Liver Flukes of Cattle and Sheep

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MANY species of flukes infest the livers of warm-blooded animals.

All liver flukes are hermaphroditic; that is, the male and female reproductive organs occur in one individual. Usually mating is unnecessary to insure their perpetuation.

Because all liver flukes of domestic animals must have one or more intermediate hosts for completion of their life cycles, it is hard to develop control measures that apply to all species.

Four well-known species attack cattle, sheep, and other domestic livestock. They are the common liver fluke, the giant liver fluke, the large American fluke, and the lancet fluke.

The liver flukes cause extensive losses. The Department of Agriculture estimated that the annual loss was 3.5 million dollars in cattle and 4.5 million dollars in sheep between 1942 and 1952. The figures represented mostly condemnations of livers at slaughter and did not include unthriftiness, lack of condition, the poor use of feed, and special care, which are hard to measure.

THE COMMON LIVER FLUKE, Fasciola hepatica, is widely distributed.

The adult fluke in the bile ducts is flat and leaflike. The anterior end is conical and is set off from the rest of the body. The parasite is about an inch long in sheep and a little larger in cattle. It apparently is long lived. Viable, egg-producing worms were recovered at the Agricultural Research Center from a sheep that had been experimentally infected and kept for 11 years under conditions that precluded reinfection.

F. hepatica occurs most abundantly in the United States in Florida, Louisiana, Texas, California, Oregon, Washington-
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The common liver fluke is a parasitic flatworm that affects cattle, sheep, goats, and other hosts. It has been found throughout the United States, except for the Eastern States, possibly due to unfavorable conditions. The fluke passes from host to host through the intermediate host, a snail, completing its life cycle. The fluke causes irritation and damage to the liver, leading to various health issues in infected animals.

The life cycle of the common liver fluke involves several stages, including the miracidium, sporocyst, redia, and cercariae. The cercariae encyst in the bile ducts of the host, maturing over time. The symptoms of liver fluke infection in cattle and sheep can include digestive disorders, anemia, and other signs of parasitic infection. In heavily infected sheep, the condition can be severe, leading to a disease called "black disease."
dark or black, and the carcass has a peculiar, sweetish odor.

The giant liver fluke, Fasciola gigantica, is like F. hepatica in form and structure, but it is much longer and its ends are less pointed. It is the common liver fluke of India, other southern Asian countries, and Africa. It is also the common fluke of cattle in Hawaii. We have had some inconclusive reports of its occurrence in cattle in the Gulf coast area.

The life cycle of Fasciola gigantica resembles that of F. hepatica. Its snail intermediate hosts are Lymnaea natalensis and Physopsis africana in Africa, L. acuminata in India, and Fossaria ollula in Hawaii.

The giant liver fluke also injures the livers of cattle and causes general systemic disturbance similar to those reported for flukey cattle in Texas and other Gulf Coast States.

The large American fluke, Fascioloides magna, was first discovered in 1875 in deer in Italy, where it was believed to have been introduced through importations of American elk. Other ruminants in Europe are known to harbor the parasite, but its widespread distribution and variety of hosts on this continent leave little doubt as to its American origin. The parasite is fleshy and leaflike. It may be 3 inches long when it is fully extended.

This fluke occurs in Texas, Louisiana, Arkansas, Wisconsin, Michigan, Colorado, Illinois, Iowa, Idaho, Oklahoma, New York, Montana, and North Dakota. It has been found in British Columbia, Alberta, and Ontario.

Its definitive hosts in North America are cattle, sheep, goats, several species of deer, bison, and elk. It also has been found in horses.

Its life history resembles that of F. hepatica. The snail intermediate hosts all belong to the family Lymnaeidae and are Stagnicola bulimoides techella, Fossaria modicella, F. modicella rustica, and Pseudosuccinea columella in the United States, and S. palustris nuttaliliana and F. parva in Canada.

The young flukes, which gain access to the liver in the same way as do those of F. hepatica, wander through the liver tissue and form extensive channels. Finally they come to rest as a result of the host's tissue reaction. They become surrounded by connective tissue and complete their sexual development within these cysts.

The cysts in cattle are thick-walled and have no access to the bile ducts. Therefore the eggs of the parasites cannot escape, and the life cycle is not completed. In deer and related mammals and in sheep and goats, the cyst wall is thin, the bile ducts are open, and the eggs and other material from the cysts flow freely into them and escape from the body in a normal manner. Consequently it is generally believed that cattle and closely related ruminants are not important in the spread of infection.

Infested cattle sometimes show symptoms of liver fluke disease in areas where F. magna is common. Sheep and goats are particularly susceptible to the effects of F. magna, and deaths are frequent. On postmortem examination, the livers show dark-red cysts, about the size of a walnut. If they are superficial, they are somewhat elevated above the surface of the liver. The liver substance, particularly in sheep and goats, often shows tracks or burrows filled with blood and pigment as a result of the migration of the flukes. Adhesions of the viscera, especially near the liver, are commonly seen; the liver, adjacent lymph nodes, and omentum show streaks and patches of black pigment, a condition that does not occur in other infestations of liver flukes.

The lancet fluke, Dicrocoelium dendriticum, is the smallest of the liver flukes that infest livestock. It rarely is more than one-half inch long. It has pointed ends and so has the shape of a lancet. The body is thin and semitransparent,
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except for the middle part of the posterior half, which contains the uterus filled with small, brownish eggs. Its small size and transparency make it difficult to detect on casual inspection of the opened bile ducts.

The lancet fluke is widely distributed in Europe, the Near East, and some other parts of the Eastern Hemisphere. It was first definitely established to be present in North America in 1930, when cases in sheep were found in Nova Scotia. The infection was first found in the United States in 1940, when eight infested cattle from New York were found during the course of Federal meat inspection at Newark, N. J. The parasite since has been reported in sheep, cattle, goats, deer, woodchucks, and rabbits in 11 counties in central New York. Two cases have been found in Massachusetts and one in northern Pennsylvania. We have had unconfirmed reports of one case in North Dakota and another in Arkansas.

The lancet fluke requires two intermediate hosts, one a snail and the other an ant.

The first intermediate host is a land snail—Zebrina detrita, Torquilla frumentum, Helicella ericetorum, and H. candidula in Europe, and Cionella lubrica in America. C. lubrica is minute and occurs widely in the United States, Canada, and parts of Mexico.

The second intermediate host in America is a common and widely distributed species of black ant, Formica fusca. The second intermediate host in other parts of the world is unknown.

Eggs of D. dendriticum are passed in the droppings of cattle and sheep or other mammalian hosts and are eaten by the snails. The miracidia hatch from the eggs in the snail’s intestine, migrate to the middle digestive gland, and are transformed into sporocysts. The sporocysts, which are saclike bodies, give rise to a second generation of sporocysts, which are tubular and have a birth pore. Long-tailed stylet cercariae develop within this generation of sporocysts. The cercariae eventually escape from the snails, and large numbers of them become cemented together by the secretions of their large glands. These masses, or slime balls, adhere to grass in the course of the snail’s migrations and are eaten by ants. Ants containing the young flukes, or metacercariae, are eaten by cattle or other host animals while grazing, and the young flukes finally reach the bile ducts, where they mature.

Lancet flukes in cattle seem to cause little injury, aside from slight enlargements of the bile ducts. In sheep, however, there is a pronounced cirrhosis of the liver, as shown by scarring of the organ and thickening of the bile ducts, thickening of the inner lining of the ducts, and adjacent fibrosis. The damage to the liver increases in proportion to the age of the infection and the number of flukes present. Infested livers are unfit for food. Infested sheep do not gain normally. Extremely heavy infestations cause death.

The control of liver flukes of livestock is a complex problem. More information on its various aspects is needed before any great success can be expected. Possible eradication of the snail intermediate hosts, treatment for the removal of the parasites from infested animals, keeping livestock off infested pastures, and the control of wild animal vectors must all be taken into account.

Drainage of the places where snails live would be a logical beginning, because the three fasciolinid flukes I have discussed have water or amphibious snails as vectors. Such drainage, however, cannot be done economically in some sections. In Texas, for example, the coastal prairie, which is essentially a continuous habitat, is 250 to 330 miles long, 20 to 80 miles wide, and 0 to 100 feet in elevation; to drain any but small places there would be extremely costly, or impossible. Some ranchers in Florida prefer to maintain the water table 4 inches below the ground surface to get good grass for grazing; extensive drainage under those
conditions would be impracticable. In some of the Western States, moreover, irrigation is necessary for crops and livestock. Except for small, swampy areas caused by seepages from the irrigation canals, drainage would tend to defeat the purpose of irrigation and return the land to an arid condition.

An effective and inexpensive way to destroy lymnaeid snails is to use chemical poisons. Asa C. Chandler, after a long search for a chemical that could be used on a large scale and was cheap, soluble in water, destructive to snails, and nontoxic to man and animals, reported in 1920 that copper sulfate met those specifications. He found that copper sulfate in dilutions of 1:100,000 would kill *Fossaria bulimoides* in 8 hours and in 1:1,000,000 in 24 hours. Subsequent investigators demonstrated the practicability of the chemical under various conditions, and it is now used extensively against snails in different parts of the world.

The concentration of copper sulfate and methods of application depend on the type of habitat and the amount and kind of vegetation. Sprays containing 0.5 percent of the chemical applied at the rate of about 140 gallons to the acre will destroy snails on damp pastures with heavy vegetation.

Dusting with a mixture 1 part of powdered copper sulfate to 4 to 8 parts of a carrier, such as sand, China clay, or land plaster, is satisfactory for treating swampy land over which spraying equipment cannot be taken. Dusting is also useful in treating small swampy areas, well overflows, and places around drinking troughs and the margins of pools. Dusting of large areas, as in the coastal prairie of Texas, by the use of airplanes might be effective, but it would be expensive. Copper sulfate will not kill the eggs of snails, and new generations will reappear soon after the treatment of pastures. Therefore it is most effective when it is used in connection with drainage in killing snails in ditches and in small areas not adequately drained. Copper sulfate is likewise useful in treating streams, but the promiscuous use of the chemical in streams is not advocated because it kills fish and other aquatic life.

Another way is to fence cattle out of land known to be infested. The fences should be placed far enough back from the infested area to keep animals away from herbage contaminated with infective metacercariae. Hay from the areas should not be fed to livestock unless it has been thoroughly dried and stacked for at least 18 months.

Medical treatment of fluke-infested animals is a valuable, if not an essential, adjunct to any program of control. Of several medicaments that will kill the mature flukes in the bile ducts, the most promising so far are carbon tetrachloride for sheep and hexachloroethane for cattle. Carbon tetrachloride is frequently toxic to cattle and should not be given to them. No treatments so far discovered are entirely satisfactory, because they do not destroy the young flukes in the liver tissue and because the animals must be treated at least twice a year in order to destroy the maximum number of flukes as they mature in the bile ducts.

Wild animal vectors complicate the task of controlling flukes in livestock. Deer, hosts for the large American fluke, contaminate ranges and pastures and so transmit the parasite to cattle, sheep, and goats. Many or all of the snails that are intermediate hosts for the parasite also are hosts of the common liver fluke. Hares and rabbits commonly are infested with *F. hepatica* and maintain infestation on pastures. To control or eradicate them is impossible.

Control or eradication of the lancet fluke is even harder. There are no control methods for snails and ants, its two intermediate hosts. We know of no medical treatment that removes the flukes from infested animals.

As for other liver flukes, control is complicated by the occurrence of the parasite in wild animals. Since the parasite in North America is restricted
to a relatively small area in New York, Massachusetts, and Pennsylvania, and perhaps a smaller area in Canada, it is important that steps be devised to eradicate the fluke before it becomes widespread. Quarantine, slaughter of infected animals, keeping noninfested animals off infective pastures until the infection dies out, and extermination of deer and the other mammal vectors are possible—but remote—measures.

**Tapeworms and Bladderworms**

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**DOMESTIC** ruminants in the United States may harbor three species of adult tapeworms and five species of bladderworms, or larval tapeworms. These larval tapeworms develop to maturity in certain nonruminant hosts, such as dogs and related animals and man.

Adult tapeworms of ruminants are flat, ribbonlike, segmented parasites up to several yards long and three-fourths inch wide. They are attached to the lining of the small intestine by a small head, or scolex, which has four suckers without hooks. The segmented body, or strobila, consists of hundreds of segments, or proglottids.

Two species, *Moniezia expansa* and *M. benedeni*, commonly occur in the small intestines of domestic ruminants and some of the wild ruminants in the United States. Both parasitize cattle, sheep, and goats, but *M. benedeni* is the species usually found in cattle and *M. expansa* is the one usually found in sheep.

Of all the parasites of ruminants, these tapeworms are the best known to farmers because of their large size and because ripe segments can be seen easily in fresh manure. Their mode of transmission was unknown until 1937. Dr. H. W. Stunkard, of New York University, then discovered that small mites, known as oribatid or beetle mites, were the intermediate hosts of *M. expansa*. Parasitologists in the Soviet Union have since determined that *M. benedeni* also is transmitted by oribatid mites.

When microscopic tapeworm eggs, or the segments containing eggs, are voided on pasture with the droppings of infected ruminants, each egg already contains an oncosphere, or small tapeworm larva. Oribatid mites eat the tapeworm eggs with their food. Inside the mite the oncosphere penetrates to the body cavity and develops into the next larval stage, known as a cysticercoid, in about 2 months. Large numbers of oribatid mites live in the humus layer of soil and migrate onto forage plants, especially in the early morning, when the grass is moist with dew.

Ruminants swallow infected mites while grazing on contaminated pastures. In their digestive tracts the cysticercoids escape from the mites.