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# IV. SCHISTOSOMIASIS

## Schistosomiasis in Indonesia, 1980

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### INTRODUCTION

The schistosome fauna of Indonesia is not well documented as only four species have been reported from this archipelago; they are *Schistosoma japonicum, Schistosoma incognitum, Schistosoma spindale* and *Trichobilharzia brevis.* Of these, *S. japonicum is* most important in terms of human health and its biology in Indonesia is best understood. In reviewing our knowledge of schistosomiasis in Indonesia we wish to briefly mention what is known about *S. spindale* and *T. brevis* and then concentrate the discussion on S. *japonicum* and *S. incognitum*. Further, in our discussion of S. *japonicum* we wish to distinguish the classical form of S. *japonicum* from *S. japonicum*-like schistosomes of Indonesia and their respective roles in the etiology of human and animal disease.

### Schistosoma spindale

*S. spindale* was the first schistosome to be reported from Indonesia. In 1935 this blood fluke was recovered from water buffalos in Northeast Sumatera. To our knowledge this is the only written documentation of S. *spindale* in Indonesia. Most likely, however, its distribution is much wider and probably includes Sumatera, Java and Kalimantan. Besides Sumatera, *S. spindale is* known to occur in India, Ceylon and Thailand. No doubt S. *spindale is* responsible for cercarial dermatitis "swimmer's itch" in any area of Indonesia where it is endemic as it is elsewhere in Asia. Eggs have been recovered from feces of humans on one occasion but this is questionable. It is definitely a cause of bovine nasal granuloma in areas of Asia where it occurs. Larval stages of *S. spindale* develop in planorbids mollusks elsewhere in Asia and no doubt planorbids are responsible for the development of the larval stages of *S. spindale* in Indonesia.

### Trichobilharzia brevis

*T. brevis is* an avian blood fluke. In Indonesia it has also been reported only once in lymnaeid mollusks from the greater Jakarta area of West Java.

The definitive hosts are usually ducks. *T. brevis* larval stages develop in lymnaeid mollusks which are common throughout the Indonesian archipelago, especially in rice growing areas. *T. brevis* causes cercarial dermatitis in areas it is endemic. Most likely its distribution is widespread throughout the western half of Indonesia as it was originally described from ducks and lymnaeid mollusks of western Malaysia.

### Classical Schistosoma japonicum

Preliminary studies of schistosomiasis in Indonesia were made in the late 1930's and the early 1940's. A focus of Oriental schistosomiasis was discovered in the Lindu Valley of Central Sulawesi (the Celebes).

Humans, dogs, wild deer were found infected and subsequent microscopic examination of adult worms from these mammals confirmed them to be *S. japonicum.* Although extensive snail surveys were conducted at that time, the molluscan host was not found.

In the 1970's there was a resurgence of interest in the epidemiology of scistosomiasis in Indonesia. *Oncomelania hupensis* was found in the Lindu Valley, thus confirming that the disease situation in Indonesia was, in fact, a form of classical Oriental schistosomiasis similar in its biology and transmission to that found in the Philippines, Japan and China.

Twenty-two species of mammals in the Lindu Lake area have been examined for S. *japonicum* and 13 species found infected. The infection rates in the animals varied considerably with relatively high rates in civet cats, dogs, rats, shrews, wild pigs and deer. Water buffalo, cattle and horses were also found infected in the Lindu Valley but infection rates were comparatively low.

Surveys were conducted in the Lindu Valley to determine the distribution and infection rates of the parasite in mammals principally the rat, *Rattus exulans.* Infections in these rodents were used to zero in on transmission foci and follow-up snail surveys. Positive mammals were collected along much of the perimeter of Lake Lindu. The lack of records along the Southeast shore reflects inpenetrability of the region rather than the absence of *S. japonicum* transmission.

The molluscan host of *S. japonicum* in the Lindu Valley has been designated a new subspecies, O. *h. lindoensis* and is most similar to O. *h. quadrasi,* the vector host in the Philippines. The subspecific status of the *Oncomelania* in the Napu

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Valley has not been determined as yet and is presently referred to at the Napu geographic strain of O. *hupensis.*

Oncomelanid snails are widely, but focally, distributed throughout the Lindu Valley. Colonies are near cultivated fields, abandoned farming areas and in the uncultivated virgin forests surrounding the lake. Over 70 foci have so far been isolated on the lowlands surrounding the lake. Most of the colonies isolated have been found on the western and northern side of the lake. However, the vast, uninhabited lowland marsh on the eastern side has only been cursorally surveyed due to its limited accessibility. Oncomelanid colonies probably will be found in similar niches along the entire perimeter of the valley.

In the Napu Valley, so far 15 colonies of the Napu geographic strain *of Oncomelania hupensis* have been delineated. These colonies are all situated in open, grassy areas adjacent to the principal north-south and east-west trails that bisect the valley. Forested areas or along the edge of the forest have not yet been searched for oncomelanids in the Napu Valley.

Of particular interest is the fact that oncomelanids are not found at lower elevations in endemic drainage systems where there appear to be suitable habitats for oncomelanids , elsewhere in Sulawesi and throughout the rest of the archipelago. Reasons for their limited distribution will be discussed later.

Many *Oncomelania* colonies are found on uncultivated, yet cleared grassy fields with a rich silty soil adjacent to actively worked paddy fields and native cane breaks. These foci are frequently flooded after rains and during the irrigation of adjacent paddy fields. Trails used by humans as well as wild and domestic animals intersect these foci. The grass cover is sufficiently dense and lush to offer adequate protection, since *Oncomelania* are usually abundant in this habitat.

Abandoned paddy fields in swampy regions serve as ideal breeding foci for *Oncomelania,* whereas fallow paddy fields do not appear to support the growth and development of *Oncomelania.* Apparently the substrate of disturbed areas must be stabilized and the flora sufficiently dense to provide suitable habitat for *Oncomelania. Oncomelania* have not yet been found in actively worked paddy fields, even though adjacent grassy fields support high populations of *Oncomelania.* The dense vegetation adjacent to irrigation ditches, which form a network throughout cultivated lowlands, also supports *Oncomelania* colonies. It appears that *Oncomelania* migrate from these small ditch bank colonies into grassy fields, after they have been abandoned for a few seasons.

Disturbed areas represent a secondary adaptation for *Oncomelania.* In the Lindu Valley *Oncomelania* thrive in these habitats along the margins of irrigation ditches, overflow areas such as abandoned paddy fields and cleared grassy areas between paddy fields and native cane breaks. Undoubtedly disturbed areas of today, located on the vast marshland and moors remaining after the lake receded to its present level, were natural habitat for *Oncomelania* before wet rice cultivation was introduced in the early 1900s.

Natural foci of *Oncomelania* have been found in a variety of undisturbed areas, chiefly in an ecotonal zone between the forest and lowlands.

Natural habitats are well shaded by medium and high tropical vegetation. In contrast to disturbed areas, the temperatures of natural foci are more constant and generally cooler. Usually natural foci are spring fed areas with a silty substrate that remain moist throughout the entire year. *Oncomelania* are found crawling over the silty soil or attached to tanned leaves or any other flotsam available.

Although the majority of natural foci are found in ecotonal areas between the forest and lowlands, some foci have been found in small pockets where the forest vegetation borders the lake shore. The substrate of these foci is typically sandy with medium size stones scattered about. *Oncomelania* are found crawling on the rocks, under the surface of tanned leaves, dead branches or any other flotsam in these spring fed areas. These foci likewise are well shaded by the medium and high forest canopy that borders the lake shores. Temperatures are constant and cooler than in the disturbed area foci.

Natural foci were found on rock slides which bordered the lake shore. Here again the tall and medium forest vegetation offered protection from the high temperatures of midday. *Oncomelania* were actively crawling about the rocks, tanned leaves and other debris scattered about the focus. These foci were moist year around since spring were present.

The Owo area of the Lindu Valley was used as a pasture for cows, water buffalo and horses. As far as we know it was never used for rice cultivation. The area became the center of a controversy a few years ago when the local government tried to transmigrate 70 families into this land. Unfortunately, the transmigration project was not stopped as a very large *Oncomelania* focus was located there. Within six months, 60% of the transmigrants, approximately 500 individuals, were infected with *S. japonicum.*

Three methods were used to estimate the population densities of O. *h. lindoensis* in the Lindu Valley. They were (I) an exhaustive technique using a brass or iron tube I3,5 cm in diameter, (2) a fractional technique using a metal ring also I3,5 cm in diameter and (3) another fractional technique counting the number of snails per unit of time (man-minute).

The simplest method was the ring sample, but in our hands this method has not been practical because it cannot be used where vegetation was thick or where the habitat was under water. Both conditions occurred frequently in the Lindu Valley.

The core type sampler which is exhaustive, e.g. most of the snails in a given area are recovered, is the best method but it is also the most time consuming. The plug sampler yields 97% of the juvenile and adult snails in a given area. In order to obtain 100% of the snails the sediment must be placed in plastic buckets and held for up to 48 hours. In view of the time and logistics involved in gaining the increased accuracy it was not deemed worthwhile.

As a primary method we adopted the man-minute approach even though we were aware of its limitations (I) the data obtained is not comparable with work done elsewhere by other technicians and (2) for accuracy it depends on the reliability of the collector. However, this method was able to be used in all habitats of oncomelanids throughout the valley and measures of population densities obtained should be sufficient to evaluate local attempts at control.

At one focus, Luo, all three methods were used to estimate the density of oncomelanids, ring samples average I8% of total snail population with a range of 7 to 30%.

When the ring and man-minute methods were compared with the plug method it was noted that correlation coefficient for the man-minute and the plug sampler was higher than that of the ring method and the plug sampler. In our trials, then, the man-minute method was actually a better estimate of the total population than was the ring method.

Man-minute estimates were made at seven foci for at least 16 months. Average values obtained ranged from 0.5 to 2.65 per man-minute. There were no significant differences between collectors who had participated in 10 or more collections. When compared to the plug sampling method 1 snail/man minute =± 500 snails/sq. meter, 2 snails/man minute = ± 1000 snails/sq. meter and 3 snails/man minute =± 1500 snails/sq. meter.

The exhaustive technique utilized at Luo revealed that there were. over 1339 snails per square meter. This abandoned rice field area covers 750 sq. meters. Thus, the oncomelanid population at this focus alone is estimated at over 10,000,000. Since the valley floor, minus that under Lake Lindu, is approximately 50 KM sq., a conservative estimate of 500 snails per sq. meter over one tenth of the marsh lands (5 KM sq.) would indicate that the population of oncomelanid in the valley is astronomical (± 25 billion).

Infection rates of S. *japonicum* in O. *h. lindoensis* varied considerably hetween foci and between sampling periods. Within a particular colony the distribution of infected snails was not uniform. The overall average infection rate in the Lindu Valley was 2.39%.
Usually, average infection rates were less than 3% in large disturbed area foci. Higher rates (as high as 7%) were frequently found in small natural foci bordering the lake shore or in the virgin lowland forests.

There did not appear to be any seasonal correlation of infection rates in one focus when compared with another. There were sharp variations in the seasonal infection rates both in disturbed and in undisturbed areas.

Infection rates were higher in female (2.70%) than in male snails (1.95%). By age (length) snail infection rates were quite consistent in snails two months of age or older.

Sentinel animal experiments using mice and monthly samplings of wild rodents throughout known foci of transmission indicated that transmission took place throughout the year and that the diurnal peak of cercarial release was between 1600 and 2000 hours.

The distribution of schistosomiasis throughout the archipelago was studied extensively in the 1970's, especially on the island of Sulawesi. Although more than 50,000 stool specimens were examined and extensive snail surveys conducted *Schistosoma japonicum* and O. *hupensis* appear limited in their respective distribution to two contiguous drainage systems of Central Sulawesi the Lindu Valley, 1,000 meters in elevation at the headwaters of the Gumbasa River drninage system and the Napu Valley, more than 1,000 meters in etevation at the headwaters of the Lariang River drainage system.

According to a 1971 census 6,500 Indonesians from a total population of 120 million lived in confirmed schistosomiasis transmission areas. However, at least 500 more individuals have moved into the Lindu Valley. Thus, at least 7,000 individuals are continuously exposed to schistosomiasis in confirmed endemic areas.

Using a very conservative infection rate (35%), 2,500 persons in Indonesia are afflicted with this disease. Most likely, however, 50 - 60% of the exposed population are infected. At the latter rate approximately 4,000 individuals are afflicted with schistosomiasis in Central Sulawesi at any given time.

However, it is important to emphasize that these numbers and percentages refer to persons passing schistosome eggs in their stools; a much smaller number and percentage of persons are really clinically compromised by this infection.

The current status of our knowledge of classical schistosomiasis in Indonesia just described really was the situation in 1975 shortly after the Ministry of Health and associated colleagues from the University of Indonesia and the U.S. Naval Medical Research Unit completed their base line studies of the epidemiology of schistosomiasis in Central Sulawesi.

Since 1975 there have been a number of developments that have changed the epidemiological picture - some for the better and some, regrettably, for the worse :

a) A pilot control project was initiated by the National Institute of Health Research and Development in conjunction with the World Health Organization. This pilot project which focused on the Paku-Anca area was a multidimensional approach to control similar in design to the current control program in the Philippines. It involved selective mass treatment, agro-engineering, mollusciciding, improved sanitation and health education. The results were good as the prevalence of schistosomiasis was reduced from 75% to 25% in the intervention area over a two year period. Regrettably, however, the control effort has not been maintained and one indicator of increased transmission, the prevalence of infection in rodents, suggests that the disease will return to its previous level of endemicity in a short period.

b) Other schistosomiasis control projects were conducted throughout the Lindu Valley during the same time frame and subsequent to the NIHRD — WHO pilot control project . The non-intervention area of one study was accidentally "controlled" by another project obviously compromising the results of both studies. In addition, during the past five years the 4 or 5 villages in the Lindu Valley have been treated by a number of agencies on more than one occasion using more than one antischistosomal compound making it difficult to determine who has been treated, with what, by whom or when ?

c) Local transmigration programs have relocated people from other areas of Sulawesi in two areas of the Lindu Valley that were already known to be schistosomiasis transmission areas and were declared off limits to human habitation by the Ministry of Health personnel involved in the basic epidemiological studies of schistosomiasis. In the'Owo area, approximately 70 families,± 500 individuals, were exposed to schistosomiasis. In less than one year 50% were infected. In Bamba, transmigrants were encouraged to farm confirmed transmission areas; they became ill as expected and left the area. Some of these farmers returned to a more primitive type of slash and burn farming on the mountains surrounding Lake Lindu and this resulted in a series of clashes with governmental officials interested in preserving the primary forests of that region.

d) In one case a Javanese Bachelor of Sciense volunteer was sent to Central Sulawesi and assigned the task of helping the farmers of Owo improve their agricultural production.

No one in the government warned him about the schistosomiasis problem and he needlessly became infected.

e) A logging road has been constructed from the Palolo Valley close to Bamba which is a confirmed schistosomiasis transmission area on the northern shore of Lake Lindu. The only reason schistosomiasis is not a major health problem in Indonesia today is because of its very focal and limited distribution. It has the potential to be a much more serious health problem. Increased contact with the outside world - as by a commercial road to the valley - would be the most sure way of spreading schistosomiasis to other areas of Central Sulawesi. The present isolation of the Lindu and Napu Valleys is the single most important reason for its limited distribution and its relative low importance as a national health problem.

The events since 1975 emphasize that if the control of schistosomiasis is to be successful it will require coordinated efforts of the local government, the Department of Health, the Department of Public Workers, the Department of Irrigation and the Department of the Agriculture. After 30 years of attempting to control of schistosomiasis in the Philippines, that government finally created a"Schistosomiasis Control Council" which has authority over all departments of the government in confirmed schistosomiasis areas. Now, in the Philippines, all agencies of the government must coordinate their developmental efforts so that the schistosomiasis problem is managed properly.

When and how schistosomiasis became established on the island of Sulawesi remain unanswered but the subject of interesting conjecture. The genus *Oncomelania* and most likely *Schistosoma japonicum* had their origin in China or in Namma Valley of Burma near the head waters of Yang Tze River and Irawady where fossil *Oncomelania* (approximately 1 million years old) have been found. Oncomelanids spread to Taiwan before it was separated from the continent. Some think that *Oncomelania* was introduced to Japan, the Philippines and to Sulawesi, Indonesia at a later time from the mainland of China or from Taiwan by activities of man - e.g. by the introduction of rice culture. If oriental schistosomiasis and its malluscan host were introduced by man to Sulawesi from the sothern Philippine island of Mindanao where both the molluscan host O. *hupensis* and *S. japonicum* are abundant, why has it not been found at seaports and low lying rice growing regions (<500 meters) ? Why has it only been found at or above 950 meters in isolated pockets of the island ? In the Philippines, *Oncomelania* habitats are usually found near sea level but they do occur at elevations up to 900 meters in one province of Mindanao. Likewise, it is important to note that wet-rice culture, when practiced in a very primitive fashion, creates habitats very suitable to the maintenance of oncomelanids. In the Lindu Valley of Sulawesi however, wet-rice culture was not introduced until the turn of the century (1900).

Recent studies in the Lindu Valley have conclusively demonstrated that the disease and its molluscan host are well established in undisturbed lowland forests. The presence of the disease and large populations of the snail in disturbed and cultivated areas appear to be secondary adaptations.

The concept that schistosomiasis was introduced to Sulawesi by man in recent time is difficult to believe. A more credible answer may be found in geological history of this area. Sulawesi is still active, geologically speaking. Schistosomiasis and its molluscan host, O. *hupensis* , possibly were widespread throughout the island of Sulawesi and high mountain valleys where it is found today may have been much closer to sea leveL

A land bridge with the Philippines seems indicated by an analysis of the vertebrate fauna and it is not surprising that the Lindu strain of *Oncomelania* most closely resembles O. *h. quadrasi* in the Philippines. The area of Indonesia east of the straits of Makassar is geologically unstable, uplifts and subsidences in the order of 1000 - 2000 meters during the past 1 to 2 million years were quite possible. A possible land bridge between Sulawesi and Mindanao via the Minahasa Peninsula and the Sangir-Kawio chain of islands seems to be a more reasonable explanation for the extension of the distribution of oncomelanids and schistosmiasis into the Indonesian Archipelago.

### Schistosoma japonicum-like trematodes.

There have been at least 10 reports of *Schistosoma japonicum-like* infections in man from Java. These have usually been considered nonautochthonous cases. Eight of the reports occurred in Indonesian residents of Chinese heritage who had previously migrated from, or made trips to, Mainland China-supposedly to an endemic area along the Yang Tze River system. To our knowledge none of them ever visited the confirmed schistosomiasis areas in Sulawesi. One case, however, reportedly made numerous trips to Central Kalimantan ( staying there for 3- 4 month periods. However, this indivual, also of Chinese heritage, denied ever having been in endemic areas of Sulawesi or having traveled outside of Indonesia. Another case that has recently been reported involved a man of Chinese heritage who denied ever leaving the island of Java. All of the above 10 cases occurred in middle to older age males between 34 and 68 years of age and each case was diagnosed following histological examination of tissue samples which were recovered for surgical reasons or at autopsy. Essentially then, these occult cases were due to *S. japonicum orS.* japonicum-like trematodes.

There are at least three possible explanations for the etiology of these cases :

1).Cases were due to classical S. *japonicum* and individuals were exposed an a confirmed endemic area either in Sulawesi or outside of Indonesia-most likely China since all cases occurred in individuals of Chinese heritage.

2). Cases were due to classical S. *japonicum* and individuals were exposed in a currently unknown area of Oriental schistosomiasis transmission in Indonesia. This area most likely would be on the island of Java as nine of the ten cases occurred in individuals where Indonesian exposure was limited to Java.

3).Cases were due to a S. *japonicum-like* trematode that is endemic to Java and/or Kalimantan.

In the cases involving individuals who had migrated from China or who had visited that country, the most probable explanation is that these individuals were exposed to a classical strain of *S. japonicum* in China. However, the two cases who never visited known endemic areas either in or out of Indonesia, are more difficult to explain. All three of the above options must be considered :

1).They may have come in contact with a classical strain of

*S. japonicum* in a transmission area of Indonesia that has yet to be identified.

2).They may have visited an endemic area of classical *S. japonicum,* such as China, but choose not to admit the fact.

3).They may have been exposed to an unknown *S. japonicum*-like trematode that is endemic to Java and/or Kalimantan.

In light of recent studies in Malaysia where *S.japonicum-likeeggs* have also been reported from liver tissue of ten aborigines; where adult worms indistinguishable from *S. japonicum* were reported in monkeys *(Macaca* fascicularis) in Ranau atea of Sabah; and where recently they have found a mammalian schistosome in a triculinid mollusk and rodents in the same area where infections of *S.* japonicum-like trematode eggs have been found in man, the possibility of a similar etiology for cases in Indonesia, particulary in Java and Kalimantan, takes on a new credibility.

The molluscan fauna of Java and Sumatra was studied extensively by Van Bentham Junting. Habitats similar to those occupied by amphibious O. *hupensis* elsewhere in Asia were surveyed throughout both islands yet oncomelanids were not found. Thus, it is very unlikely that a classical form of *S. japonicum,* transmitted through O. *hupensis,* exists in lndonesia west of the Wallace's Line. However, habitats occupied by small aquatic, triculinid mollusks may not have been examined or they were examined in a very cursory sort of manner. In Malaysia, triculinid mollusks have been found at the headwaters of river systems — in the quartenary branches — far removed from concentrations of human populations. Many such areas exist in Sumatera today and many probably did exist on the island of Java in the not too distant past.

Likewise, it is unlikely that either of the two cases who denied having left lndonesia, in fact did. A journey to China especially if it was done clandestinely, would be very expensive and neither individual's family was in a financial position to afford such a luxury.

Thus, the most reasonable explanation of those given for the cases involving individuals who never left Indonesia or who never visited endemic areas in Sulawesi is that they came in contact with another mammalian schistosome with *S. japonicum-like* eggs-possibly one more related to *S. mekongi* than to *S. japonicum. S. mekongi* is endemic to the mainland of Southeast Asia, where it occurs naturally in dogs and humans along the Mekong River in Cambodia and Vietnam. lt is transmitted by a triculinid mollusk, *Tricula aperta,* which is a tiny freshwater mollusk, distantly related to O. *hupensis.* Until recently schistosomes recovered from humans and dogs in Cambodia and Vietnam were simply called the Mekong strain of *S. japonicum.The* morphological features of the adult and larval stages are very similar but there are distinct biological differences including their respective fastidiousness for particular mollusks : *T. aperta* for *S. mekongi* and O. *Hupensis* for *S. japonicum.*

As the picture of the co-evolution of schistosomes and their molluscan hosts in Asia comes into focus though it appears that there are two distinct branches in the evolution and distribution of Asian schistosomiasis. One branch involving ancestors of *Oncomelania* and *S. japonicum* that make way from China to Japan, Taiwan, the Philippines and Sulawesi, Indonesia during glacial periods and the other branch involving ancestor of triculinid mollusks and *S. mekongi* that make their way south from the mainland of Southeast Asia via the Malaysian peninsula and possibly to Borneo (Kalimantan), Sumatera and Java.

### Schistosoma incognitum

*S. incognitum* was described from human fecal specimens collected in India in 1926. Since then, Indian parasitologists have found it is a variety of domestic mammals and, experimentally, they have established patent infections in a wide range of laboratory and domestic mammals. *S. incognitum* was found in Thailand during the 1960's ; there rodents served as natural host. During the 1970's it was found on two islands in the Indonesian archipelago, namely Java and Sulawesi. Although a variety of rodents and wild deer have been found naturally infected in Indonesia, human infections have not been diagnosed by stool examinations in areas of Indonesia where it is enzootic.

*S. incognitum* is considered a potential health hazard in Asia for the following reasons :

1). It lacks definitive host specificity as it can develop in at least six orders of mammals.

2),It is a common parasite of domestic mammals in India and of commensal rodents in areas of Southeast Asia where it has been discovered.

3).Although patent infections have not been reported in experimentally exposed primates development to recognizable adult stage has been documented.

4).Humans are constantly being exposed to the cercarial stage (the infective stage) of *S. incognitum* in rice fields of Asia where lymnaeid snails and commensal rodents maintain this sylvatic cycle of this blood fluke. Thus, with any favorable changes in its gene pool, *S. incognitum* may be able to exploit the second most common mammal in Asia-man.

Evolutionary pressure is always present and man's cultivation of rice in habitats that are ideal for the continuation of *S. incognitum* presents a continual opportunity for *S. incognitum* to expand its host range to the readily availble human population.

In Sulawesi, *S. incognitum* and *S. japonicum* are sympatric both in geography and definitive hosts. Their overlapping distribution obviously raises the question of their potential hybridization as these two Asian schistosomes have much in common :

1). Both lack definitive host specificity; both develop in a wide range of mammalian species from insectivores to primates.

2).Both utilize amphibious molluscan hosts : a pomatiopsid 0. *hupensis,* in the case of *S. japonicum* and a lymnaeid, *Radix rubiginosa,* in the case of *S. incognitum.*

3).Both occur in Southeast Asia.

However, there are also important differences between *S. incognitum* and *S. japonicum :*

1).Most strains of *S. japonicum* readily develop to maturity in humans and other primates whereas *S. incognitum* has not been shown to develop to patency in any primate in spite of its purported origin as a parasite of humans in India. Indian parasitologists now consider that the source of the original specimens of *S. incognitum* was really of porcine origin.

2).The distribution of classical *S. japonicum is* limited to the distribution of O. *hupensis* and this species is very fastidious in its ecological requirements. On the other hand, *S. incognitum* which is adapted to ubiquitous lymnaeid snails potentially has a much larger distribution in Asia and elsewhere than classical *S. japnnicum* because of the latter snail's dependece on O. *hupensis* for transmission.

If these sympathic schistosomes which share the same definitive hosts in the same geographic region of Indonesia hybridize successfully, the result could be offspring capable of infecting humans yet also capable of utilizing mollusks such as lymnaeids. In that event human schistosomiasis'could become a problem throughout all of Asia.

*S. japonicum* and S. *incognitum* share the same geographic area and hosts in two areas of Central Sulawesi - the Lindu and Napu Valleys. There, *Rattus exulans* have been found infected with both schistosomes. In two cases both schistosomes species were concurrently found in the same rodent and in one of these cases a heterologous pair- a S. *incognitum* male and a S. *japonicum* female were found *in copula.* Subsequently, this same phenomenon was observed in experimental animals. Laboratory mice were exposed to 50 *S. incognitum* cercariae from West Java and challenged with 50 *S. japonicum* cercariae from Central Sulawesi 40 days later. When perfused 48 days after challenge female S. *incognitum* were found in the gynecophoral canal of S. *japonicum* males and vice versa. Heterologously paired females of both species contained eggs which, as would be expected, were of maternal origin. The viability of these eggs regrettably was not determined. Thus, even though these two mammalian schistosomes have been isolated through a high level of intermediate host specificity, their sympatric distribution, both geographically and in regards at least some definitive hosts, presents a natural opportunity for recombination of genes that may favorably affect the hybrid's ability to infect a wider range of intermediate or definite host. As far human health is concerned the most dangerous hybrid would be a schistosome capable of infecting man that was transmitted through lymnaeid snails. Schistosomes, like all forms of life, continually adapt to changes in their environment to survive. It is not unreasonable to assume that their ability to cycle through humans in addition to other mammals would enhance their chance of perpetuating themselves in rice growing areas of Asia.

### SUMMARY

As we can see from today's discussion schistosomiasis in Indonesia is not as simple as one might suppose. There are most likely a number of unidentified schistosomes in the Indonesian archipelago. In regard to human health the primary concern is classical Oriental schistosomiasis which is presently limited to two remote mountain valleys of Central Sulawesi. It is of utmost importance that a rational control or eradication program be developed in the near future before economic exploitation of Sulawesi spreads this disease to other areas. The second public health concern involves schistosomes of mammals other than man which may adapt themselves such that they exploit or utilize the human population in areas where they are now enzootic for their own survival. Obviously the evolutionary stage is set for them to do so. If this occurs schistosomiasis in Indonesia could become a major public health problem. However, with determined efforts classical schistosomiasis can be controlled and possibly eradicated from Indonesia. Indonesia, in this case, would be the first country in the world to accomplish such an objective, and of any country where schistosomiasis is currently endemic, Indonesia has the best opportunities of eradicating this disease. Further, continued monitoring of animal schistosomes throughout the archipelago can provide a sufficient early warning system in the event zoophilic schistosomes take a liking to man and become anthropophilic.

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# V. CACING USUS

## Pengobatan Massal Infeksi Cacing Usus dengan Pyrantel Pamoate pada Anak SD di Yogyakarta

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### PENDAHULUAN

Jalan yang paling cepat untuk menanggulangi dan memberantas parasit adalah memutuskan lingkaran hidupnya.

Pada keadaan infeksi cacing usus yang ditularkan melalui tanah ("Soil transmitted helminths") termasuk : *Ascaris lumbricoides, Trichuris trichiura,* cacing tambang dan *Strongyloides stercoralis,* cara-cara yang dapat diterapkan untuk memutuskan lingkaran hidup mereka dapat berupa :

1. Pengobatan masal berulang-ulang (secara periodik) terhadap penduduk yang terkena infeksi untuk menghilangkan cacing dari dalam tubuh mereka.
2. Perlakuan atau pengobatan terhadap kotoran tinja untuk membunuh telur cacing maupun larva.
3. Tindakan menghilangkan telur cacing atau membuat agar telur menjadi inaktif dari dalam makanan atau sayur-sayuran.

Namun di antara hal-hal tersebut di atas, pengobatan masal berulang-ulang telah diakui sebagai penyangga utama ("The main pillar") tempat bersandarnya usaha penanggulangan atau pemberantasan infeksi Ascaris dan cacing tambang (1).

Di dalam masyarakat, terutama di daerah pedesaan, pengobatan masal diberikan dengan tujuan untuk mengurangi jumlah cacing yang dapat menghasilkan telur, sehingga dengan demikian dapat mengurangi kesempatan terjadinya reinfeksi.

Di Indonesia, meskipun prevalensi cacing yang ditularkan