

# World Health Organization

## Division of Control of Tropical Diseases



**Malaria** 瘧疾

**Filariasis** 血絲蟲症

**Leishmaniasis** 利什曼原蟲症

**Trypanosomiasis** 錐蟲症

**Schistosomiasis** 血吸蟲症

**Leprosy** 癩瘋

# Schistosomiasis 血吸蟲症

Dr.Theodor Bilharz discovered the parasite in 1851 in Cairo

One-sixth of the world's population is at risk  
Endemic in 74 countries  
200 million persons are infected, 200,000 death annually  
Highest prevalence and severity in children



## Intestinal 腸道 Schistosomiasis

***Schistosoma mansoni***

曼氏(森)血吸蟲

*Schistosoma intercalatum*

間插血吸蟲

-> *S. guineensis*

幾內亞血吸蟲

***Schistosoma japonicum***

日本血吸蟲

*Schistosoma mekongi*

湄公血吸蟲

*Schistosoma malayensis*

馬來血吸蟲

## Urinary 尿道 Schistosomiasis

***Schistosoma haematobium*** 埃及血吸蟲

# *Schistosoma* spp. 血吸蟲



Bilharz

1851 - Bilharz

1904 - Katsurada

1907 - Sambon

1934 - Fisher

1978 - Voge, Bruckner, Bruce

1988 - Greek, Ow-Yang, Yong

*S. haematobium*

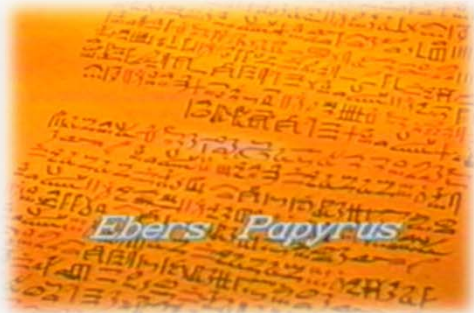
*S. japonicum*

*S. mansoni*

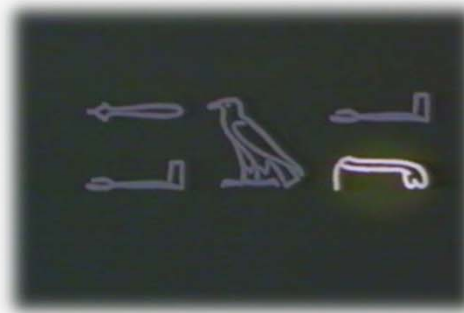
*S. intercalatum*

*S. mekongi*

*S. malayensis*



Ebers Papyrus



馬王堆 追辛夫人[西漢]



## 中國古屍體內寄生蟲感染情況

古尸名称	性别	年龄(岁)	身份	发现地点	埋葬时代	发现时间 (年)	埋葬时间 (年)	寄生虫种类	报告者
戴缙	男	54	工部尚书	广州	明弘治至正德年间	1956	约 450	人蛔虫	黄文宽
戴周氏	女	80	戴缙之妻	同上	明弘治 15 年	同上	同上	人鞭虫、姜片吸虫、肝吸虫	同上
盛仪	男	不详	太仆寺卿	扬州	未确	同上	约 420	人蛔虫、人鞭虫	苏州医学院
彭淑洁	女	60	盛仪之妻	同上	明嘉靖 33 年	同上	402	同上	同上
追辛	女	约50	软侯利苍之妻	长沙	西汉	1973	约 2,100	血吸虫、烧虫、人鞭虫	湖南医学院
遂少言	男	约55	五大夫	江陵	公元前 167 年	1975	2,142	血吸虫、肝吸虫、人鞭虫、绦虫	魏德祥等
周瑀	男	28或40	不明	江苏金坛	南宋	同上	约 800 多	人蛔虫、人鞭虫	镇江市博物馆
北宋古尸	男	约50	不明	衡阳	北宋	1973	同上	肝吸虫	衡阳医学院
福清古尸	男	约50	不明	福建福清	明嘉靖 37 年	1980	422	肝吸虫、人蛔虫、姜片吸虫、人鞭虫	林金祥等
王锡	男	41	进士	福建邵武	明嘉靖 32 年	同上	427	人蛔虫	同上
龙岩古尸	女	74	官宦家属	福建龙岩	明万历壬寅年	同上	378	人蛔虫、人鞭虫	同上
陈妙祯	女	50—60	户部尚书之妻	福州	明代	同上	约 400	肝吸虫、人鞭虫	福州市文管会
战国古尸	女	不详	不详	江陵	战国中期	1982	约 2,300	肝吸虫、人鞭虫、人蛔虫	雷森等



# The worm that saved Taiwan



Mackenzie Kwak -  
Parasitologist  
@mackenziekwakparasit  
ologist



10/10/2019



Mackenzie Kwak -  
Parasitologist  
@mackenziekwakparasit  
ologist



## Mackenzie Kwak - Parasitologist

10/10/2019 10:57am

### -The worm that saved Taiwan-

Today is Taiwan's national day, so let me tell you the story of the worm that saved Asia's most free and open democracy from totalitarianism.

During the late 1940s a civil war raged in China between the forces of the nationalists (KMT) and the communist. After a bloody struggle (and assistance from the USSR) the communists had driven the nationalists out of most of China and by 1949 they were retreating to Taiwan where they set up the new administrative capital of the Republic of China (ROC).

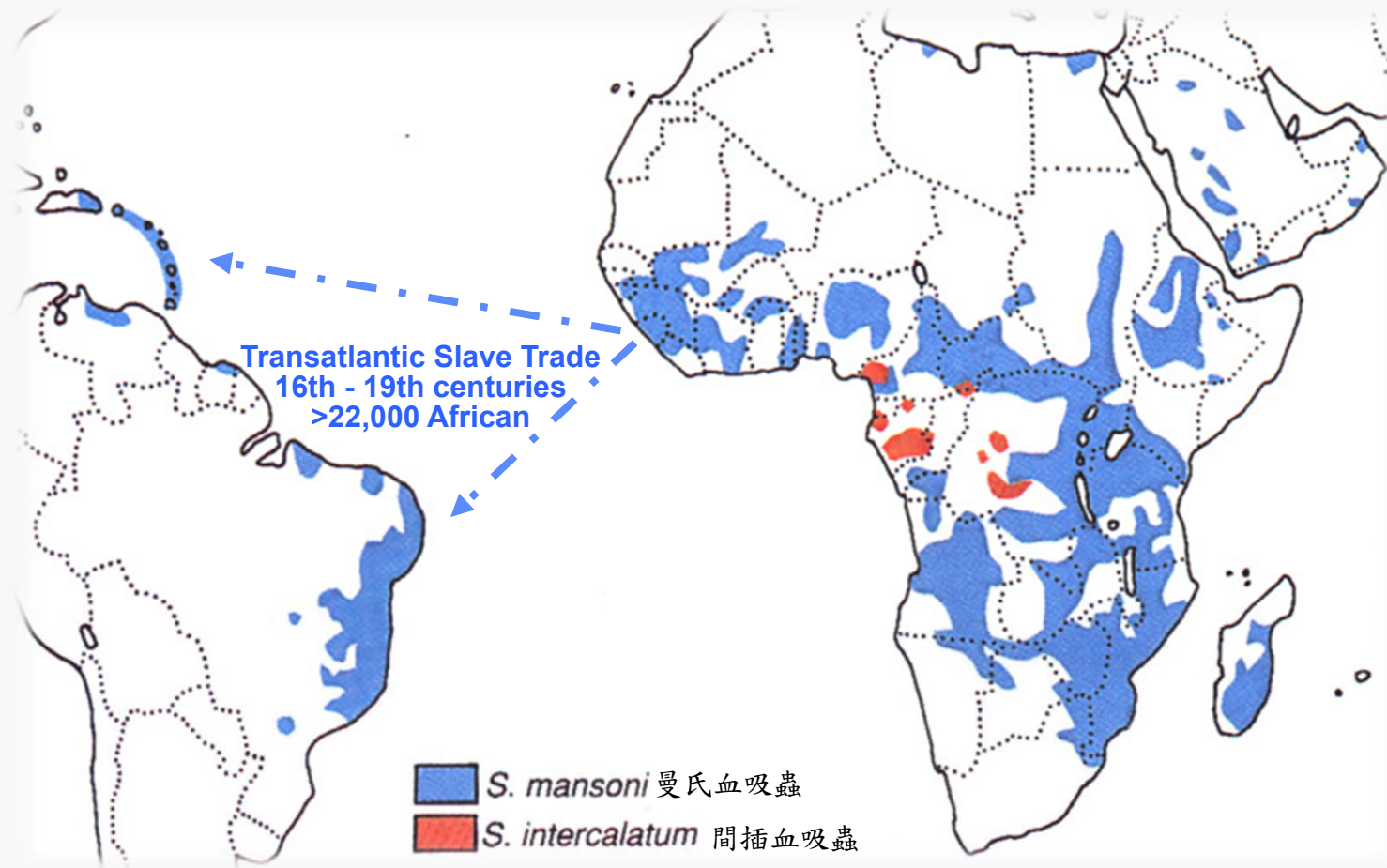
However, Mao was determined to destroy them and sent many of his forces south to train for an imminent amphibious invasion of the island. Though few of these troops could swim. So, the military had them learn in the rivers and waterway of southern China. However, these same waterways were full of the larvae (cercariae) of the Asian blood fluke (*Schistosoma*). These cercariae burrowed into the swimming soldiers and caused mass schistosomiasis. This crippled the invasion force long enough for the US to send in war ships to defend Taiwan from any invasions by the communists.

Thanks to *Schistosoma*, Taiwan avoided the mass killings and famines that claimed the lives of millions during Mao's deadly 'Great leap forward' and the 'Cultural revolution'. Today Taiwanese are free to protest, vote, and criticize their government if they see fit, and it may all be due to a little parasitic worm that saved them in 1949

50年代統計，疫區遍及江南12個省、市的350個縣，患者1000萬人。

# Distribution of *S. mansoni* and *S. intercalatum*

## 血吸蟲症分佈 (曼氏血吸蟲及間插血吸蟲)



***S. mansoni***  
曼氏血吸蟲

非洲 馬達加斯加.中東.  
南美(巴西).加勒比海.

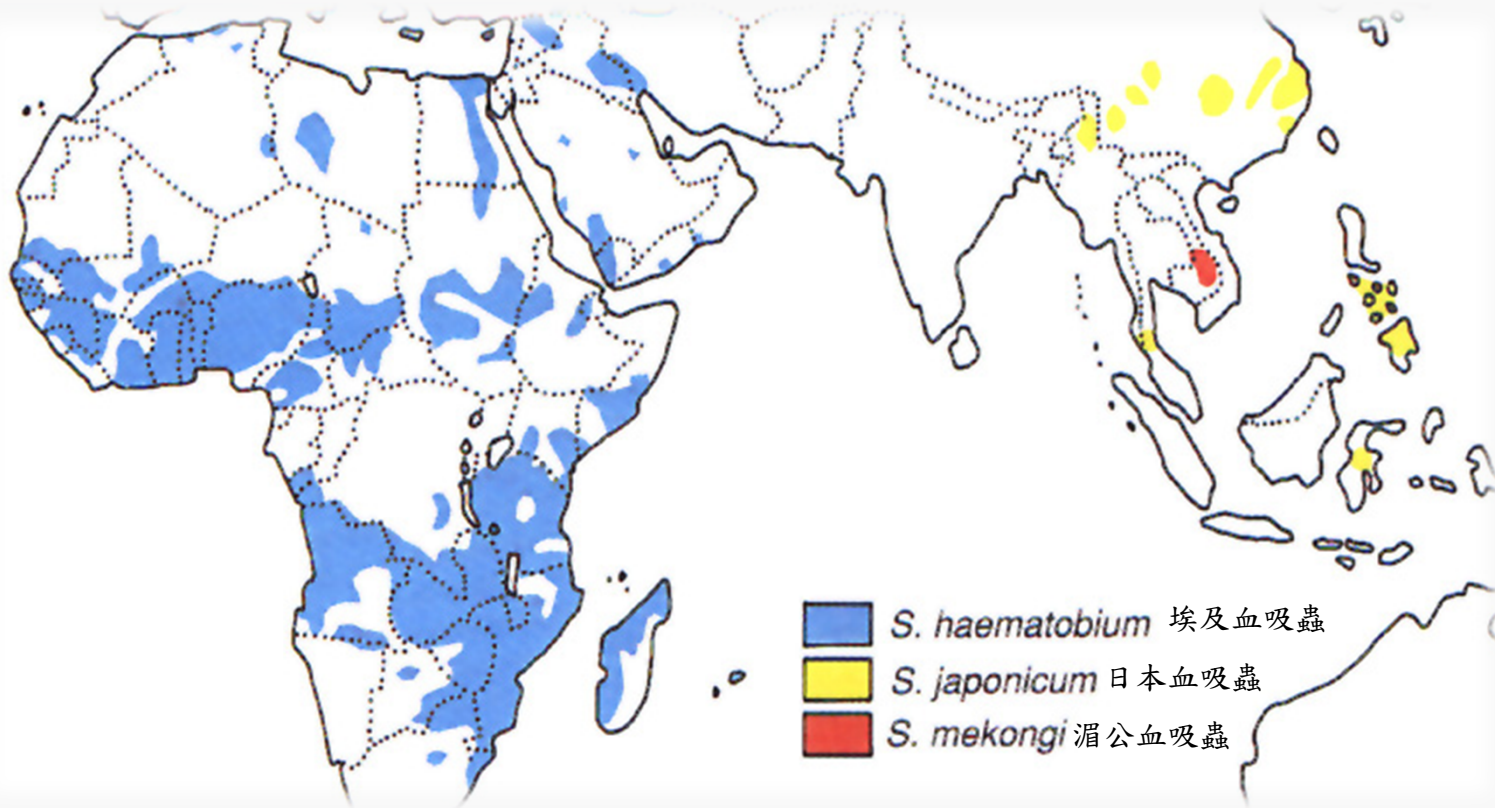
***S. intercalatum***  
間插血吸蟲

非洲中西部



# Distribution of *S. japonicum*, *S. mekongi* and *S. haematobium*

血吸蟲症分佈 (日本血吸蟲、湄公血吸蟲及埃及血吸蟲)



***S. japonicum***  
日本血吸蟲

中國大陸，印尼，  
菲律賓。

***S. mekongi***  
湄公血吸蟲

泰國湄公河流域

***S. haematobium***  
埃及血吸蟲

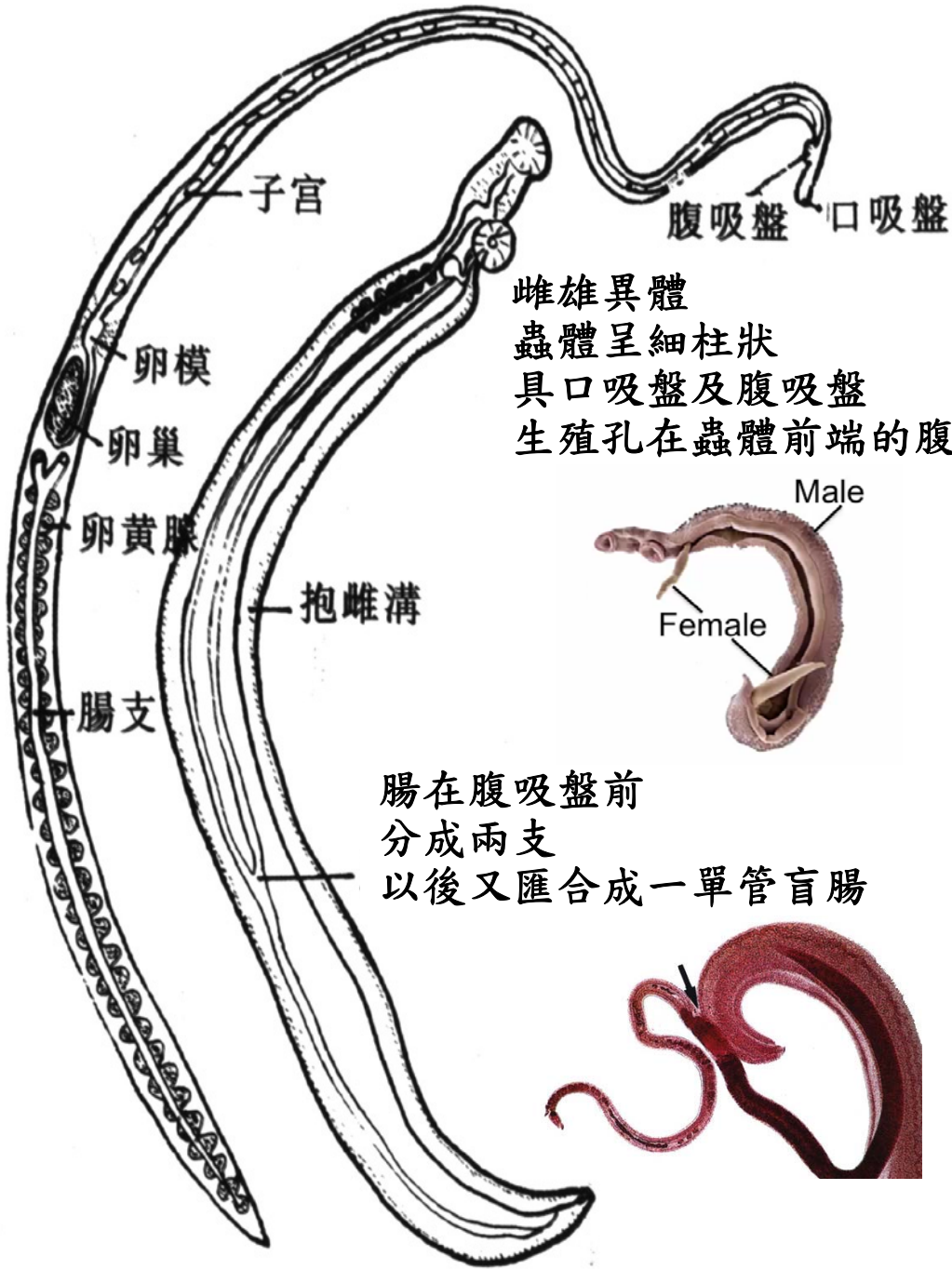
非洲，阿拉伯，中東，  
馬達加斯加，模里斯

# *S. mansoni* (male & female)

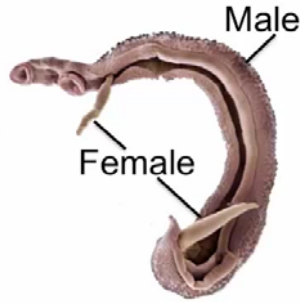
曼氏血吸蟲



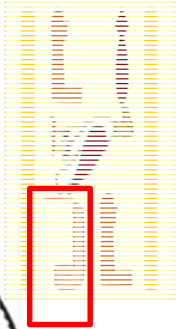
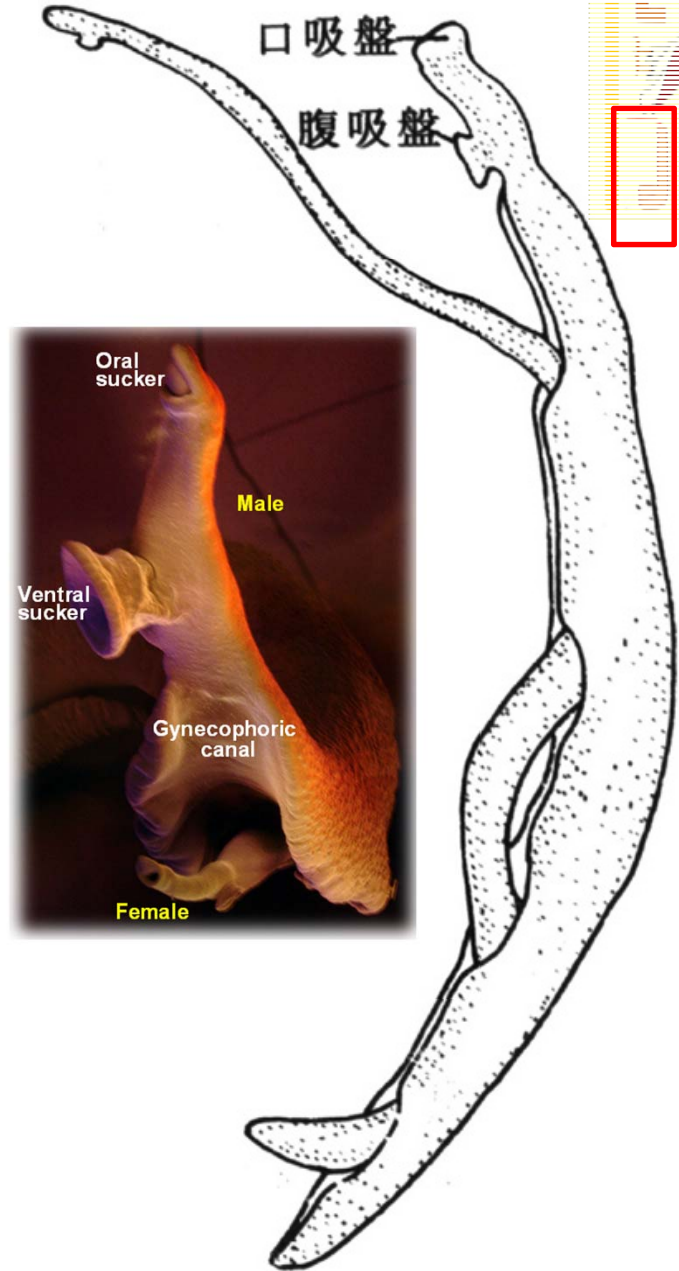
*Till death us do apart* 相愛至死不渝



雌雄異體  
 蟲體呈細柱狀  
 具口吸盤及腹吸盤  
 生殖孔在蟲體前端的腹側



腸在腹吸盤前  
 分成兩支  
 以後又匯合成一單管盲腸





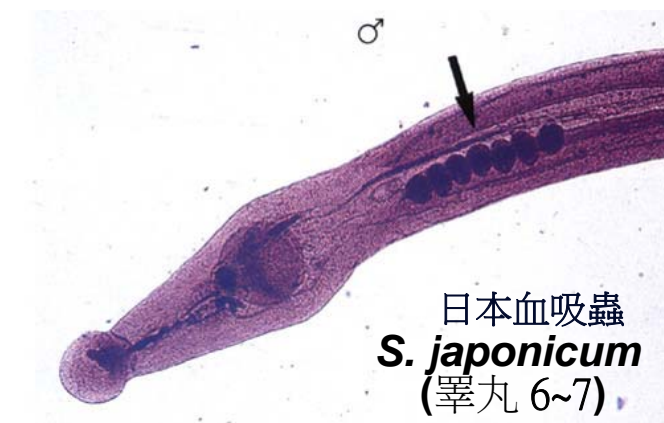
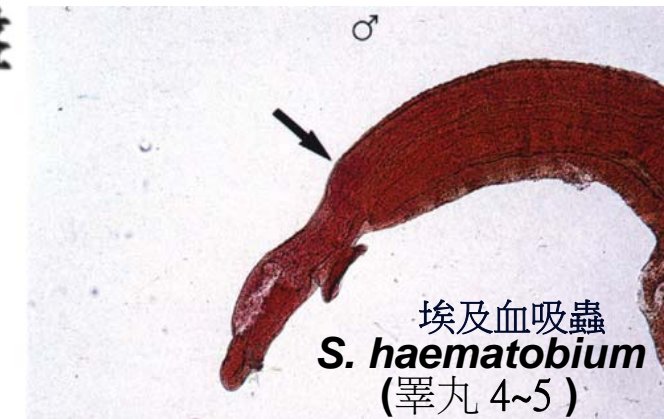
# 血吸蟲雄蟲形態

雄蟲呈灰白色

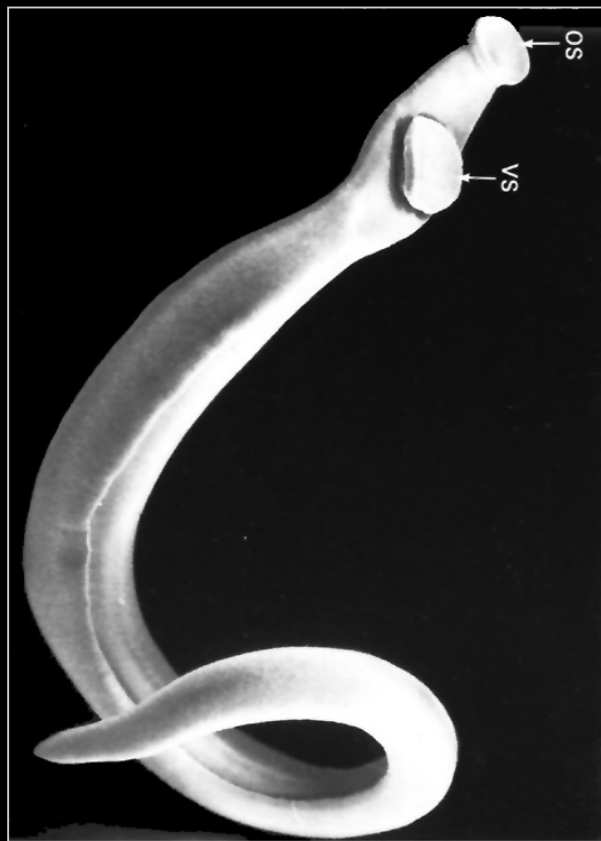
圓柱狀 10~20×0.5~0.55 mm

腹面具有抱雌溝  
(gynecophoric canal)

圓形睪丸呈串狀排列  
於腹吸盤下方



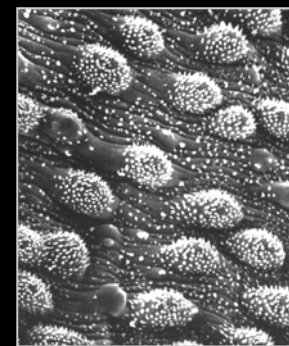
# 血吸蟲雄蟲表皮構造



*S. japonicum* 日本血吸蟲



*S. mansoni* 曼氏血吸蟲



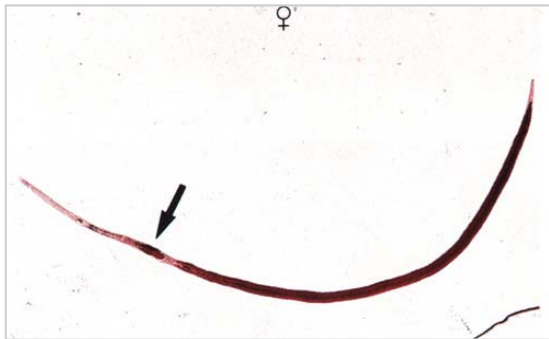
表皮之  
結節 (nodules)  
及棘 (spines)

# 血吸蟲雌蟲形態

呈暗褐色，體細長 12~28x0.3mm

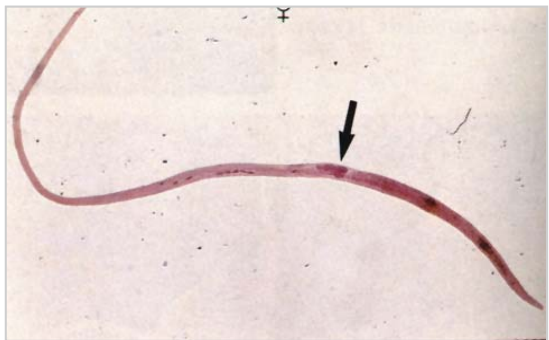
卵巢長橢圓形位於蟲體腸支匯合處前

子宮長管狀，內含蟲卵。後端由葉狀卵黃腺組成



## 曼森血吸蟲

卵巢位於 蟲體前半  
子宮 短  
蟲卵數 1-4



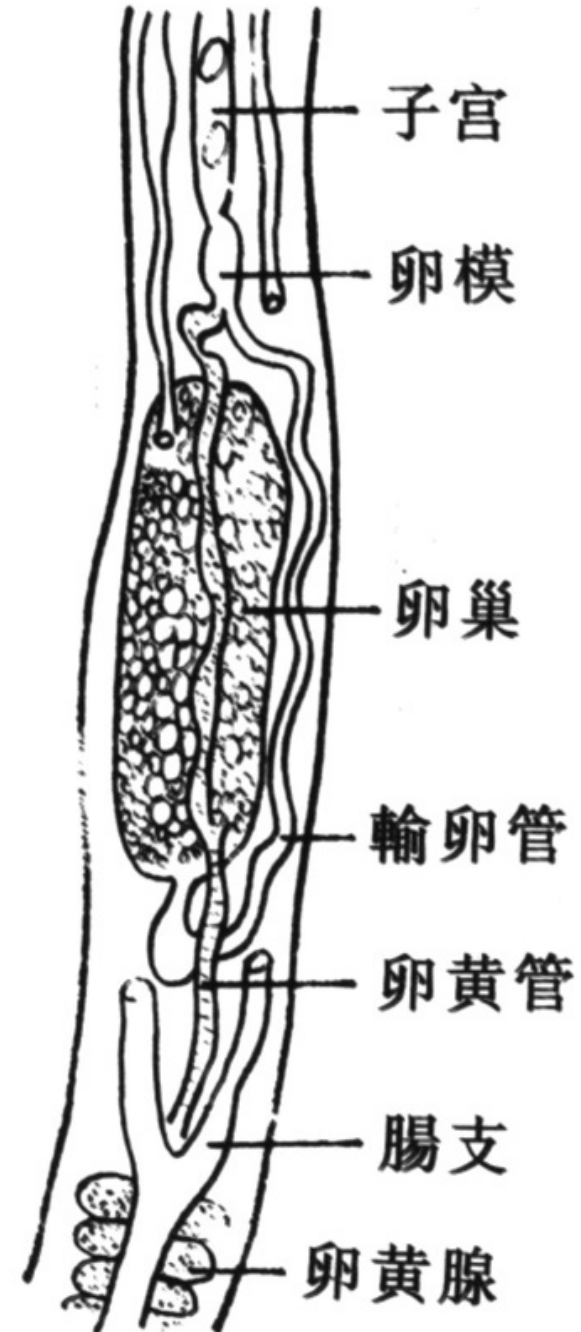
## 埃及血吸蟲

卵巢位於 蟲體中央  
子宮 短  
蟲卵數 20~100  
(平均50)

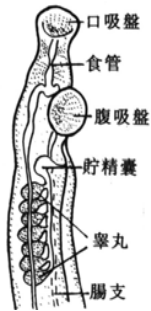


## 日本血吸蟲

卵巢位於 蟲體後半  
子宮 長  
蟲卵數 ~300  
(平均50)



# 血吸蟲成蟲形態比較



## 雄蟲

表皮上之結節  
盲腸連接處  
睪丸數目

## 日本血吸蟲

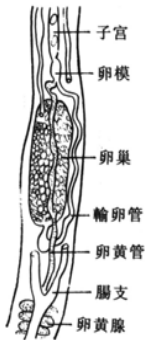
無  
後1/3處  
6~7

## 埃及血吸蟲

細  
中  
4~5

## 曼森血吸蟲

粗  
前1/3處  
6~9



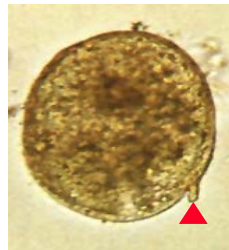
## 雌蟲

卵巢位置  
子宮  
蟲卵數

蟲體後半  
長  
~300  
平均 50

蟲體中央  
短  
20~100  
平均 50

蟲體後前半  
短  
1~4





# Intermediate hosts for Schistosomes: Freshwater snails

## 血吸蟲中間宿主：淡水螺螄

***S. haematobium***  
***S. intercalatum***

埃及血吸蟲， 間插血吸蟲



***Bulinus spp.*** 浦螺  
Ovoid with short spires 尖頂。  
9~18 mm in length  
Aquatic 水生。 Hermaphroditic

***S. japonicum***

日本血吸蟲



***Oncomelania spp.*** 釘螺  
Oval and operculated with a steep spire.  
<10 mm  
Amphibious 兩棲。 Unisexual



*Batillaria zonalis* (Bruguiere, 1792).  
燒酒海蜷 (燒酒螺、鐵針螺、灘棲螺)

***S. mansoni***

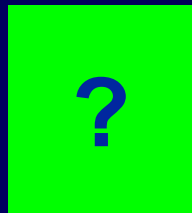
曼氏血吸蟲



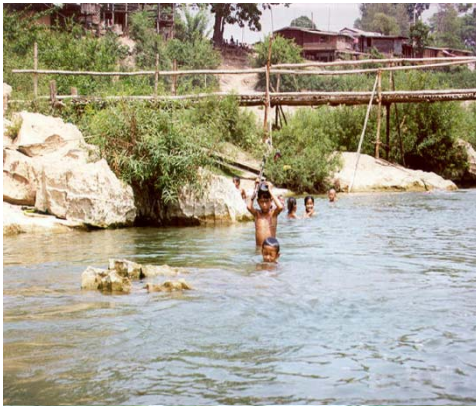
***Biomphalaria spp.*** 扁捲螺  
Flat without a spire up to 20 wide  
Aquatic 水生。 Hermaphroditic

***S. mekongi***

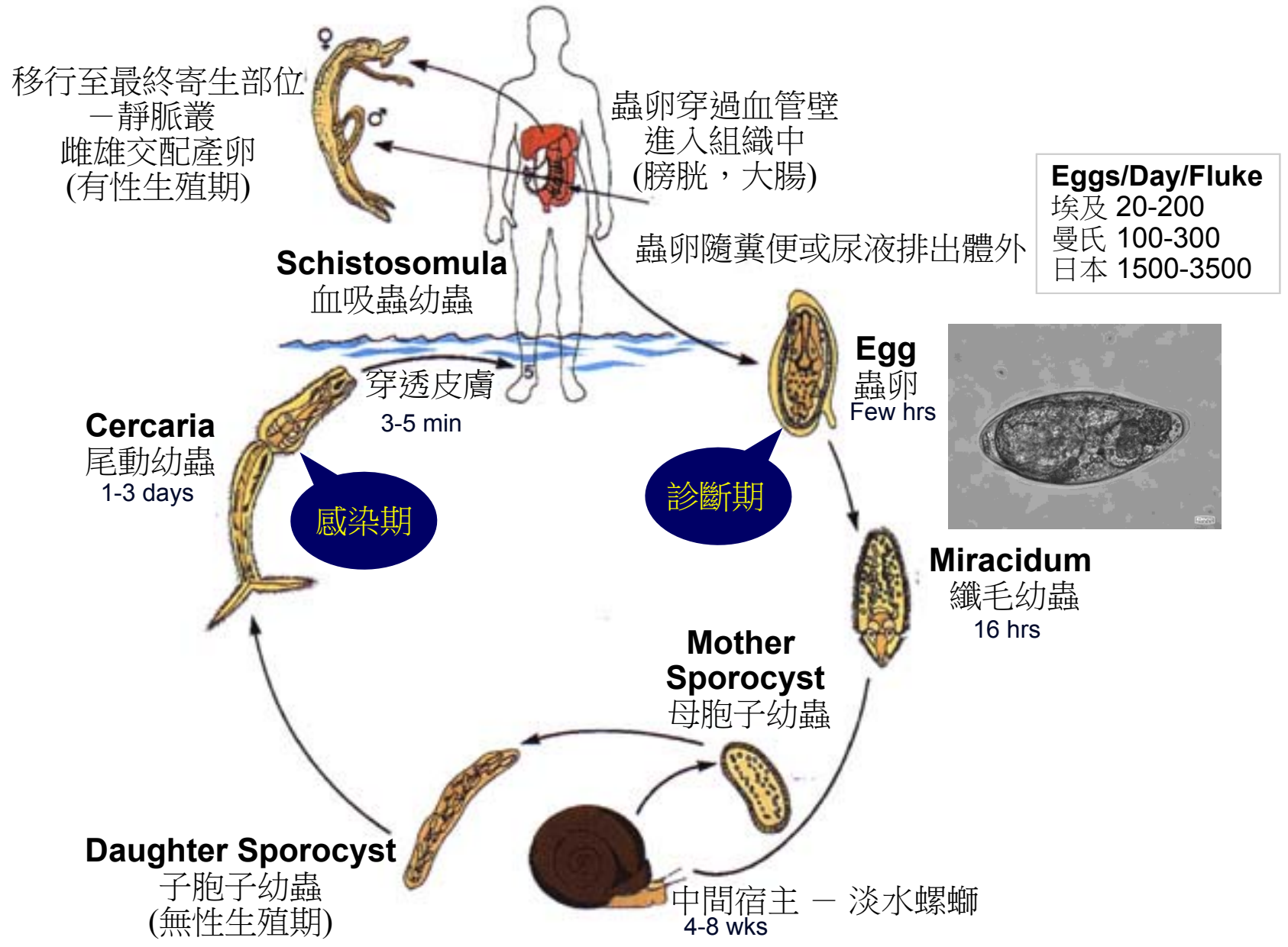
湄公血吸蟲



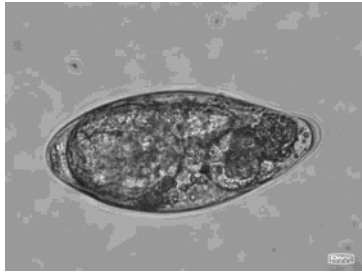
***Tricula aperta*** 開放擬釘螺  
An aquatic snail lives in water on soil debris



# Schistosome Life Cycle 血吸蟲生活週期

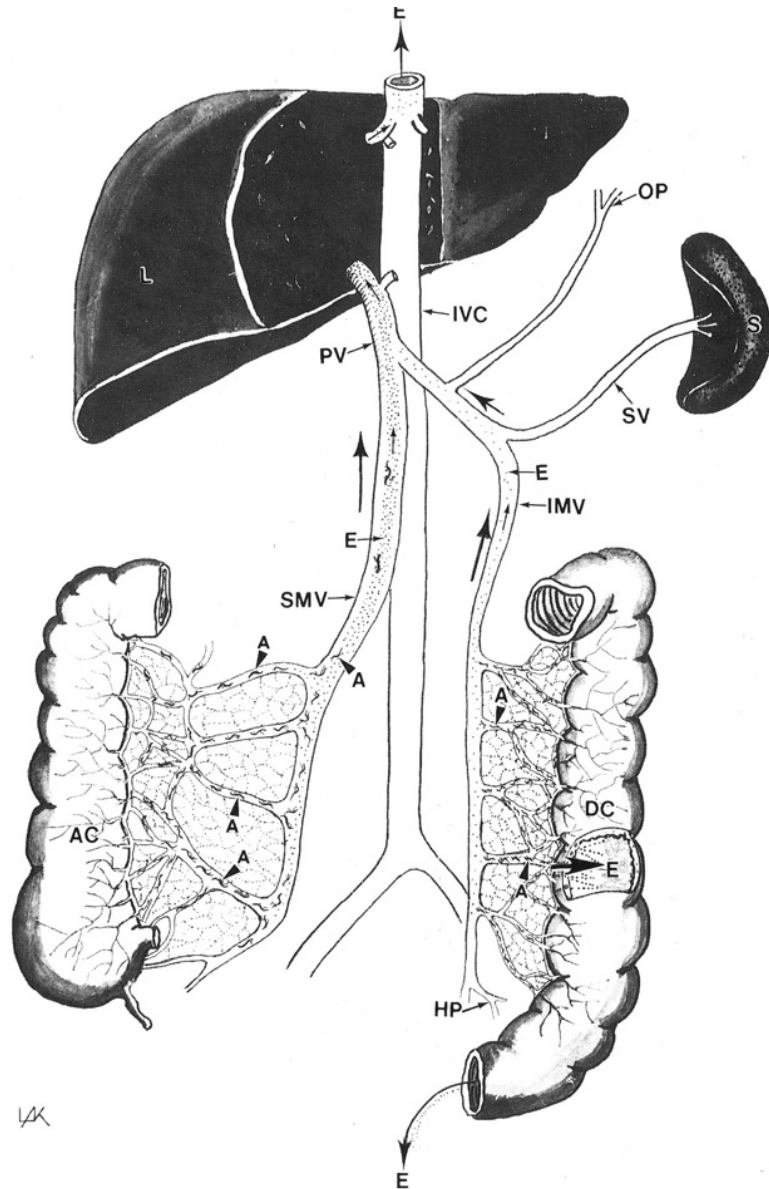


Eggs/Day/Fluke
埃及 20-200
曼氏 100-300
日本 1500-3500



# Migration of Schistosomules

## 血吸蟲幼蟲內臟移行



### Schistosomules 血吸蟲幼蟲

Veins 進入周邊靜脈及淋巴

Right side of the heart

Lung 肺血管

Left side of the heart

Abdominal aorta 腹主動脈

Hepatic portal vessels 肝臟



### Paired Mature Worms

*S. haematobium* vesical venous plexus

膀胱，攝護腺及子宮靜脈叢

*S. mansoni* inferior mesenteric vein

下腸系膜靜脈叢

*S. japonicum* superior mesenteric vein

上及下腸系膜靜脈叢

# Paired Mature Worms Migration



# Clinical Diseases

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**Stage 1** **Effect of cercariae penetration**

尾動幼蟲穿透皮膚

**Stage 2** **Formation of immune complex**

肝臟中血吸蟲代謝產物形成免疫複合體

**Stage 3** **Reaction to eggs**

蟲卵形成肉芽腫

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# Clinical Disease

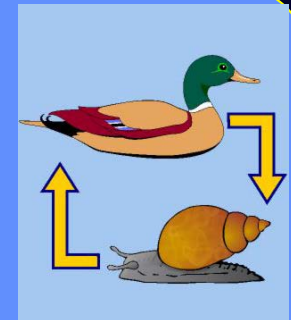
**Stage 1** Site of cercariae penetration

**Swimmer's itch (Fisherman's itch )**

itch papular rash 發癢丘疹 within 24 hours



Penetration of cercariae of animal schistosomes can cause severe dermatitis  
皮膚炎



# Clinical Disease

## Stage 2 Formation of immune complex

soluble excretory-secretory worm antigens  
(2~6 weeks post infection) + host antibody

## Katayama Fever (片山熱)



Fever

(發燒)

Urticaria

(蕁麻疹)

Eosinophilia

(嗜伊紅性白血球增加)

Diarrhoea

(腹瀉)

Cough and wheeze

(哮喘)



# Clinical Disease

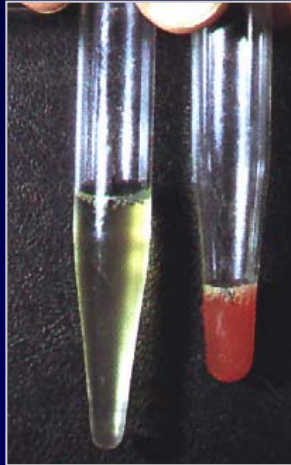
## Stage 3 The eggs

Eggs passed  
蟲卵排出體外

Eggs retained in tissue  
蟲卵留在組織中

### *S. haematobium*

Eggs passed in urine  
Haematuria 血尿  
Proteinuria 蛋白尿  
Dysuria 頻尿

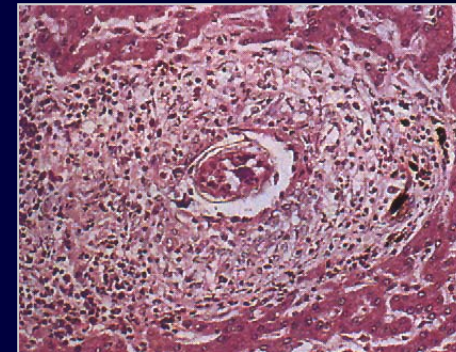


### *S. mansoni* & *S. japonicum*

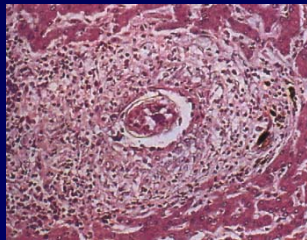
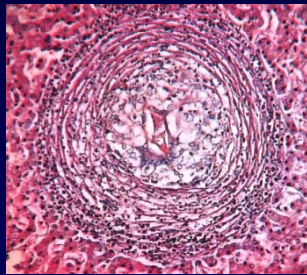
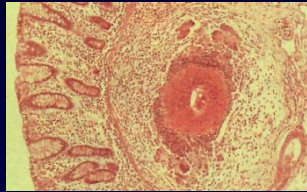
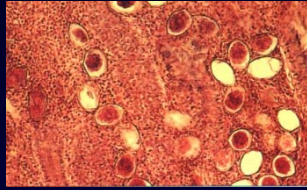
Eggs passed in feces  
Diarrhea with blood and mucus  
腹瀉伴隨血液及黏液



Granuloma Formation  
(血吸蟲肉芽腫)

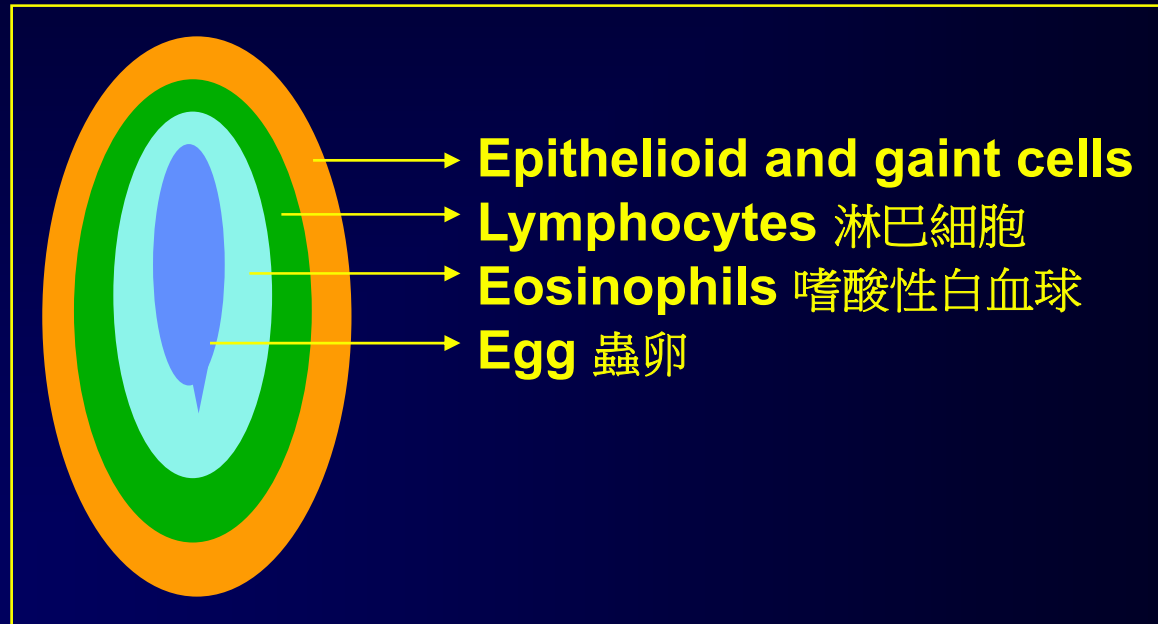


## Stage 3 Tissue reaction to eggs

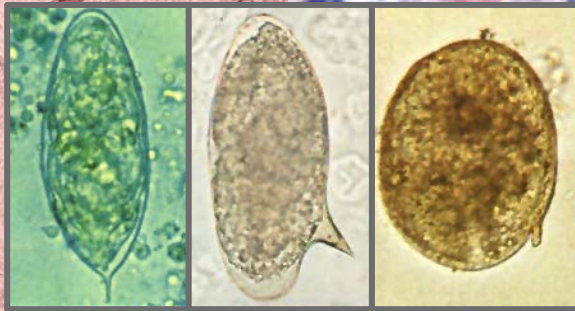
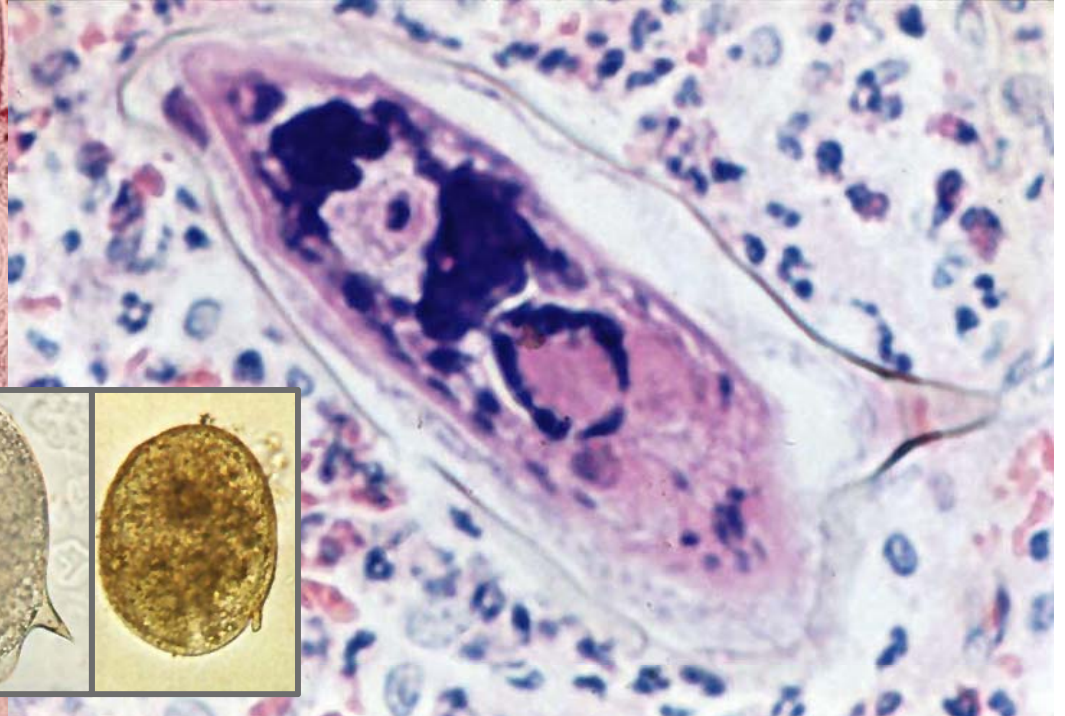
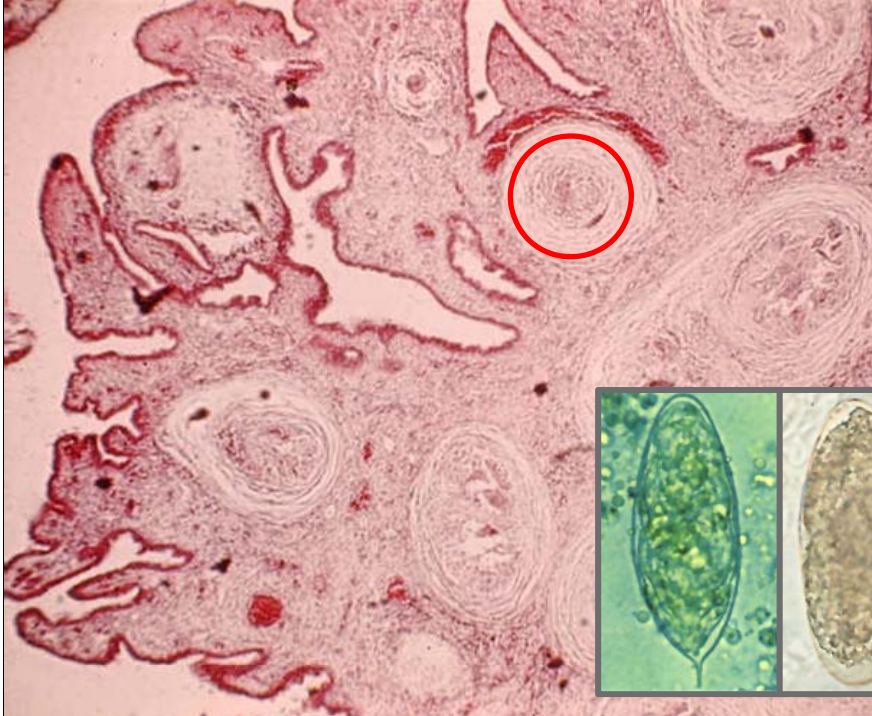
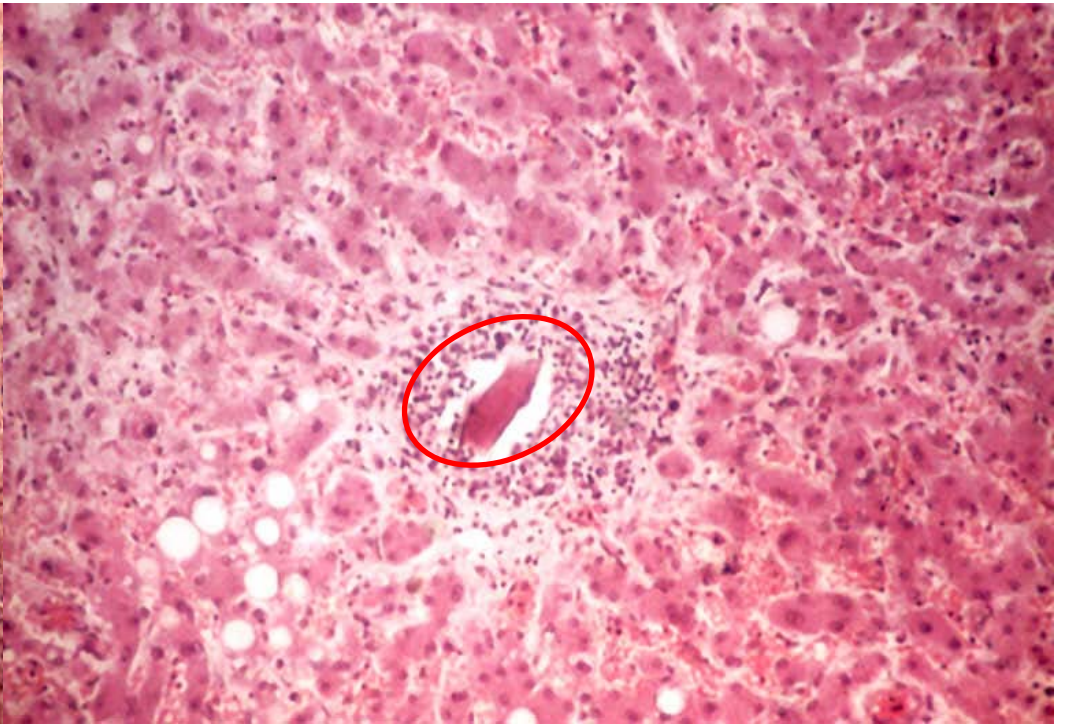


### Egg Granuloma (血吸蟲肉芽腫)

results from the combined humoral and cell mediated immunity against the egg



The cellular contents diminishes with time to be replaced by fibroblasts and collagenous scar



# Granulomatous reaction 血吸蟲肉芽腫

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***S. haematobium*** Obstructive uropathy 阻塞性泌尿道病變  
埃及血吸蟲 Schistosomal cor pulmonale 血吸蟲心肺症  
Calcaification of the bladder 膀胱鈣化  
→ Bladder cancer 膀胱癌

***S. japonicum*** Intestinal diseases 腸道疾病  
日本血吸蟲 Liver diseases 肝臟疾病

***S. mansoni*** 除重度感染或異位感染大多數病人無明顯症狀  
曼氏血吸蟲 症狀與日本血吸蟲相似但比較輕

# Granulomatous reaction 血吸蟲肉芽腫

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- S. haematobium*** Obstructive uropathy 阻塞性泌尿道病變  
埃及血吸蟲 Schistosomal cor pulmonale 血吸蟲心肺症  
Calcaification of the bladder 膀胱鈣化  
→ Bladder cancer 膀胱癌
- S. japonicum*** Intestinal diseases 腸道疾病  
日本血吸蟲 Colon pseudopolyposis 大腸性假息肉症  
Ulcerate 潰瘍, bleeding and dysentery 血痢  
Liver diseases 肝臟疾病  
Periportal (Symmers clay pipestem) fibrosis  
Enlargement of liver and spleen 肝脾腫大  
Bleeding from oesophageal varices 食道靜脈曲張出血
- S. mansoni*** 除重度感染或異位感染大多數病人無明顯症狀  
曼氏血吸蟲 症狀與日本血吸蟲相似但比較輕

# Obstructive Uropathy 阻塞性泌尿道病變 in *S. haemtobium* infection

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Cystitis 膀胱炎

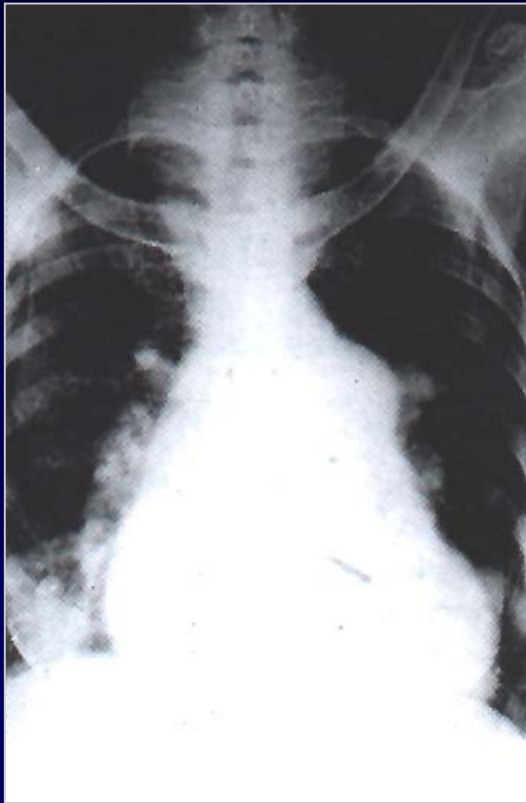
Ureteritis 輸尿管炎

Bladder cancer 膀胱癌

- Eggs escape from the pelvic veins
  - Reached the ureters 輸尿管 and ureteric orifices 輸尿管出口
  - Granuloma formation 形成肉芽腫
  - Obstruction of ureteres 輸尿管阻塞
  - Hydroureter 輸尿管水腫
  - Hydronephrosis 水腫
  - Uraemia 尿毒症
- Pseudopapilloma 假性乳頭狀瘤
  - Egg granuloma formed in the bladder mucosa which resemble tumors.

# Schistosomal cor pulmonale 血吸蟲心肺症 in *S. haemtobium* infection

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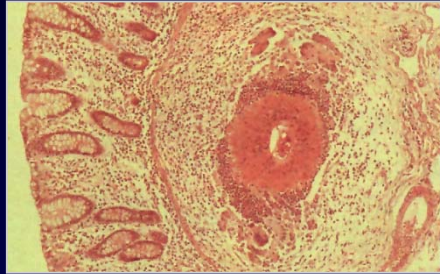


Eggs that reach the lungs by metastatic-blood spread lead to periarteritis. This is followed by fibrosis of the pulmonary arterioles with pulmonary hypertension and, finally, enlargement of the right heart (cor pulmonale)

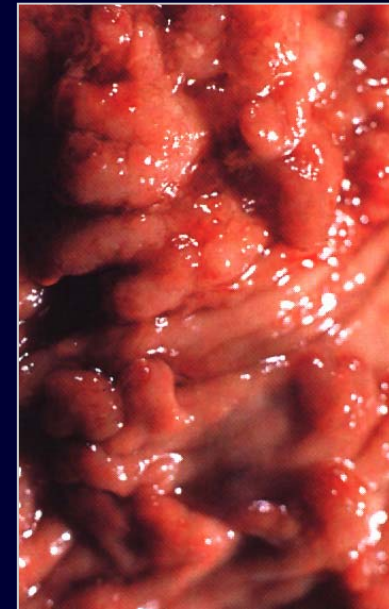
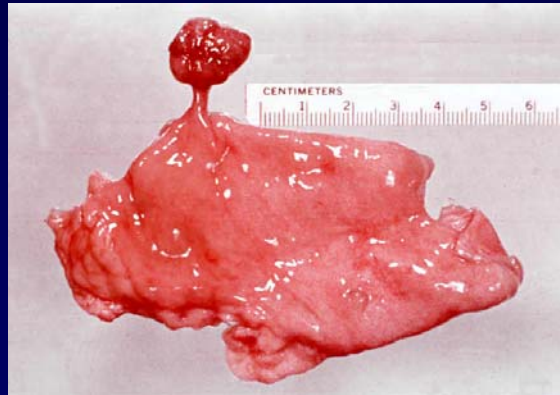
蟲卵經由血液循環從入肺小動脈引起肺性高血壓，右心室肥寸及鬱血性心衰竭。

# Colon pseudopolyposis

## 大腸性假息肉症



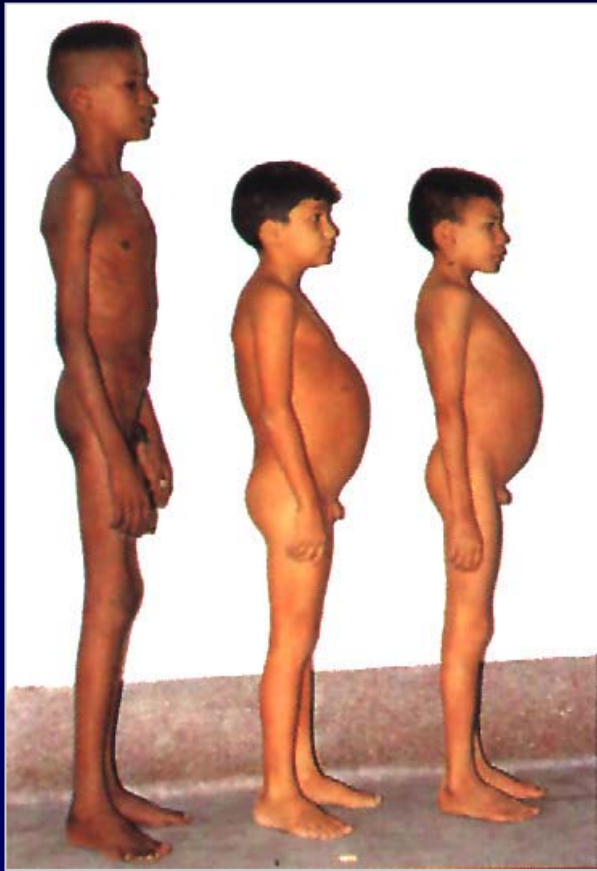
Hoepli reaction: The fibrotic granuloma around the dead ovum in colon.



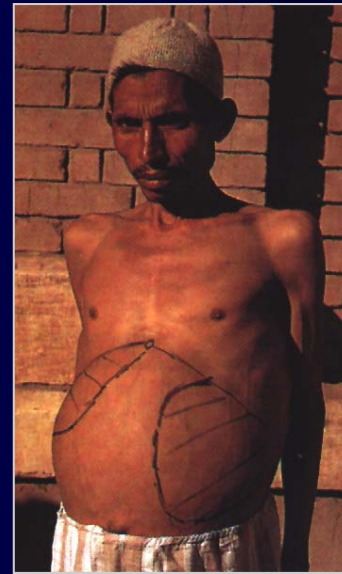
Egg granulomata in the large intestine develop into a papilloma—like outgrowths of the mucosa 大腸中的肉芽腫在黏膜形成乳頭狀突出物

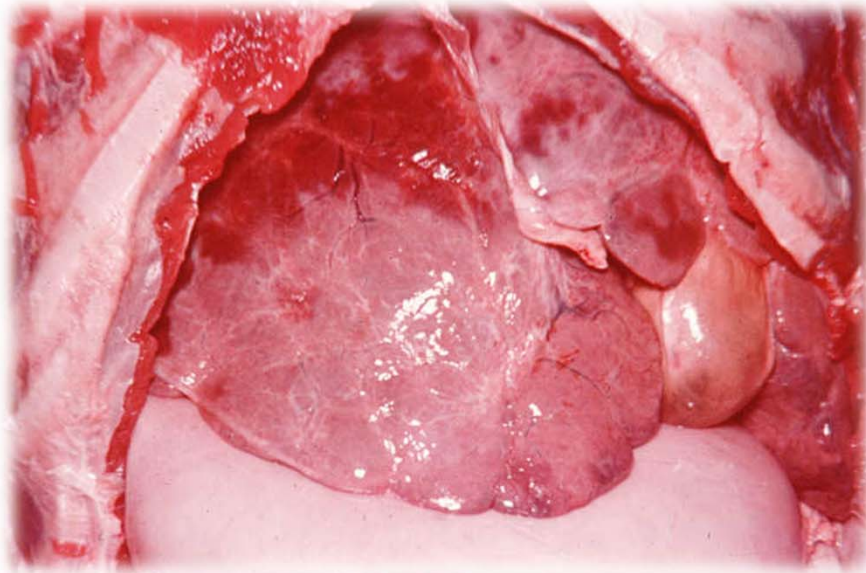


# Hepatosplenomegaly 肝脾腫大



Granulomata in periportal regions leads to gradual occlusion of the intrahepatic portal veins  
→ Enlargement of liver and spleen  
肉芽腫阻塞肝門靜脈引至肝臟及脾臟腫大





# Ectopic Mansonii Schistosomiasis

## 曼氏血吸蟲異位感染

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- CNS-paravertebral venous plexus 脊髓旁靜脈叢
  - Cerebral cortical veins 大腦皮質靜脈
  - Spinal cord compression 脊髓壓迫
  - Cauda equina lesion 在脊髓尾形成病兆
  - Subserosal veins of the abdomen 腹部臟膜下靜脈
  - Peritoneal granulomata 腹膜肉芽腫
  - Female genital tract
    - Sterility 不孕症
  - Cutaneous
    - Itchy, punctate skin eruption 皮膚疹
-

# Schistosome Eggs

All Schistosomes eggs are pale yellow-brown to colorless and contains a fully developed miracidium

Shape  
Size  
Spine

*S. haematobium*

Large & oval

145 x 55 um

Terminal

尾刺



*S. mansoni*

Large & oval

150 x 60 um

Lateral

側刺



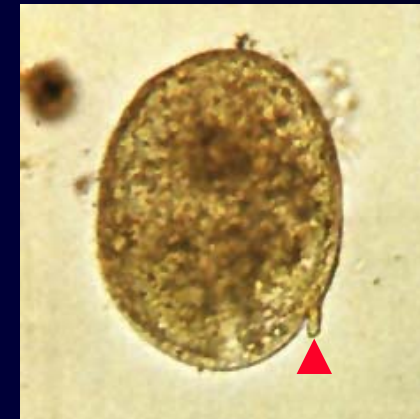
*S. japonicum*

Round to oval

90 x 65 um

Rudimentary

不明顯側刺



# Laboratory Diagnosis

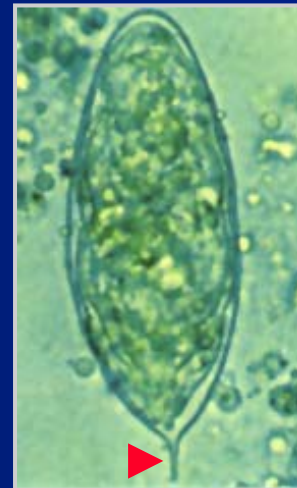
## *S. haematobium*

Finding eggs in urine 檢查尿液中之蟲卵

收集尿液時間：12.00 ~ 14.00

以靜置,離心或過濾法濃縮蟲卵

取出鏡檢



## *S. haematobium*

Large & oval

145 x 55  $\mu$ m

Terminal spine

尾刺

# Laboratory Diagnosis

## *S. mansoni* and *S. japonicum*

Finding eggs in faeces 檢查糞便中之蟲卵  
必須先以濃縮法提高靈敏度

Formol - ether

Thiomersal -iodine -formol (TIF)

Kato smear



***S. mansoni***  
Large & oval  
150 x 60  $\mu\text{m}$   
Lateral spine  
側刺



***S. japonicum***  
Round to oval  
90 x 65  $\mu\text{m}$   
Rudimentary spine  
不明顯側刺