrofti* at Wantan and Little Isle of Liuchiu in Pintung, Taiwan," *Acta Japonica Medicina Tropicalis*, 1: 2 & 3 joint edition, pp. 411-435.

Linyuan 林園, and Chiaotou 橋頭 in Kaohsiung County; and Checheng 車城 in Pingtung County. In addition, during the 1950-1970s, Fan and other scholars carried out several surveys with military force, “righteous people” withdrew from Tacheng 大陳 and Kinmen 金門 Islands to Taiwan, overseas Chinese students coming from Southeast Asia, as well as inhabitants on Penghu, Matsu 馬祖 and Kinmen Islands. After several years of investigation, prevention and control, the infection rate of *Filaria bancrofti* on Kinmen Island was reduced to zero, and the goal of eradicating filariasis was finally reached in 1978.<sup>173</sup>

As for why the infection of *Filaria bancrofti* was relatively fewer on the island of Taiwan, a recent study has tried to investigate this question. In a paper he gave in 2005, Liu Shi-yung compared the ecological condition and the infection of malaria and filariasis in Taiwan. He suggested that filariasis, a disease transmitted mostly by *Culex p. fatigans* in Taiwan, tended to be an infectious disease confined at fishing villages along the southwestern coast while malaria, transmitted by anopheles, was an island-wide infectious disease. After taking over Taiwan, Japanese thought that the main vector of malaria was *Anopheles sinensis* breeding mostly in the plain area and therefore, they devoted a great effort to study the habitat and characteristics of this species of mosquito and applied the knowledge in the 1920s for its eradication. Comparatively, little attention and control had been given to *Anopheles minimus* which was encountered in the 1930s when the mountain area was developed. Besides, epidemiological surveys tended to reveal a cluster character of these diseases, and this seemed to provide a good reason for the confinement of filariasis at the southwestern corner in Taiwan. Comparatively, the colonial government had made great efforts in constructing irrigation systems for promoting agriculture in the plain area and encouraging Japanese capitalists to enter the mountain area for lumbering; these economic activities often induced moving of people between regions. Consequently, not only the ecological condition and the distribution of diseases had been changed but malaria was also transmitted from the plain to the mountain area.<sup>174</sup> In short, further studies are required to understand changes in the interactive relationships of parasites, intermediate hosts, human activities, and ecological environment.

## Concluding Remark

The above literature review demonstrates that the parasitic infection rate in

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<sup>173</sup> Fan Ping-chin, 1982, “A retrospection of research on filariasis with an emphasis on eradication of filariasis on Kinmen Islands,” *Special Report of the Department of Parasitology, National Yangming University*, pp. 134-188.

<sup>174</sup> Liu Shi-yung, 2005, “From filaria to plasmodium: The development of western plain in Taiwan from the perspective of changing endemic diseases,” paper delivered at the International Conference on the Environment in Chinese History, August 17-19, Nankai University, Tientsin.

Taiwan was rather high during the first half of the twentieth century. Among the helminth, *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm were three major parasites and the total infection rate was usually above 90%. Among the protozoa, the infections were mostly found with *Entamoeba histolytica*, *Entamoeba coli* and *Giardia lamblia* with the highest rate reaching around 30%, but other species could not be ignored. No matter with the helminth or the protozoa, multiple infections were rather prevalent. The infection rates of major parasites are listed in Appendix 3 and 4 by time and place, so that the changes through time and distribution in space can be more easily perceived. In terms of space, there was few survey research related to today's Taoyuan, Taichung, Yunlin and Chiayi counties in the past and it is difficult to do comparative observation. With the results of surveys from other counties, it is quite clear that in the 1950-1960s, the infection rates were still quite close to those in the 1920-1930s, reflecting that the results of expelling parasites in the 1930s might have been destroyed during the war time. In the 1980s, however, there was an obvious decrease in the parasitic infections and this is no doubt related to the parasitic controlling program carried out from 1972.

It is also notable that in the 1920s, Japanese living in Taiwan had a considerable high infection rate with *Clonorchis sinensis*, and that some Taiwanese had gradually accustomed to eat raw fish and also infected with this parasite. A survey in 1916 by Ooi even found that in some places in middle Taiwan, inhabitants had a habit of eating raw fish since the old days; this provide another clue for the infection of *Clonorchis sinensis* required further study. In the 1980s, the infection rate of *Clonorchis sinensis* at some localities had been found over 50% and became a new focal point of attention. In 1999, the infection rate of *Enterobius vermicularis* among children at some place still accounted for 25%. Moreover, there were also some new parasitic diseases, especially those related to protozoa, which were not discovered in earlier surveys. Further studies are required for details of controlling parasitic infection and their implications and consequences related to the environment.

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