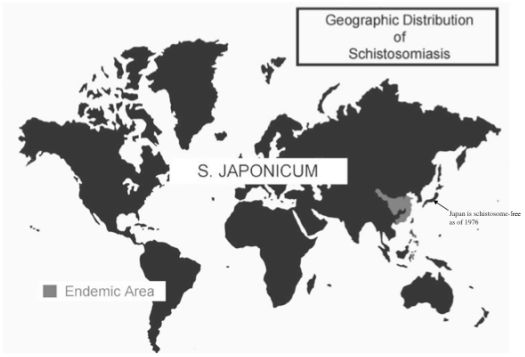
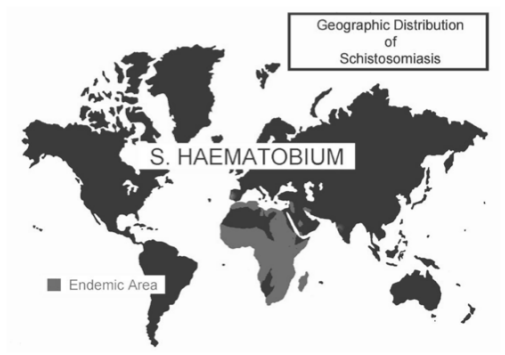
## Helminths:

Trematoda - non-segmented flat worms

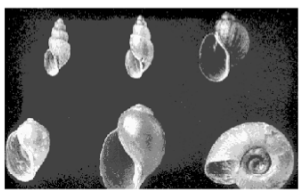
The schistosomes:

*Schistosoma mansoni*
*Schistosoma haematobium*
*Schistosoma japonicum*
*Schistosoma mekongi*


Aquatic freshwater snails are the intermediate hosts for all schistosome species

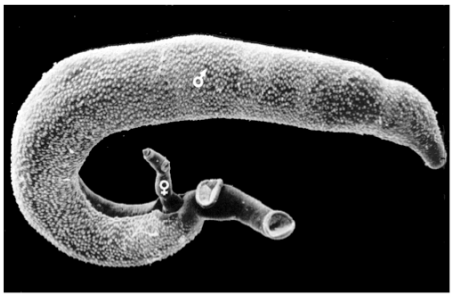


Simply by entering the water, these famous actors were at risk for acquiring schistosomiasis. Filming of "*The African Queen*" was done on location, Lake Victoria, Kenya.

*Schistosoma mansoni*

*Schistosoma japonicum*

Adult male and female *Schistosoma mansoni*



One Effective Evolutionary Strategy for Survival:
Camouflage

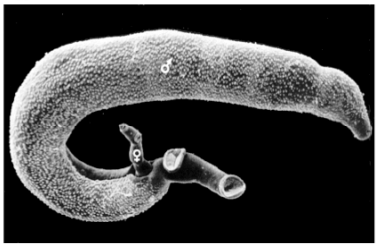
*Decorated Crab*

*Praying Mantis*

*Sargasso Sea Horse*

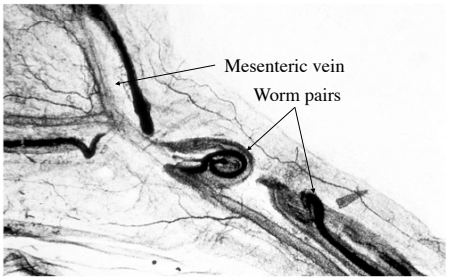
Observation: Schistosome adults live up to 20 years in the bloodstream avoiding immune attack by employing a unique set of molecular mechanisms. One scheme involves incorporating host serum proteins onto the tegumental surface as camouflage, mimickin the strategy of the decorated crab. The other employs a mimic surface molecule similar to beta -2-microglobulin, a macrophage recognition factor.

Possible application: transplant heterologous tissues at will.

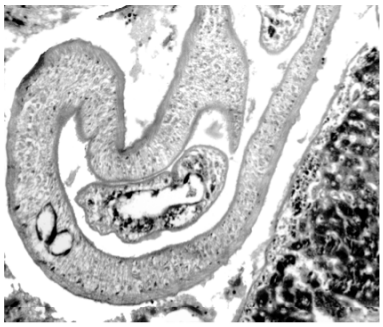


Locked in life's embrace

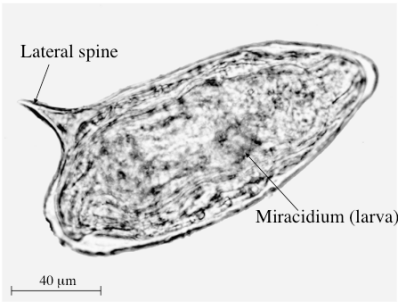

*Schistosoma mansoni* in situ



Cross section of a pair of adult schistosomes in situ in a mesenteric venule

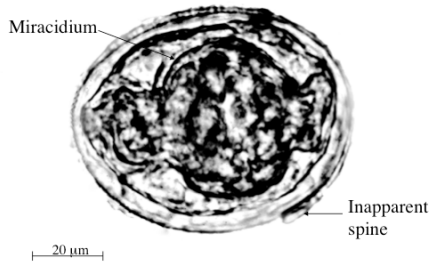


Embryonated egg of *Schistosoma mansoni**

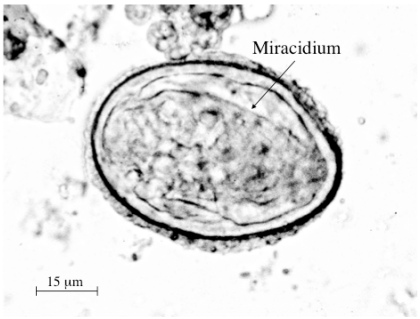



* The adult female requires tumor necrosis factor for maximum egg production

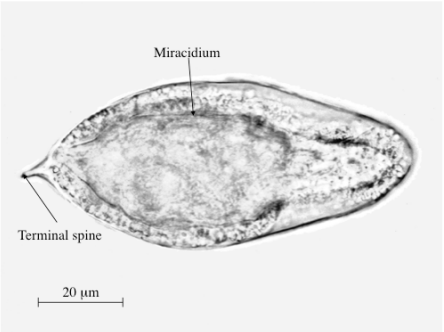
Embryonated egg of *Schistosoma japonicum*

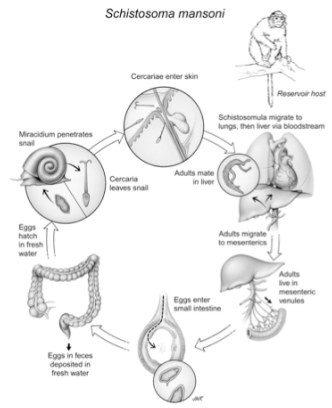



Embryonated egg of *Schistosoma mekongi*



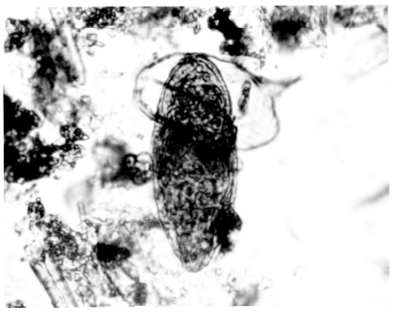

Embryonated egg of *Schistosoma haematobium*



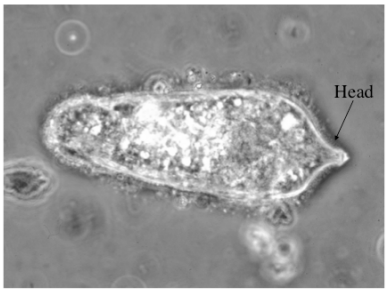



*Biomphilaria glabrata*, a common intermediate snail host for *Schistosoma mansoni*

Miracidium of *Schistosoma mansoni* caught in the act of hatching



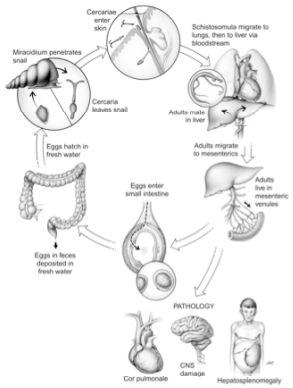
Miracidium of *Schistosoma mansoni*




SEM of a cercaria of *Schistosoma mansoni*, the infective stage for humans

Photo: D. Scharf

*Schistosoma japonicum*




*Oncomelania nosophora*, a common snail intermediate host for *Schistosoma japonicum* in China

## Pathogenesis:

1. Miracidium inside egg in small intestine releases proteases, dissolves tissues, induces bleeding and diarrhea.
2. Eggs (50% of those produced) wash back into liver, lodge in pre-sinusoidal capillaries, eventually block flow of blood.
3. Blockage of portal circulation results in portal hypertension.
4. Portal hypertension leads to induction of embryonic circulatory paths, eggs then by-pass liver. Toxic brain syndrome may ensue.
5. Adults avoid immune detection by:
   a. camouflage strategy, incorporating host serum proteins on tegumental
   b. synthesizing β-2 microglobulin-like molecule on tegumental surface.

## Clinical Disease:

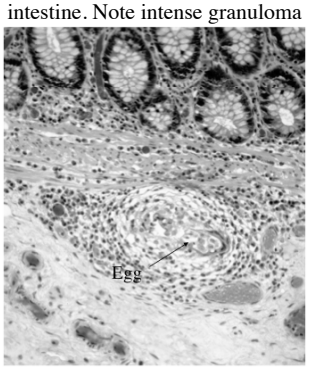
### Acute Phase

1. "Katayama Fever"
2. Paralysis
3. CNS involvement

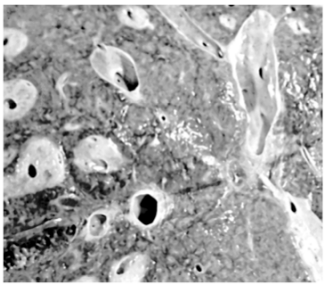
### Chronic Phase

1. GI bleeding and diarrhea
2. Portal hypertension due to blockage of pre-sinusoidal capillaries
3. Esophageal varices
4. Ascites
5. Rupture of varices, bleeding, death
6. *Cor pulmonale*, right side heart failure, death
7. Toxic brain syndrome

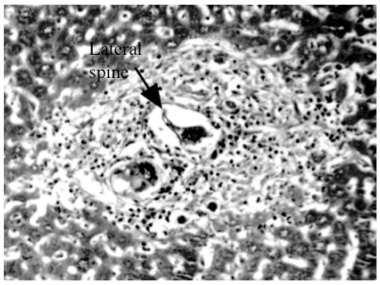
Schistosome egg in tissue of the small intestine. Note intense granuloma



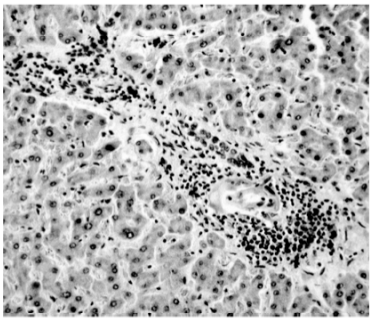

Pipe stem fibrosis in liver due to heavy infection with *Schistosoma mansoni*. Note normal liver tissue next to fibrotic vessels



Granuloma in liver surrounding eggs of *Schistosoma mansoni*




Granuloma surrounding an egg of *Schistosoma mansoni* in liver tissue



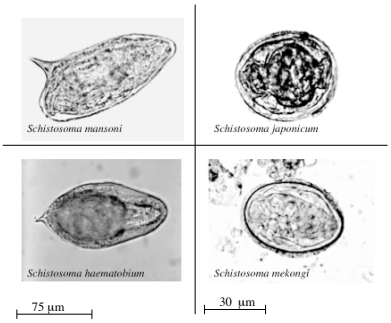
## Diagnosis:

1. Microscopic examination of feces, urine, rectal "snip" for eggs.

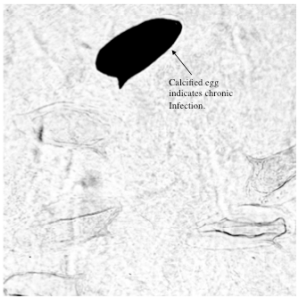
2. Capture ELISA for detecting circulating antigens (experimental).

3. Serological tests (e.g., ELISA): indirect measure of exposure, not active disease.

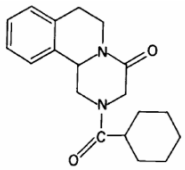
## Summary of Schistosome Egg Morphology




## Biopsy of rectal tissue revealing eggs of *Schistosoma mansoni*

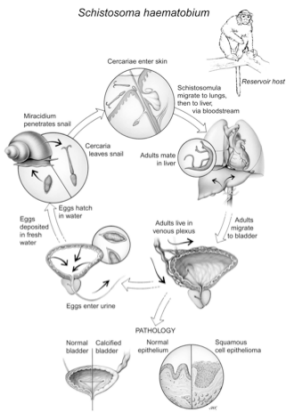



## Drug of Choice:
Praziquantel

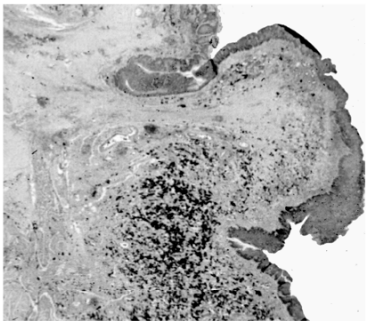


Mode of Action:
Interferes with $Ca^{2+}$ ion channels, leads to disrupted tegument. This drug is more effective if the patient has already developed antibodies against tegumental antigens.

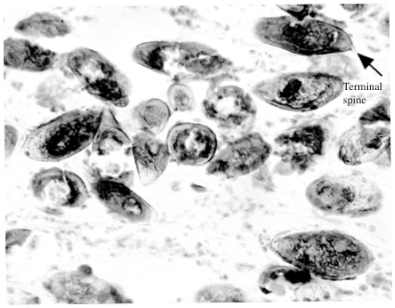
## *Schistosoma haematobium*



Histological section of bladder with pseudopolyp due to chronic infection with *Schistosoma haematobium*



*Schistosoma haematobium* eggs in bladder wall

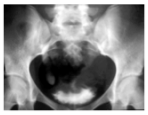



## Pathogenesis:

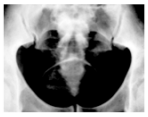
Eggs lodge in bladder wall, induce cellular changes associated with granuloma formation.

## Clinical Disease:

1. Squamous cell epithelioma

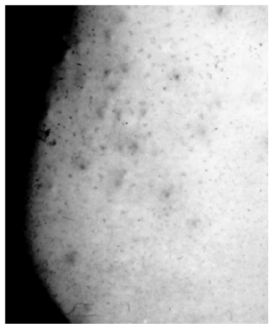


2. Calcification of dome of bladder due to accumulation of dead eggs

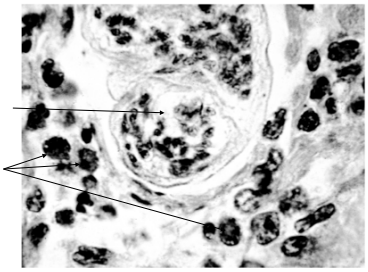


3. Hydronephrosis

## "Swimmer's Itch"



Cercaria of *Schistosoma mansoni* in skin surrounded by eosinophils




Th2 protective mechanism:
Eosinophils and specific IgE antibodies combine to kill the parasite

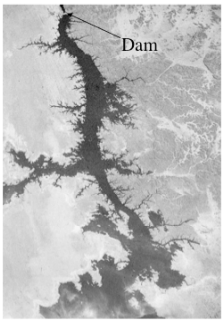
## Medical Ecology:
Transmission is encouraged by:

1. Dam building, irrigation projects (e.g., 3 Gorges Dam, China).

2. Reservoir hosts (primates, oxen).

3. Indiscriminate dispersal of feces and urine into environ


Lake Nasser and the Aswan high dam in Egypt




NASA photo courtesy S. Musgrave, P&S class of 1964

## Prevention and Control:

1. Sanitary disposal of feces

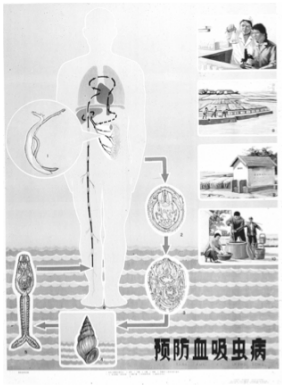
## Prevention and Control (cont'd)

2. Public health education.

3. Snail control.

4. Community-based drug programs (praziquantel).

5. Vaccine development for reservoir hosts (e.g., water buffalo).




One picture is…….