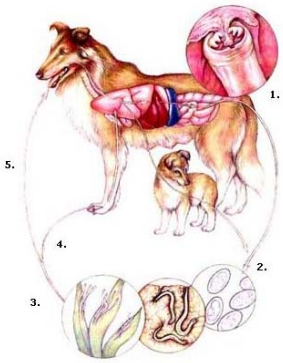
BIO 221
Invertebrate Zoology I
Spring 2010

Stephen M. Shuster
Northern Arizona University

http://www4.nau.edu/isopod

Lecture 23

Ancylostoma caninum



Ancylostoma caninum

cuticular larval migrans

Order Ascarida

A. Stout worms with 3 distinct lips

1. Muscular esophagus

2. Often with caudal bulb (ventriculus).

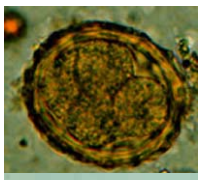
3. Spicules, males often with curved tail

Order Ascarida

B. Eggs are distinctive.

1. Shed unembrionated, often in early stages of development.

2. Outer surface is mammillated - covered with bumps.



Ascaris lumbricoides

a. Parasite of humans

b. Appears very closely related to *Ascaris suum*.

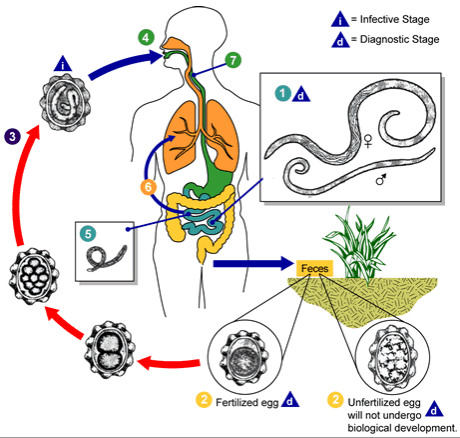
1. Recently distinguished by mtDNA analyses

2. Some gene flow, but seems to be dependent on location and frequency of transfer.

Ascaris lumbricoides

Life Cycle

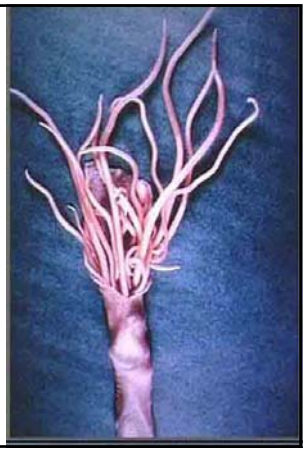
1. Eggs in feces, swallowed in contaminated water, food.
2. J1 hatches in gut.
3. J2 migrates to lungs.
4. J3 is coughed up, swallowed, J4 into gut.
5. Adult develops there.



Ascaris lumbricoides

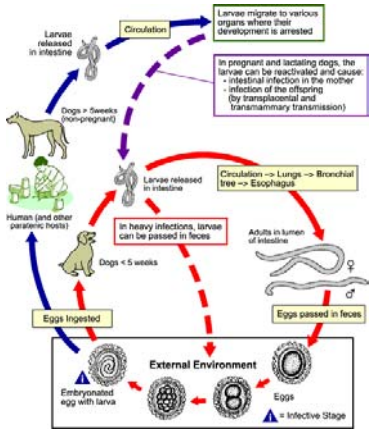
Other Notes:

1. Long standing infectivity of eggs
2. Migrating larvae - immune reactions
3. Migrating adults - blockages, tissue invasion.



Massive Ascaris infection in child. A large bolus of roundworms expelled following anthelminthic treatment.

Toxocara canis

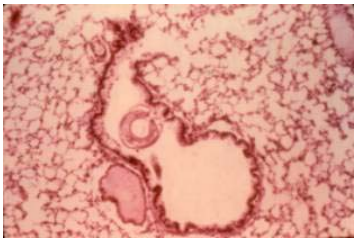


Toxocara canis

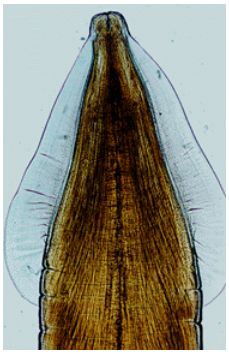
Visceral Larval Migrans

a. Similar life cycle to *Ascaris*.

b. Larvae migrate in wrong host.



Toxocara catti



***Toxocara cati* eggs were found in the faeces of 42.5% of house cats in Mexico City. 20.7% of apartment cats and 49.1% of house cats were infected.**

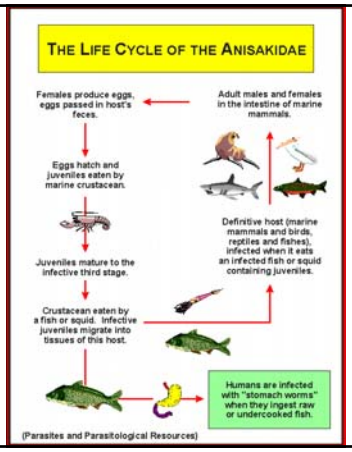
Anisakis spp.

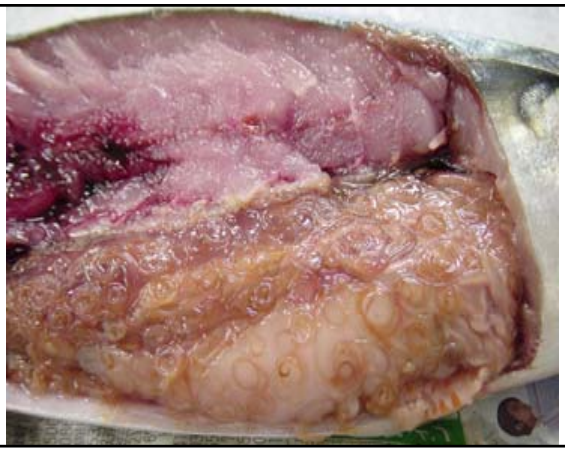
a. Several intermediate hosts:

1. Usually marine mammals.
2. Also bears and humans.

b. Larvae have a tendency to migrate and imbed in tissue.

1. Especially stomach and gums.





Heterakis gallinarum

a. Intestinal worm of fowl

1. Recognized by sharp tail, often with sucker.

2. Eggs shed into soil, larvae eaten by earthworms.

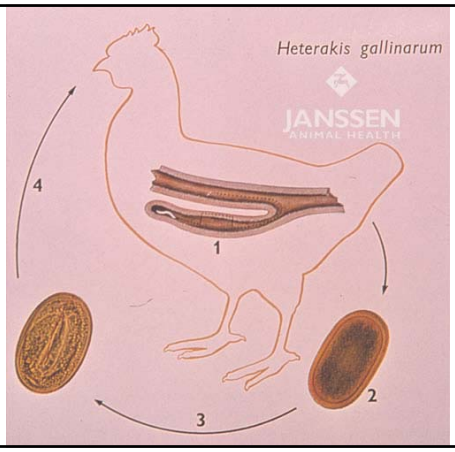
a.Also eaten by birds.

3. Birds eat earthworms and get adults

b. Vector for *Histomonas.*

1. Protozoan eaten by worm, protozoan multiplies in ovaries.

2. Gets into eggs, and thereby infects birds



The principal economic importance of caecal worms lie in their role as a carrier of **blackhead**, caused by the protozoan *Histomonas meleagridis*. It is passed via the worm eggs in the faecal material of infected birds. It remains viable in the eggs of the caecal worm and occurs in the caecum and liver of young turkeys, partridges and occasionally of chickens. Blackhead develops 2 to 3 weeks after ingestion of the worm eggs.

Oxyurids

A. Generally small worms with nearly spherical enlargement of esophagus.

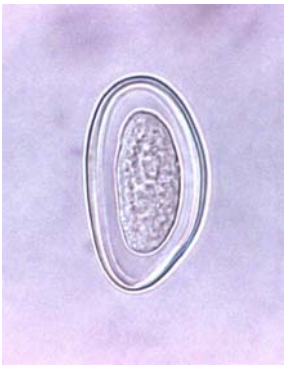
1. Males with single copulatory spicule.

2. Parasties of large intestine.

Oxyurids

B. Eggs are distinctive.

1. Flat on one side.



Oxyurids

Females oviposit outside of anus, sometimes even exploding on contact with air.

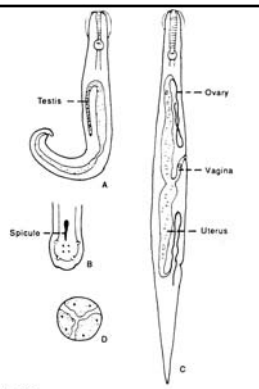
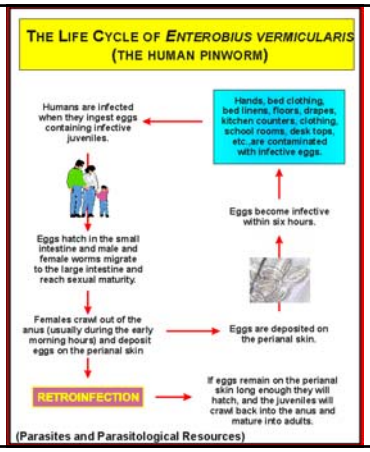


Figure 5.24
Enterobius vermicularis. (A) Adult male; (B) ventral view of caudal end of male, showing spicule and papillae; (C) adult gravid female; (D) en face view, showing three lips, each with two papillae.


THE LIFE CYCLE OF ENTEROBIUS VERMICULARIS
(THE HUMAN PINWORM)
Humans are infected when they ingest eggs containing infective juveniles.
Hands, bed clothing, bed linens, floors, drapes, kitchen counters, clothing, school rooms, desk tops, etc. are contaminated with infective eggs.
Eggs become infective within six hours.
Eggs hatch in the small intestine and male and female worms migrate to the large intestine and reach sexual maturity.
Females crawl out of the anus (usually during the early morning hours) and deposit eggs on the perianal skin
Eggs are deposited on the perianal skin.
RETROINFECTION
If eggs remain on the perianal skin long enough they will hatch, and the juveniles will crawl back into the anus and mature into adults.
(Parasites and Parasitological Resources)

Butt It Itches

The pinworm is a parasite
That makes a journey every night,
from the intestine where it resides
to lay its eggs on the outside.

The usual symptom's an itchy bottom
though in the appendix it can cause a problem.
It generally lives in tiny tots
but can infect both moms and pops.

Its thin walled eggs float in the air
so they can end up anywhere.
So if tonight you start to squirm,
remember it might be this worm.

But, this nematode's easy to diagnose
By affixing scotch tape to the host;
then examining the microscope slide
for eggs that are flatter on one side.

And if you have him, don't be embarrassed.
Anyone can have *Enterobius vermicularis*.

Superfamily Filaroidea

Characteristics

1. Adults are tissue dwelling forms
2. Often vectored by biting insects

a. J3s deposited on skin

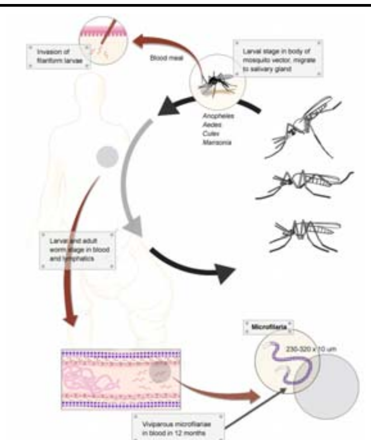
b. They crawl into wound and enter tissues.

Family Onchocercidae

1. *Wuchereria bancrofti*

a. Vectored by several genera of mosquito.

1. *Aedes, Anopheles, Culex*, can *support* filariae
2. But do not always transmit it



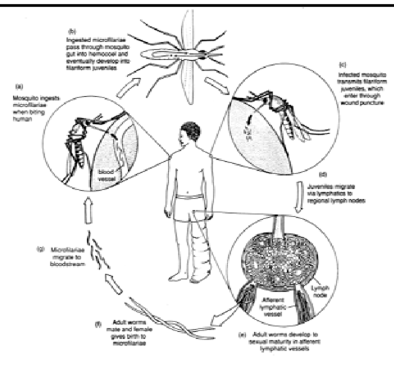


FIGURE 29.1

Life cycle of *Wuchereria bancrofti*. (a) Mosquito ingests microfilariae when biting human. (b) Microfilariae pass through mosquito gut and develop to filariform J_3. (c) Filariform juveniles escape from mosquito's proboscis when the insect is feeding and then penetrate wound structure. (d) Juveniles migrate via lymphatics to regional lymph nodes. (e) Worms develop to sexual maturity in afferent lymphatic vessels. (f) Adult worms mate, and female gives birth to microfilariae. (g) Microfilariae enter blood circulation.

Drawing by William Ober and Claire Garrison.

Family Onchocercidae

2. *Brugia malayi*

a. Similar to *W. bancrofti*

b. Spread by mosquitos (*Culex*)

c. primarily in South Pacific

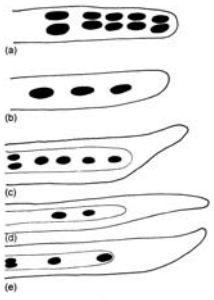


FIGURE 29.4

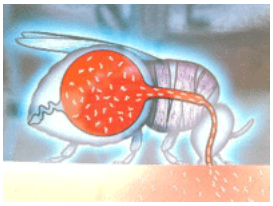
Presence or absence of a sheath and the arrangement of nuclei in the tail are useful criteria in identifying microfilariae. (a) *Mansonella perstans*; (b) *Mansonella ozzardi*; (c) *Loa loa*; (d) *Wuchereria bancrofti*; (e) *Brugia malayi*.

Family Onchocercidae

3. *Onchocerca volvulus*

a. responsible for river blindness in Africa and SA

b. Vectored by *Simulium*



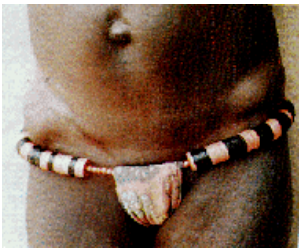
Onchocerca volvulus

Onchocerca volvulus

a. Life Cycle

1. Host with adult worms in sheathes in skin

2. Microfilariae remain in skin where they are ingested by blackflies



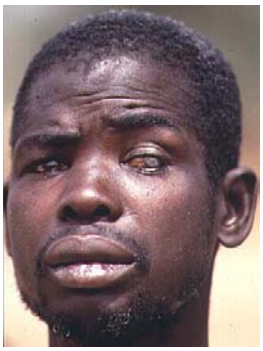
Onchocerca volvulus

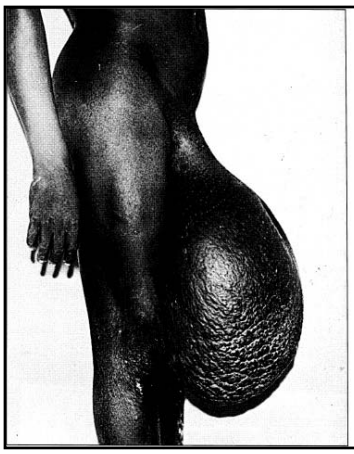
3. Microfilariae migrate to thoracic muscles of fly
4. Develop into J1 and then J2 (sausage stage)
5. Become filariform J3s (infective)
6. J3s transferred in fly bite
7. Cutaneous adults appear in year.

Onchocerca volvulus

c. Microfilariae invade cornea and after death cause scarring;

d. *Wolbachia* bacteria in worms seems to be responsible.





Onchocerca volvulus

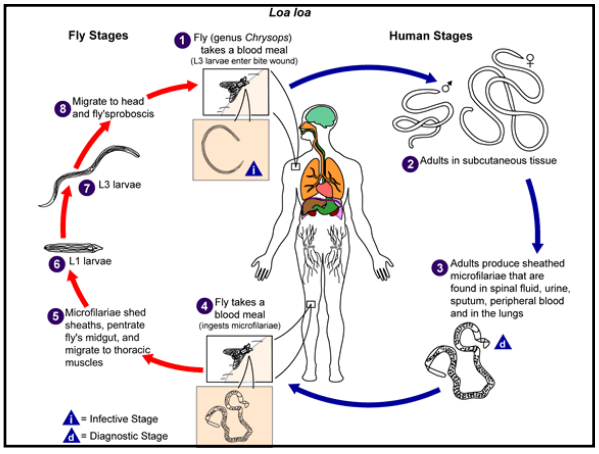
1. Invasion of lymphatic system can also cause elephantiasis, particularly in genitalia and mammary glands.

A Note On Microfilaria

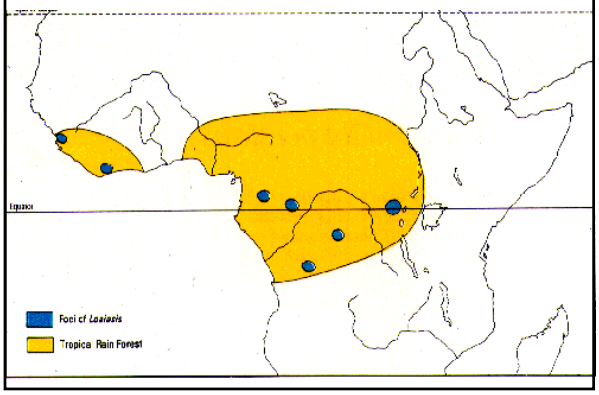
Your book states (p. 447), that *microfilaria* are not as differentiated as normal J1 larvae and hence are not to be considered as such.

The J1 stage does not develop until they are within the insect vector's stomach; after 8 more days, they molt to J2s and after another 4 days molt to slender J3 larvae.

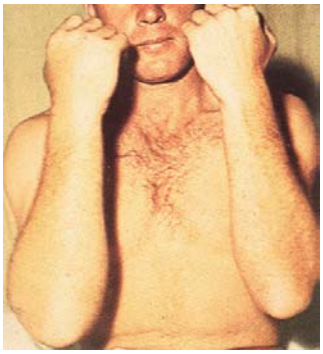
These are the infective *filariform larvae* that leave the insect and enter the definitive host during a bite.



Loa loa - Distribution

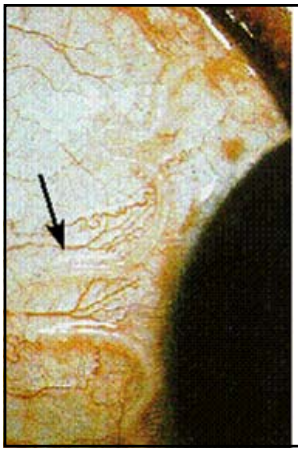


Loa loa



Calabar swellings

Loiasis is prevalent in West and Central Africa. After burrowing into the deeper subcutaneous tissue, the larvae mature to adult worms. Allergic reactions produce localized inflammation in the subcutaneous tissue, particularly in the forearm.



Loa loa

b. Also corneal irritation when worms cross sclera.

c. Can cause calcification of sclera and of soft tissues.

Loa loa

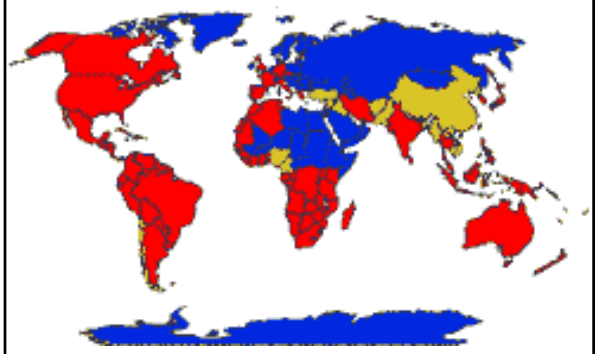
c. Vectored by *Chrysops*.

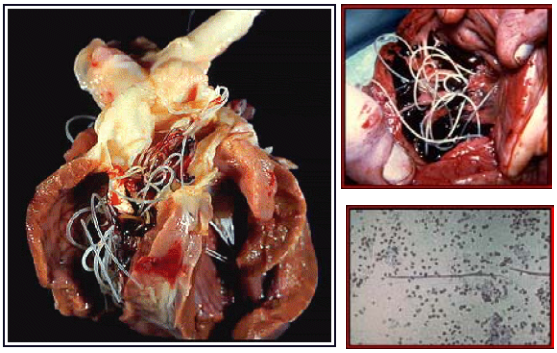
Dirofilaria immitis

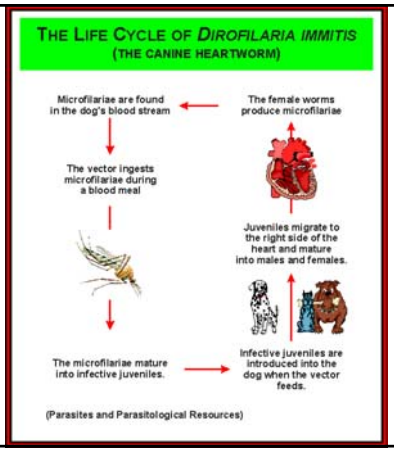
1. Canine heartworm
2. Vectored by lots of mosquitoes

Distributions of two vectors of *D. immitis*

Aedes spp.



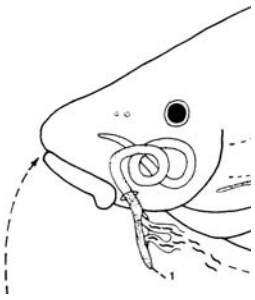




Dirofilaria immitis

1. 3. Treatment
   1. Ivermectin - effective on microfilariae, not adults.
   2. DEC (diethyl carbamazine) - can cause encephalitis.

Superfamily Camallanina



Family Philometridae

a. Tissue parasites of fishes

b. Life cycle is similar to those of dracunculids

Philometroides nodulosa

1. J1s released into water, eaten by copepods
2. leave intestine, enter haemocoel, molt 2x
3. J3s encyst in copepod until eaten by fish
4. migrate through tissues, molt again, mature in cutaneous tissue, mate; females break out and release larvae.

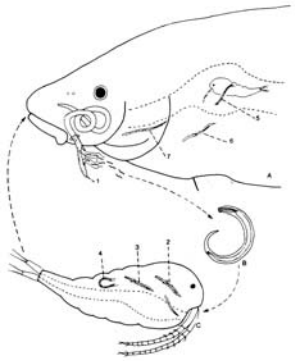
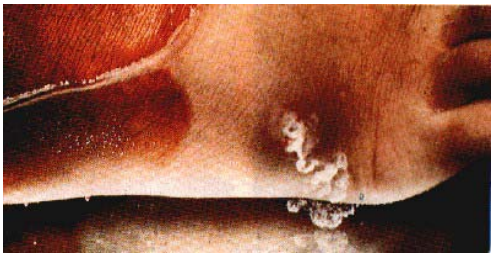


Figure 5.32
Life cycle of *Philometroides nodulosa*, an example of a dracunculid cycle. (A) Adult females in cheeks of white sucker; (B) first-stage juvenile in water; (C) copepod intermediate host ingests juveniles; (1) Adult females extend anterior end of body through ulcers, the uterus prolapses, and juveniles are liberated; (2) juveniles ingested by copepod enter hemocoel from intestine and molt; (3) second-stage juvenile molting; (4) third-stage ensheated juvenile in hemocoel; (5) juveniles escape from digested copepod; (6) juveniles molt while migrating in fish tissues; (7) juveniles grow to adult males and females.

Family Dracunculidae

a. Similar life cycle to philometrids.

b. Common in many species with access to water.



Dracunculus medinensis

a. The "fiery serpent," also Guinea worm.

c. Can get very large; up to 8 m long!

Dracunculus medinensis

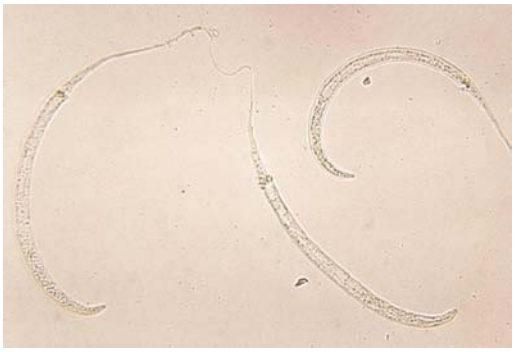
Life Cycle

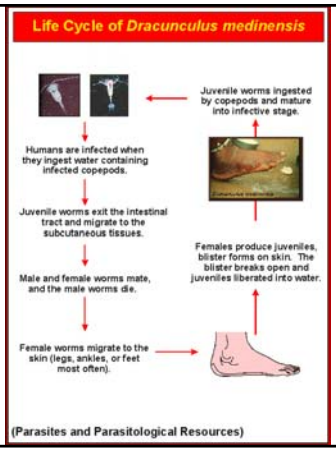
1. Eggs released by adult
2. Larvae hatch, are eaten by copepods.
3. Copepods swallowed with drinking water.
4. Worms form subcutaneously in host

2. Adult female bursts out when exposed to water; causing much pain and irritation.

a. Non-emergent worms and bacterial infections are problems.

Dracunculus medinensis larvae





Dracunculus medinensis

a. The Staff of Asclepius

b. The Caduceus

FIGURE 30.9

Seal of the American Medical Association and the double-serpent caduceus of the military medical profession. Might the serpent on a staff originally have depicted the removal of guinea worm?

Courtesy of the AMA.