BIO 475 - Parasitology Spring 2009

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http://www4.nau.edu/isopod

Lecture 11

Plasmodium falciparum

5. Pathology

a. liver, brain damage due to blockages

b. fevers, chills, incontinence, dehydration

c. anemia, immunosuppression.

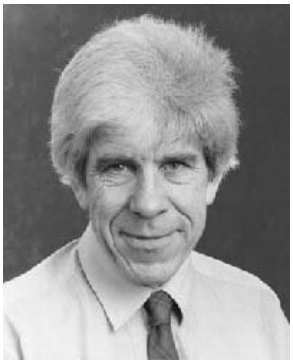
Plasmodium falciparum

d. blackwater fever - due to insufficient treatment with quinine; followed by re-treatment

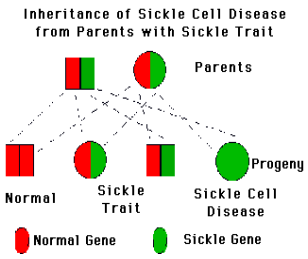
W. D. Hamilton 1936-2000

W. D. Hamilton was best known for his theory of kin selection, which he originated while still a student and expanded upon in a series of classic papers in the early 1960s. Since then, he worked on, and made important contributions to, a number of problematic issues in evolutionary biology including:

• The importance of parasites in explaining the maintenance of sexual reproduction.

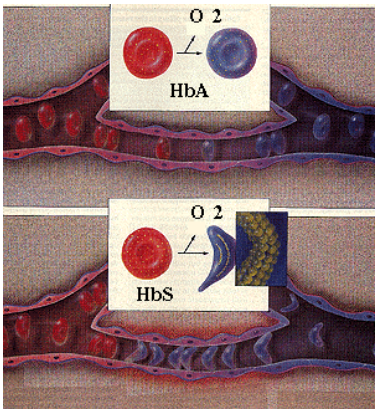


Sickle Cell Anemia

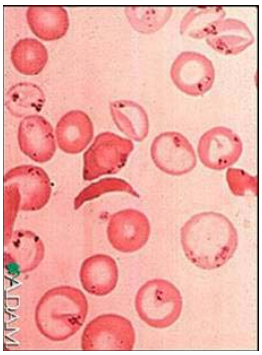


1. Due to recessive allele, overdominance
2. Causes cells to sickle in low O_2 concentrations.

a. Makes it difficult for parasite to invade



Sickle Cell Anemia



b. Also, sickled cells leak K^+

3. Macrophages can recognize parasitized cells.

Sickle Cell Anemia

4. Similar conditions in South American, Asian Indian populations, Unrelated to Africans.

6PGDH Deficiency

1. In some populations, individuals lacking this enzyme in large amounts in RBCs have malarial resistance.

2. Exists in African and Mediterranean.

3. Drug therapies work on the same principal; inhibit biochemical pathways important to the parasite.

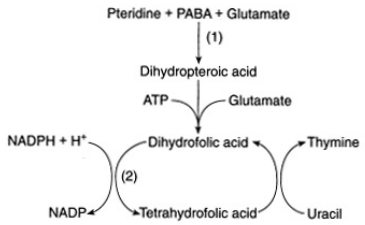


Figure 9.9
Metabolism of folate in *Plasmodium*. (*1*) Site of action of PABA analogs, such as sulfadoxine, which inhibit the synthesis of dihydropteroic acid from PABA and pteridine. (*2*) Site of action of pyrimethamine, which inhibits synthesis of tetrahydrofolic acid from dihydrofolic acid, which prevents the synthesis of thymine required for DNA synthesis.
Source: D. L. Looker et al., *Chemotherapy of Parasitic Diseases*, 1986. Plenum Press, New York, NY.

Malarial-like Organisms

A. also belong to Haemosporina, but differ as follows:

1. no schizogony in peripheral circulation (usually in liver)

2. Sporogony in insectes other than mosquites

Haemoproteus sp.

1. Common in domestic fowl as well as ducks, turkeys, reptiles.

b. Similar life cycle except that merozoites form in reticuloendothelial cells.

c. Merozoites entering blood cells become gametocytes.

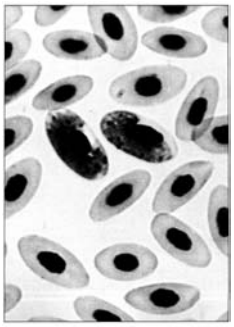


Figure 9.10
Haemoproteus gametocytes in blood of a mourning dove. They are about 14 μm long.

Haemoproteus sp.

d. Vectored by hippoboscid flies (Hippoboscidae).

Leucocytozoon sp.

a. Common blood parasite of birds (wild and domestic)

b. Similar life cycle except that merozoites form in liver

c. Symptoms:

1. Marked anemia, often fatal

d. vectored by blackflies (Simuliidae)

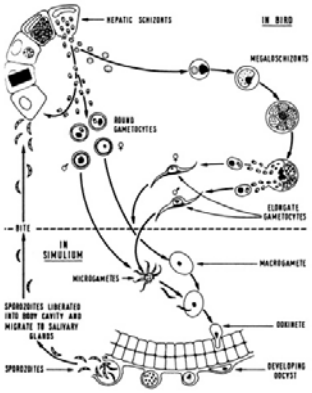


FIG. 5-21. *Leucocytozoon simondi* life cycle. (From Adam, K. M. G., et al.: Medical and Veterinary Protozoology. Edinburgh, Churchill Livingstone, 1971.)

Subclass Piroplasmia

Order Piroplasmida

1. Pyriform (or other spheroid) shaped parasites of vertebrates.

a. Locomotion by body flexion.

b. Commonly vectored by ticks.

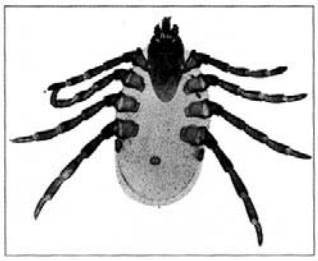


Figure 9.13
Boophilus annulatus, the vector of *Babesia bigemina*.
Courtesy of Jay Georgi.

Babesia sp.

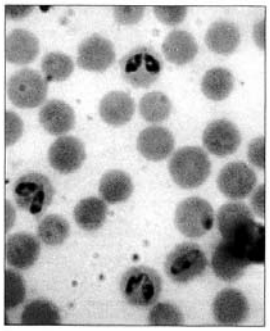


Figure 9.14
Babesia bigemina trophozoites in the erythrocytes of a cow.
Courtesy of Warren Buss.

a. Usually associated with domestic animals

a. babesiosis or piroplasmosis.

b. Cattle tick fever; Texas fever.

Babesia sp.

c. Severe internal problems, due to massive infection of RE system by trophozoites.

d. Symptoms:

1. Bloody diaharrea, 90% death in some infections.

2. In dogs,

a. similar symptoms, but survivors acquire immunity.

Babesia sp.

2. Generalized life cycle

a. Trophozoites ingest red blood cytoplasm - undergo asexual reproduction.

b. Ticks pick up infected cells

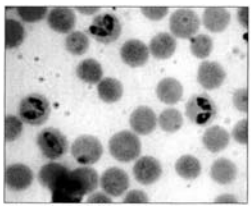
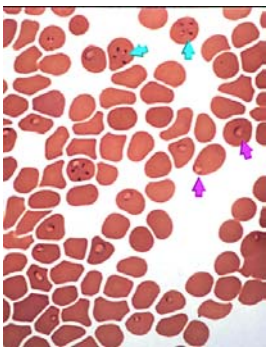


Figure 9.13
Boophilus annulatus, the vector of *Babesia bigemina*.
Courtesy of Jay Gough.

Babesia sp.



c. gamonts form within tick, fertilization occurs

d. motile kinetes leave gut, infect tick including salivary glands

e. host is infected by bite.

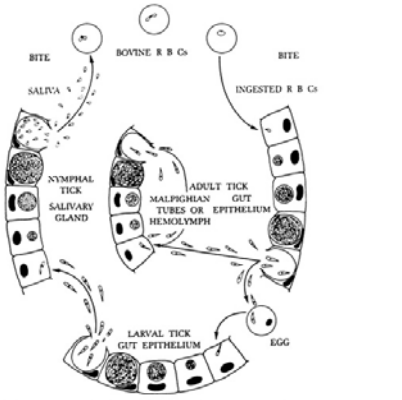


FIG. 5-22. *Babesia bigemina* development in the tick, *Boophilus microplus*. RBC, Red blood cell. (Modified from Riek, 1964. *In* Adam, K. M. G., et al.: Medical and Veterinary Protozoology. Edinburgh, Churchill Livingstone, 1971.)

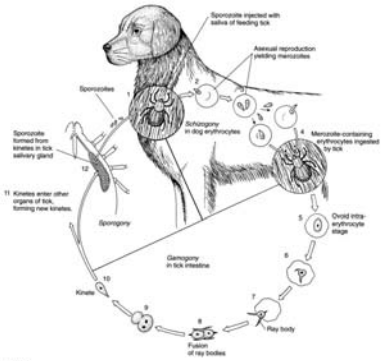
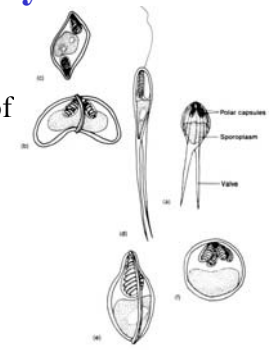


Figure 9.15
Life cycle of *Babesia canis*. (*1*) Sporozoite injected with saliva of feeding tick. (*2, 3*) Asexual reproduction in red blood cells of vertebrate host by binary fission, yielding merozoites. (*4*) Merozoites in erythrocytes are digested in tick. (*5, 6*) Gametocytes form protozoites after ingestion by tick and become ray bodies. (*7–9*) Two ray bodies fuse to form zygote. (*10*) Zygote becomes motile kinete. (*11*) Kinetes leave intestine, enter other cells, and form new kinetes. (*12*) Kinetes that enter cells of salivary gland give rise to thousands of small sporozoites.
Drawing by William Ober and Claire Garrison.

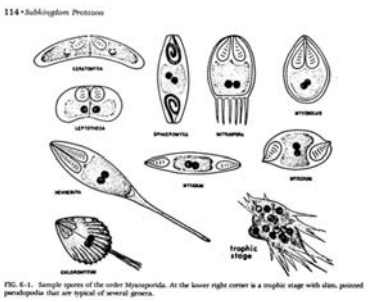
Phylum Myxozoa

Characteristics:

1. Polycellular spores with variable numbers of valves.
2. 1-6 polar capsules with coiled hollow filaments.
3. Multinucleate sporoplasm.



Phylum Myxozoa



4. Polycellular developmental stages in which spore formation occurs.

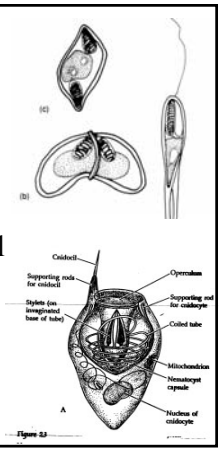
Class Myxosporea

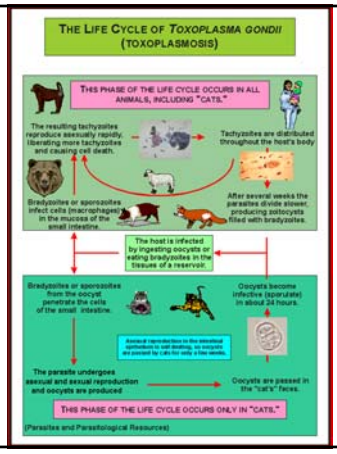
(Order Myxosporida)

1. Histozoic or coelozoic parasites of fish.

2. Direct life cycle: spores ingested, valves open, asexual reproduction until cells unite, form more spores.

3. some suggest they may have affinities to Cnidaria.





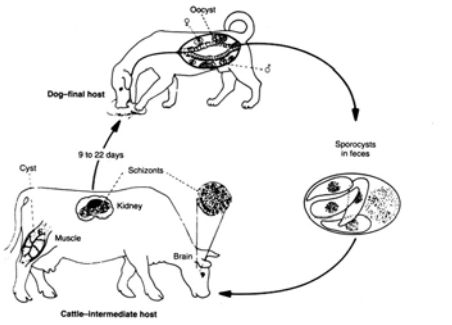


FIGURE 8.14

Life cycle of *Sarcocystis cruzi* of cattle with the dog exemplifying the definitive host. Dogs, wolves, coyotes, raccoons, and foxes shed sporulated oocysts or sporocysts in their feces after eating infected bovine musculature. Cattle become infected by ingesting sporocysts from the feces of carnivores. Generalized infection occurs in bovine tissues, and schizonts are formed in many tissues, especially in the kidneys and brain. After schizogonic cycles, cysts are formed in the musculature in two months. Current evidence indicates that canines become infected by ingesting only mature cysts. Sporocysts are noninfectious to definitive hosts.

From J. P. Dubey, "A review of *Sarcocystis* of domestic animals and of other coccidia of cats and dogs," in *Am. Vet. Med. Assoc.* 169:1061–1078. Copyright © 1976. Reprinted with permission of the publisher.