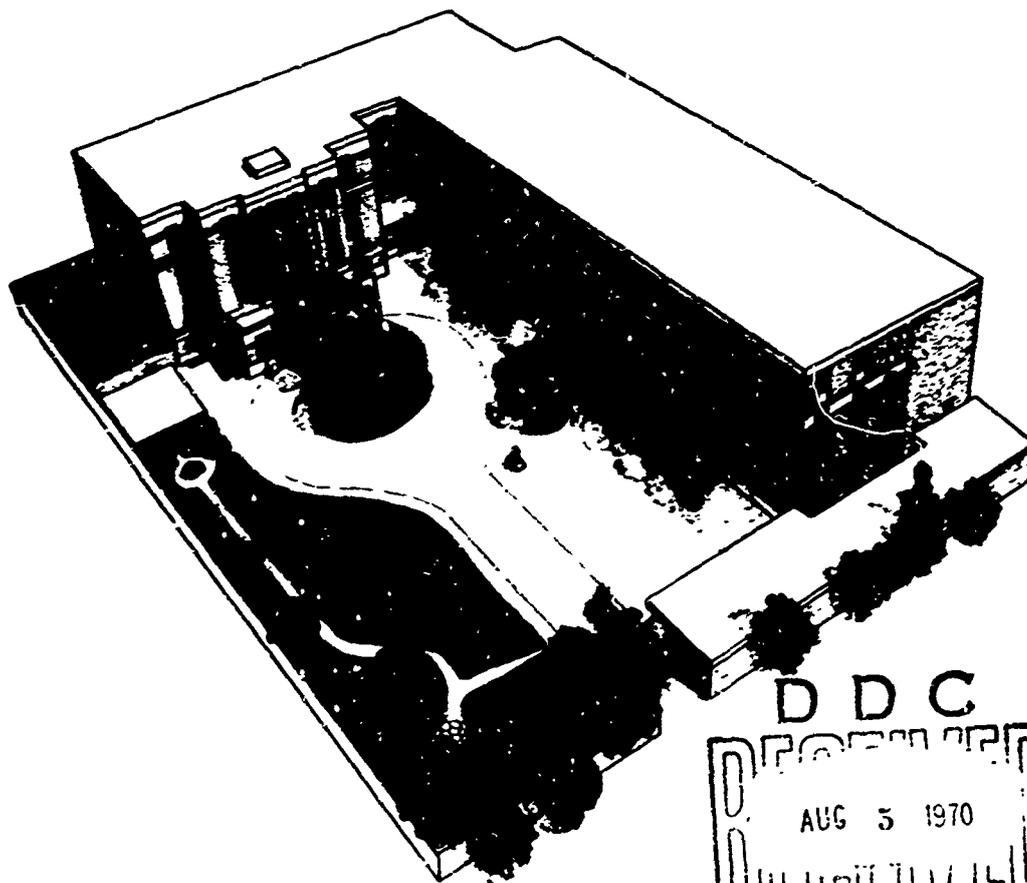


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FASCIOLOPSIASIS IN SOUTHEAST ASIA
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**REPRINTS FROM PROCEEDINGS
OF
THE FOURTH SOUTHEAST ASIAN SEMINAR
ON
PARASITOLOGY AND TROPICAL MEDICINE,
SCHISTOSOMIASIS AND OTHER
SNAIL-TRANSMITTED HELMINTHIASIS**

FASCIOLOPSIASIS IN SOUTHEAST ASIA AND THE FAR EAST: A REVIEW†

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In his classic paper, "This Wormy World", Stoll (1947) estimated 10 million human infections with the giant intestinal fluke *Fasciolopsis buski* in Asia. Nearly half the cases, however, were ascribed to Chekiang Province of mainland China. The remaining, according to Stoll, were elsewhere in China, Taiwan, Southeast Asia, and Assam. At the present time it is almost impossible to establish the present distribution of this parasite on mainland China. It is equally difficult to estimate the infection rate and distribution of the parasite in other areas of the Far East since there exist only a few scattered reports of the parasite and the disease in the current literature. An attempt has been made to assemble the available information and to present the distribution of this parasitosis by various countries. The main sources of reference were the Tropical Disease Bulletin and the Index Catalog of Medical and Veterinary Zoology. Although a number of references, mostly old, were found, the availability of published papers/reports has been less than one would desire in preparing a review article. The reference section contains a great number of articles which have not been cited in the text. They are listed simply to assist future investigators who may wish to have a bibliography of some of the past works. This bibliography should not be considered complete, however.

MAINLAND CHINA

Fasciolopsis buski has been reported from ten provinces of mainland China. In certain areas of Chekiang and Kiangsi the prevalence rate has been reported as high as 85 percent and in other areas it may vary from less than 1 to 5 percent (Hsü and Li, 1953). Man and pigs, and possibly dogs (Chen, 1934), are reported to be the main definitive hosts for the parasite, and the aquatic snails, *Segmentina hemisphaerula* and *Hippeutis cantori*, the intermediate hosts. Metacercariae are found encysted on aquatic plants such as water caltrop (*Trapa natans*), water chestnut (*Eliocharis tuberosa*), water hyacinth (*Eichornia crassipes*), and water bamboo (*Zizania aquatica*, *Salvinia natans*, *Lemna polyrhiza*). These plants are considered the main sources of human infections. Most water-bodies in which these plants are cultivated are fertilized with human excrement. In addition, there are other plants upon which the metacercariae may encyst and these plants may serve as vehicles of transmission to pigs and other animals. Infections in mainland China, as elsewhere, are acquired most commonly by people who eat water plants raw and peel off the outer layers of the plants with their teeth. Recent reports from mainland China indicate that *Areca* nut may be of therapeutic value in the treatment of fasciolopsiasis (Fang, 1955; Teng, *et al.* 1959; Liao, 1959).

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The opinions and assertions contained herein are those of the authors and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

REPUBLIC OF CHINA - TAIWAN

Human infection with *F. buski* on Taiwan was first recognized by Maxwell in 1911. This report was followed by the first description of the life cycle of the parasite in Taiwan pigs by Nakagawa (1921) and additional reports of human infections by Oi (1924), Suzuki (1925), Huang (1947), and Hsü *et al.* (1953). It was not until the report by Hsieh (1959), however, that fasciolopsiasis was considered a significant parasite of man in certain areas of the island.

Pigs from many areas of Taiwan appear to be infected (Lee, 1957) but the prevalence of human infections, except for a few areas, is minimal. The most highly endemic area is in Taiwan Hsieh in Southern Taiwan where stool surveys have shown infection rates of 28 percent (Hsieh, 1959), 48 percent (Hsieh, 1960), and 24 percent (Kuntz *et al.* 1961).

Hsieh (1960) carried out extensive studies in this area of Taiwan and found the highest infection rate to occur in children in the age group of 10 to 14 who resided in villages situated near ponds where water caltrop and other edible water plants are cultivated. Families in villages closer to ponds demonstrated even higher infections than those living some distance from them. Although seven species of snails were recovered from ponds in the area, only *S. haemisphaerula* was found positive (1.9%). Two edible water plants, *Trapa bispinosa* (caltrop) and *Ipomoea reptans*, (Kuug-shin tsai), were also grown in the water and encysted metacercariae were found on these plants in varying numbers. The latter is commonly fed to pigs and is considered the main source of pig infections. Pigs in the area were also studied and the infection rate by stool examination was determined to be 29 percent and at the time of slaughtering, 52 percent. Of interest in the reports by Hsieh (1960) and Kuntz *et al.* (1961) was the finding of great numbers of cercariae-producing snails in ponds in the vicinity of slaughter houses and the observation that the abattoir drains emptied into nearby ponds. This, of course, leads to a continuous "seeding" of the ponds.

A few studies on the treatment of *F. buski* have been carried out in Taiwan. Brown *et al.* (1959) found tetrachlorethylene to be effective in the treatment of the disease, and Hsieh *et al.* (1953) reported a cure-rate of 62 percent with stilbazium iodide (Monopar).

JAPAN

Kobayashi (1915) was one of the first to report the parasite in Japan and later there were a few additional reports of *F. buski* eggs in stools of Japanese (Morishita *et al.* 1964). Whether or not these infections were acquired in Japan is not known.

KOREA

Although Korea has not been considered endemic for *F. buski*, there are reports in the literature which suggest the possible presence of the parasite in this country. Kobayashi (1920) reported abnormal-appearing eggs of the parasite in human stools. Many years later Brooke *et al.* (1956) reported eggs of either *F. buski* or *Fasciola hepatica* in six North Korean

prisoners of war. In another report in the same year, Maschke (1956) reported *F. buski* in a child who had recently immigrated from Korea to Germany. The most interesting report, however, was by Kuntz *et al.* (1958) who found *F. buski* eggs in the feces of a retired Turkish soldier who had served with the United Nation Forces in Korea during the Korean War. In the light of these reports it seems appropriate to suggest that further studies be undertaken to determine whether *F. buski* is truly endemic in Korea. It is entirely possible that the parasite might be present in the human and pig population in isolated areas and has gone unnoticed. On the other hand, it may also be possible that the eggs found in the feces in the above reports were of *F. hepatica* rather than *F. buski* since it is often very difficult to differentiate between the eggs of these two species of trematodes.

RYUKYU ISLANDS

Reports of *F. buski* could not be found in any scientific journal; however, a statement appears in a textbook (Simmons *et al.* 1944) on the occurrence of the parasite in some of the inhabitants of these islands.

PHILIPPINE ISLANDS

While there have been reports of fasciolopsiasis in the Philippines there is some question whether the infections were acquired there or imported. Garrison (1910) reported *F. buski* collections from the Philippines, and Schwartz (1924) found eggs in the stools of several Chinese in Sulu (Tubangui, 1933). It was not known whether these latter infections were acquired locally or in China. Africa *et al.* (1940) did not believe that the infection was endemic to their country and reported no authentic records of infection among native Filipinos. In recent studies carried out jointly by NAMRU-2 and the Philippine Health Department on nearly 4000 residents in Northern Luzon, no infections of *F. buski* were found. It is probable that any infections reported in the past in the Philippines were from immigrants from China, and the Philippines, therefore, should probably be considered a nonendemic area.

VIETNAM

There are a few reports on *F. buski* in Vietnam, the earliest of which was by Brau and Bruyant (1913). In North Vietnam, Galliard (1948) reported infections in pigs, and Bauge (1954) found nearly 15 percent and 3 percent, respectively, of Asians and Europeans infected with the parasite. Landmann *et al.* (1961) using *F. buski* skin-test antigen reported a very low prevalence of infection, however, Fournier (1954) reported the parasite in Asians as well as Europeans in Saigon. In studies by NAMRU-2 in DaNang, South Vietnam, only one of several hundred people examined was found to be passing eggs of the parasite in his feces. Snails of the genera *Planorbis* as well as *Segmentina* have been reported as the intermediate host in North Vietnam, and more than likely they are also the intermediate host in South Vietnam. Buffle and canines have also been listed as possible definitive host in this country (Segal *et al.* 1968).

LAOS

No information was found in a search of the literature regarding the prevalence of *F. buski* in Laos. It has been stated, however, in a health data bulletin distributed to U. S. military personnel and by Segal *et al.* (1968), that the parasite is present in humans of this country.

CAMBODIA

Cambodia is another country where very little information is available on fasciolopsiasis. The only paper seen was that of Brumpt and Kong-kim-chuon (1965) in which the parasite was reported in 0.04 percent of the human and 5 percent of the pig populations in the region of Phnom-Penh.

THAILAND

It has been only in recent times that human fasciolopsiasis was found to be endemic in Thailand. Daensvang and Mangalasmaya (1941) reported the first infections in five people from Dhonburi Province, in Central Thailand. In 1951 an epidemiologic investigation of the disease was initiated by Sadun and Maiphoom (1953) following the death of a 15-year-old girl infected with over 500 adult worms. The study was carried out in three provinces of Central Thailand in areas of water caltrop (*Trapa bicornis*) cultivation. Over 1500 people were examined and 13 percent were found to be infected. The prevalence of infection was highest in children 5 to 14 years old with the intensity of infection, determined by egg counts, to be greatest among children between 10 and 14 years of age. The authors found that children often ate raw water caltrops during their walk to and from school. The people in these areas for the greater part of the year live more or less in floating villages where the dwellings are built on stilts. Lacking toilet facilities, people commonly defecate into the water surrounding the houses. Although the people did not defecate directly into the water caltrop beds, the same waters surrounding the dwellings also flowed into the cultivated areas. Snails in the area (*Lymnaea pignis (sulvaria)*, *Lymnaea plicatula*, and *Caridia tenuicostata*), however, were found to be negative for cercariae of *F. buski*.

In another aspect of this study, Sadun and Maiphoom (1953) examined people in Bangkok and Ayuthya who commonly eat water caltrop purchased in local markets. *Fasciolopsis buski* eggs were not found in any of those examined. This information was presented by the authors to further show that the greatest numbers of infections take place in localities where water caltrops are cultivated and that the consumption of the plant some distances from the caltrop plantations is of little epidemiological importance. In the studies of Saovakontha *et al.* (1965) and Manning (1969) other endemic areas of fasciolopsiasis in Thailand were described.

INDONESIA

Although statements are made regarding the occurrence of *F. buski* in Indonesia there are very few actual reports on the parasite in this country. Hegner *et al.* (1923), Hsü and Li

(1953), and Faust and Russell (1964) refer to the parasite as being found in man and pigs in Borneo and Sumatra. The only reference in the more recent literature, however, is that by Ressang *et al.* (1959) who mentioned the parasite in pigs.

MALAYSIA

Sandosham (1955) reported *F. buski* to be rare in man and pigs in Malaysia but in a later publication he (Sandosham and bin Keiing, 1967) suggested that reports of the eggs of the parasite in human feces in Malaysia were probably due to misidentification. Lie (1964), on the other hand, reported the recovery of adult worms from two Chinese. In the first case worms were recovered from an adult in Kuala Lumpur following treatment with carbon tetrachloride. The second case was a 13-year-old Singapore girl who died of other causes and worms were recovered at autopsy. It was believed by Lie that the adult acquired the infection in China. In the second case, however, the 13-year-old girl was born in Singapore and had never left the country. Lie suggested that the infection of the latter may have resulted from eating water chestnuts imported from China. This seems unlikely since this would have required the water chestnuts to be maintained in a wet or moist condition for an extended period of time in order to enable the encysted metacercariae to remain viable. Sadun and Maiphoom (*vide supra*) showed that even at distances of from 10 to 20 miles from endemic areas in Thailand no infections could be found in people who commonly ate water caltrop purchased from street peddlers or markets. Lie (1964) also examined pigs in Kuala Lumpur and failed to find the parasite.

BURMA

The only reports of *F. buski* that could be found in a literature search regarding Burma referred only to the presence of the trematode in pigs (Bhalerao, 1924; Bhattacharjee, 1937; Chatterjee, 1938; Griffiths, 1957). It seems likely that human infections would also be present but references to such infections could not be uncovered.

EAST PAKISTAN

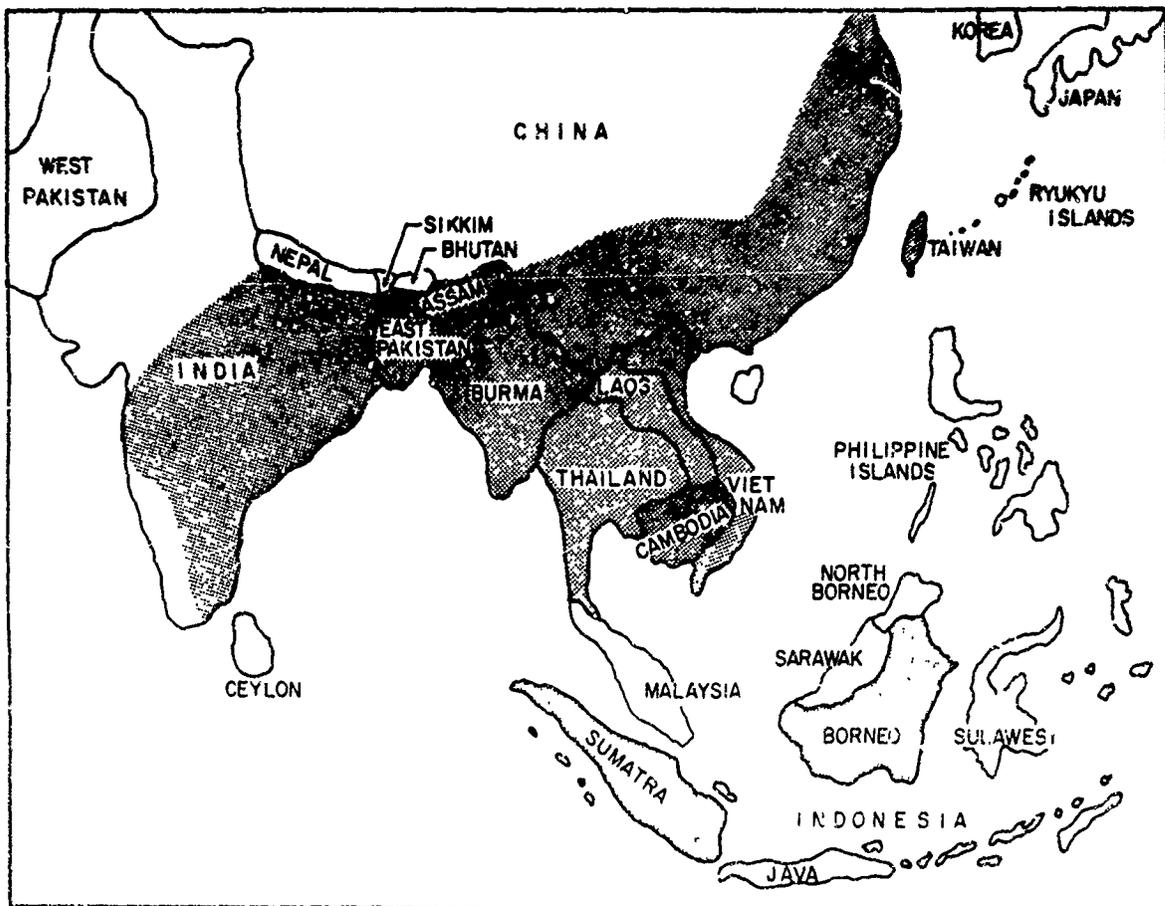
Two reports show fasciolopsiasis to be endemic in East Pakistan. Kuntz (1960) reported one human case and Muazzan and Ali (1961) five additional cases. No other reports of the disease or the parasite were found.

INDIA

The prevalence of *F. buski* in pigs and man in India seems to be variable. While Buckley (1939) found nearly 60 percent of the people examined in Assam infected with the parasite, Sataya Prakash and Varmani (1967) failed to find a single human infection in the Ghaziabad area of Uttar Pradesh. These latter authors, however, reported 1.4 percent of the pigs and 24

percent of *Planorbis* sp. infected with the parasite. In other studies in Bihar, Kant and Rama (1954) found 7 percent of the population infected and, following treatment with tetrachlorethylene, recovered from 1-57 adult worms from the patients. Other reports indicate the parasite to be in pigs and man in Calcutta (DeRivas and Lucke, 1915; Thapar 1956). According to a recent publication, Shah *et al.* (1966) found 29 percent of a population in Bombay infected with the parasite and they suggest that infections may also be present in parts of Bihar, Orissa, and Madras.

Additional studies by Buckley (1939) in Assam have shown *Segmentina trochoideus* to be an intermediate host for the parasite. Although Buckley was unable to determine the principal sources of infection, he listed the following water plants as possibilities: *Ottelia alismoides*, *Nymphaea lotus*, *Trapa natans*, *Euryale ferox*, and *Nelumbo nucifera*. He noted that pigs were rare in the area because of religious prejudices against eating pork, but examination of 30 pigs in a slaughter house failed to reveal the parasite. Similarly, Shah *et al.* (1966) reported the absence of the parasite from animals in Bombay. This is not unusual, however, as Cameron (1927) stated that in certain areas where *F. buski* is common in man the parasite may be uncommon in pigs and vice versa.



Distribution of *Fasciolopsis buski* in the Far East.

REPORTS OF FASCIOLOPSIASIS OUTSIDE THE FAR EAST

Unusual reports of human infection with *F. buski* have been made from several non-endemic areas of the world. For example, there are references to fasciolopsiasis in the United States (Moore and Terrill, 1905), South Africa (Nicol, 1910), Venezuela (Risquez, 1911), Australia (Nicoll, 1914), Russia (Seminov and Garmatti, 1927), Melanesia (Russell and Scott, 1945), and Guatemala (Penalver *et al.* 1955). It is probable that reports of *F. buski* outside the Far East are due either to misidentification of the egg or to instances where the parasite was imported with emigrants from the Far East.

COMMENT

In searching the literature and in preparing this review the author was impressed with the paucity of information available regarding *F. buski*. There appears to be little interest in this trematode today. Except in drug studies or an occasional report of finding the eggs in faces, reports of experimental studies are meager. Only two papers of recent vintage concerning experimental investigations (Kuntz and Lo, 1967; Lo, 1967) were found. This is incongruous as the parasite should be of great value to the experimentalist. The worm is large, is easily obtainable from pigs in endemic areas, and would offer those interested in biochemistry, physiology, and immunology of helminths a ready source of material.

SUMMARY

In 1947 it was estimated that over 10 million people in the Far East were infected with *Fasciolopsis buski*. Most of these infections were reported from mainland China. Although fasciolopsiasis is endemic in Taiwan, Thailand, Vietnam, Laos, East Pakistan and India, the distribution of infections in these countries is limited and the overall prevalence rates are considerably lower than those of mainland China.

While human fasciolopsiasis has not been reported from Indonesia and Burma, pigs in these countries have been found infected with the parasite. Further studies should be carried out in these countries to determine whether or not the parasite is present in man. Studies are recommended in Cambodia where little information is available and in Korea in order to determine whether or not the parasite is endemic.

Human infections have been reported from Japan, the Philippines, Malaysia, and a number of western countries, but it is probable these were from people who immigrated from endemic areas or were due to misidentification of the egg.

Fasciolopsiasis seems to be restricted to areas where populations raise water plants, such as water caltrop, water chestnuts, water hyacinth and water bamboo; and to populations that commonly ingest the uncooked metacercariae-laden plants. In addition, in most but not all the endemic countries, pigs appear to be an important reservoir of infection and species of snails of the genera *Segmentina*, *Hippeutis*, and *Planorbis*, the intermediate hosts.

Investigations show infections are found most commonly in individuals and families that live in the immediate vicinity of water culture plantations and that prevalence rates are highest in children.

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DISCUSSION

SANDEGEM: : So far in Malaysia we have had several adult specimens of *Fasciolopsis buski* sent from the mortuary both from Singapore and Federation of Malaysia (West Malaysia). Most of the persons who harboured the worms were Chinese, and many of them could have brought the infection from outside. However, some cases were supposed not to come from abroad. With regard to mis-diagnosis, you find in the reports from the clinical laboratories that "*Fasciola hepatica*" eggs were seen, but since *Fasciola hepatica* is very uncommon, and we have never seen, any specimens obtained from the post-mortem, I assume that those would be *Fasciolopsis buski* and not the other way about.

SEO: I simply want to give information on the possible incidence of fasciolopsiasis in Korea. We have *Segmentina* snails in Korea and also some water chest-nut, its size being a little bit smaller than those in Taiwan and mainland China. Korean people do not have the habit of eating raw food. However, we have a great incidence of *Fasciola hepatica* in cattle. Recently we made faecal surveys among primary school children about 20,000 in number, but we did not find any single specimen with eggs like those of *Fasciola* or *Fasciolopsis buski*.

MAESTRINI: Recently we just completed surveys in about 20 provinces in Central Thailand with special reference to *Fasciolopsis* infection. In those areas we found that approximately 100,000 individuals, we estimated, were infected with *Fasciolopsis buski*. However, the infection seemed to be somewhat different from other areas, i.e. the infection rates or the worm burdens in the people were somewhat lower than those reported by others workers. We very rarely got an individual with over 20-30 worms. Of course, we saw cases of young children with 80-90 worms, and those individuals also passed worms in their stools which is probably an indication of very heavy infection, and they were very sick. Recently a complete study on the clinical aspects of fasciolopsiasis using the D-xylose absorption screening test and the blood pictures seemed to indicate that there was no difference between the individuals infected with *Fasciolopsis* and those with negative faeces.

With regard to the incidence of infection, in one area over 70% of the people were found to be infected, which seemed to indicate that approximately 100% of the people were infected at one time or another during their life, because from one stool examination only over 70% of them were found to be positive and the majority was young children. From surveying the human population and the animals in several villages, we found that the infection rate in pigs was almost parallel to that in the people. For example in 3 villages we surveyed, the infection rates among man were very similar, i.e. about 10% and those among the pigs were about 8-10%, indicating that the eating habits are quite similar in many respects because neither one of them cook their vegetables. As far as the plants are involved, we took all the plants in the vicinity of the houses of known infected people and examined them; essentially all of the plants had infected snails on them. So I shall assume that all the plants are potentially capable of causing infection. However, there are only 2-3 species of the plants that the people normally eat raw; the most important ones are water caltrop and Morning Glory ("Pak-beong" in Thai). Those are eaten by most of the people. However, from case histories of individuals with fasciolopsiasis, there is no one common plant they eat, probably it is an indication that there is more than one plant involved in the transmission. From our work we found that the *Segmentina*

Levinseniella snail was naturally infected as well as *Segmentina trochoideus* and also we succeeded in experimentally infecting them. However, *Gyreulus convexiusculus* which is living in the same areas, we have never found infected, and also we could not infect it in the laboratory.

SORNMANI : I just would like to ask Dr. Manning, in which part of Thailand did you do the survey?

MANNING : The surveys were made in Central Thailand, limited to the provinces of Suphanburi, Ayuthaya, Angtong, Bangkok, Nakorn-pathom (all in the central plain). It also included Pha-yao district of North Thailand where there was a report of a focus *buski* infection. We did surveys twice in that area and failed to turn up any infection.

SORNMANI : I ask the question because it seems to me that it is difficult to differentiate the eggs of *Fasciolopsis buski* from those of *Echinostoma* flukes.

MANNING : It is not so difficult, if you have a micrometer on your microscope. The echinostome eggs are much smaller than those of *Fasciolopsis*.

SORNMANI : But it is better if you would confirm it by getting the adult worms.

MANNING : It is true. In clinical studies which we have completed and will be published soon, we treated many cases, and obtained the adult worms. First of all we made egg counts to find out how many eggs they had, and then found how many adult worms they had; thus we got the confirmation that the eggs were those of *Fasciolopsis buski*.

We suspected that perhaps the cattle would be a reservoir for *Fasciolopsis* and then we spent a great deal of time at the slaughter house examining them, and most of them had *Fasciola* worms but not *Fasciolopsis*. On the other hand in examinations of the people we have not yet found an individual infected with *Fasciola* either.

CHAMLONG : I would like to give more information on *Fasciolopsis buski* in Thailand. The first case of fasciolopsiasis, a Thai boy 6 years old, was reported in 1941. Later in 1951-1953 Sadun and Maiphoom discovered three endemic areas of *Fasciolopsis buski* in Central Thailand, i.e. Bang Khun Sri, Thonburi (18%), Pak-hai, Ayuthaya (15%) and Pra-pra-thon, Nakorn-pathom (1%). In these areas the people usually grew water-caltrop. They described that the infection was prevalent among the children because the children had a habit of biting and eating the raw fruit of the water-caltrop where *Fasciolopsis buski* metacercariae were located. Since then there was no work on fasciolopsiasis until 1964-1965 when the research team of the Faculty of Tropical Medicine discovered a new endemic area of this infection in Suphanburi province of Central Thailand (134 kilometers northwest of Bangkok). The infected area was confined to six villages of two districts of that province. The average prevalence of infection among the people was about 20%; there was not much difference in the rates of infection among different age groups, the lowest being 15% in 1-4 years age group and the highest 24% in 40-54 years. The severity of the infection was not high as only an average of 2,300 eggs per gram of faeces were found per individual. The local pigs were also found to harbour *Fasciolopsis buski*, the incidence of which being about 30%. The interesting thing

is that there was no water-caltrop in that area; only a plant called Morning Glory was found. Moreover, neither *Segmentina* nor *Gyraulus* snails were located in the water-beds, ponds and canals in that region. However, we succeeded in completion of the life cycle of this intestinal fluke in our laboratory using the pigs as experimental animals, and *Thochorbis trochoides* snails and Morning Glory vegetation as the intermediate hosts.

E. H. Kwo : I shall add a little information about *Fasciolopsis* in Indonesia. In all text books you will find they mention fasciolopsiasis in Indonesia, but when I was in Sumatra in 1962-1967, I was unable to find any human cases of fasciolopsiasis or any pigs infected with *Fasciolopsis* at all. I tried to find the literature concerning this infection but the only one which I could find was a publication before the Second World War; it was not a paper but just a list of the parasites found in the animals in Indonesia, mentioning about *Fasciolopsis buski* in pigs in Sumatra. I think from that it brought the authors to publish *Fasciolopsis* in the text books. Now whether or not *Fasciolopsis buski* would be found in man in Indonesia needs further observations and investigations.

MIYAZAKI : I would like to ask Dr. Cross the difference between the eggs of *Fasciolopsis buski* and *Fasciola hepatica*. Would it be difficult to differentiate them?

CROSS : It is very difficult.

MANNING : We tried to study the difference between those two parasites. We took fresh stool samples containing *Fasciola* eggs from water buffaloes and those from human cases containing *Fasciolopsis* eggs. We tried to use the criteria that had been used in the past to differentiate the two different eggs, i.e., the clustering of yolk material in the nucleus, the number of yolk cells and the size of germinal area. I, however, would not feel confident about it.

MIYAZAKI : In the northern part of Japan human infection with *Fasciola hepatica* is not so infrequent, but there is no fasciolopsiasis.

FAN : I would like to give brief information about *F. buski* in Taiwan.

In Taiwan fasciolopsiasis was found as an endemic disease located in certain areas especially in the southern part of the country. It was found mostly in pigs; human infections in general were not high. However, the infected people usually resided in houses situated near ponds (in the vicinity of the pig slaughter house) where the water caltrop and other edible water plants were cultivated. There were three important kinds of water plants in Taiwan, namely, water chest-nut, water caltrop and a kind of Chinese water plant; the last one is a vegetable commonly eaten among the Chinese families. In 1962-1964 I went to the endemic areas several times in order to examine the water plants in the ponds for *F. buski*. I found that our Chinese water plant named "Kung-shin tsai" or *Ipomoea reptans* harboured metacercariae of *F. buski* on its surface as well as in the hollow of its stem.

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13. ABSTRACT

In 1947 it was estimated that over 10 million people in the Far East were infected with Fasciolopsis buski. Most of these infections were reported from mainland China. Although fasciolopsiasis is endemic in Taiwan, Thailand, Vietnam, Laos, East Pakistan and India, the distribution of infections in these countries is limited and the overall prevalence rates are considerably lower than those of mainland China.

While human fasciolopsiasis has not been reported from Indonesia and Burma, pigs in these countries have been found infected with the parasite. Further studies should be carried out in these countries to determine whether or not the parasite is present in man. Studies are recommended in Cambodia where little information is available and in Korea in order to determine whether or not the parasite is endemic.

Human infections have been reported from Japan, the Philippines, Malaysia, and a number of western countries, but it is probable these were from people who immigrated from endemic areas or where due to misidentification of the egg.

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13. ABSTRACT

- Fasciolopsiasis seems to be restricted to areas where populations raise water plants, such as water caltrop, water chestnuts, water hyacinth and water bamboo; and to populations that commonly ingest the uncooked metacercariae-laden plants. In addition, in most but not all the endemic countries, pigs appear to be an important reservoir of infection and species of snails of the genera Segmentina, Hippeutis, and Planorbis, the intermediate hosts.

Investigations show infections are found most commonly in individuals and families that live in the immediate vicinity of water caltrop plantations and that prevalence rates are highest in children.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
<u>Fasciolopsis buski</u>						
South East Asia						
Far East						
<u>Segmentina sp</u>						
<u>Hippeutis sp</u>						
<u>Planorbis sp</u>						
<u>Trapa bispinosa</u>						
<u>Ipomoea reptans</u>						
<u>Eliocharis tuberosa</u>						
<u>Eichornia crassipes</u>						
<u>Zizania aquatica</u>						
<u>Salvinia natans</u>						
<u>Lemna polyrhiza</u>						