Cattle Coccidiosis

BY DONALD C. BOUGHTON

AN INFECTIOUS intestinal disease caused by a minute parasite, coccidiosis sometimes causes heavy losses among calves. An uninfected calf is the exception rather than the rule, because carriers of the disease are everywhere. There is no cure, but careful management and sanitation can go a long way toward prevention.

BOVINE COCCIDIOSIS is an infectious disease of cattle, known in its spectacular form as bloody scours or red diarrhea because of the characteristic bloody fecal discharges seen in severe cases. The disease is of economic importance in many parts of the world, including the United States. (1, 12, 15). To the outright loss from fatal infections, which may take a heavy toll among calves, must be added the no less significant loss from retarded growth and general un thriftiness among survivors of nonfatal infections, many of which go undiagnosed because marked clinical symptoms are lacking.

NATURE OF THE DISEASE

Coccidiosis is essentially intestinal malaria. The microscopic, one-celled animal parasites, called coccidia, that cause it are close relatives of malaria organisms. As in malaria, a knowledge of the two-phase life cycle of the parasites is of fundamental importance. Whereas the malaria parasites utilize the blood cells, the coccidia invade the intestinal lining of their victim. The injury to the host occurs during this phase of the coccidian life cycle. After a period of multiplication within the intestinal tissues, coccidia produce resistant forms, known as oöcysts, which are discharged in the feces. Outside the animal they live a nonparasitic existence until picked up by a new

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2 Italic numbers in parentheses refer to Literature Cited, p. 570.
injury. This second phase is obviously responsible for the transmis-
sion of the disease. Malaria parasites, on the other hand, are trapped
in the blood stream and require the aid of a mosquito to make the
transfer from one host to another.

A significant feature of bovine coccidiosis is that the massive mul-
tiplication of the parasites within the host does not continue indefi-
nitely but is culminated rather abruptly with the discharge of large
numbers of oöcysts. Following natural exposure or experimental
inoculation, the oöcysts appear in the dung in from 1 to 3 weeks,
depending on the species of coccidia involved. Reproduction of the
parasites appears to be self-limited. Possibly the length of the
multiplication period may be affected by host reaction. In any
event, at least two points of practical significance depend upon this
limitation on multiplication. In the first place, infection is often of
short duration and recovery consequently spontaneous. Claims for
successful treatment must be judged in the light of this fact. Second,
the final number of coccidia within the host’s tissues at the end of
the multiplication period is likely to be smaller if only a few infective
oöcysts were ingested. Other things being equal, small numbers of
coccidia produce less damage than large numbers. The severity of an
infection, therefore, depends on the number of parasites introduced
into the intestinal lining.

Acute outbreaks of bovine coccidiosis often appear where young
animals are crowded together. This is in line with the general ob-
servation that coccidiosis becomes of economic importance wherever
mass production of animals involves crowding of the host population
whenever mass production of animals involves crowding of the host population.
Groups of calves confined in small lots are more often heavily
infected than calves on pasture. Acute infections may appear among
yearlings confined in feed lots at the end of the grazing season. Two
factors are generally held to be responsible for outbreaks when young
or previously unexposed older animals are confined in close quarters:
(1) Such animals have less resistance than those that have already
experienced infection, and (2) they are exposed to a relatively high
concentration of parasites.

INJURIES PRODUCED AND SYMPTOMS

The injuries produced by coccidiosis in cattle result directly or
indirectly from massive multiplication (asexual reproduction) of coc-
cidia within the linings of the small intestine, cecum, colon, or rectum.
Resulting gross lesions include: (1) Loss of surface epithelium, or
lining membrane; (2) thickening of the mucous membrane, with the
formation of irregular, whitish ridges; and (3) hemorrhages, which
may be petechial—of pinpoint size—in mild cases and diffuse in
acute cases. Catarrhal enteritis (intestinal inflammation) is often
present in both the small and the large intestines.

Symptoms associated with this condition are bloody diarrhea,
anemia, weakness, and general emaciation. Severe straining accom-
panies the voiding of feces, which may consist primarily of stringy
masses of mucus and blood. Secondary bacterial infection—another
disease coming on top of the first one—is a common sequel. Pneu-
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monia often develops. An animal that does not die within a week or two after the onset of an acute attack may be expected to recover rather promptly from the diarrhea and improve gradually in general condition.

Calves, often during the second month of life, may suffer from rather severe but nonfatal coccidal infections which fail to produce marked symptoms. There is a more or less persistent nonbloody diarrhea, which has often been mistaken for a prolongation of white scours. Affected animals are unthrifty and often fail to make normal gains in weight.

TRANSMISSION

The ultimate source of the parasites causing bovine coccidiosis is an infected bovine host. Formerly it was thought that all coccidia found in the various domestic and wild animals belonged to the same species. Sparrows, for example, were accused (8), falsely, as it was shown later (4), of harboring poultry coccidia. Cross-infection experiments, however, have proved that with a few exceptions the different coccidia are specific to their own hosts. None of the species of cattle coccidia tested have been found to infect other animals, such as rabbits, sheep, goats, swine, guinea pigs, rats, mice, and chickens (7, 15, 18). Coccidial infections of nonbovine origin have not been demonstrated in cattle, which are undoubtedly exposed while grazing to coccidia of various invertebrate, avian, and mammalian hosts.

Coccidial infection in cattle that do not show clinical symptoms is common. Surveys of wild and domesticated animals have revealed high percentages of infected individuals (2, 3, 9, 10, 11, 12). As a matter of fact, an uninfected calf is the exception rather than the rule. Although special concentration techniques may be required to discover the coccidia, they can often be found in healthy adult cattle, and the actual number of oöcysts discharged during a given period, say a month, is enormous. Such healthy animals harboring the organisms are known as carriers of coccidiosis. The carrier state probably involves repeated infection and, possibly to a limited extent, the prolongation of low-grade parasite reproduction following an attack. Second and subsequent infections, under ordinary management practices, are usually milder than first infections, presumably because resistance is increased and exposure is reduced. Carriers are a constant source of oöcysts.

Bovine coccidiosis is transmitted by means of the infective oöcysts, which, as already pointed out, must be of bovine origin. Following the parasitic phase within the host, undeveloped oöcysts are discharged in the feces. Large numbers are characteristic of severe, nonfatal infections; small numbers may be discharged by carriers, presumably as the result of mild reinfection with the same species or new infections with different species. The majority of the oöcysts from a single infection may often be eliminated in the short period of 3 to 6 days.
Before an oöcyst becomes infective, the living material within the cyst wall must undergo a development (sporulation) which requires 2 to 6 days under the most favorable conditions of oxygen and moisture. This is a vulnerable period in the coccidian life cycle during which sanitary measures can operate successfully. If manure were removed daily, the freshly passed oöcysts would not have time to become infective. Oöcysts are resistant and can remain alive for several months in fecal material in a barn or pasture. Large numbers are often plastered on the coat of a calf befouled with manure, where they are readily accessible to the calf's tongue. Oöcysts can be destroyed by drying and by strong disinfectants. Strong solutions of lye or bichloride of mercury are effective when applied to walls and floors by means of a stiff brush. When an infective oöcyst is ingested by a susceptible calf, the cyst wall is digested, releasing eight small forms (sporozoites) within. The latter penetrate the cells of the lining membrane of the digestive tract, where they begin parasitic multiplication.

SPECIES OF COCCIDIA INVOLVED

There are at least 10 species of bovine coccidia (3, 13). This fact complicates and at the same time helps to clarify studies on bovine coccidiosis; generalizations regarding the disease must be qualified and conflicting observations interpreted on the basis of the individual species involved. It is believed that all the species belong to the genus Eimeria, the report of a bovine Isospora (5) not having been verified. At present, species differentiation is based on the following traits: (1) Characteristics of the oöcyst, such as size, shape, color, micropyle, residual body; (2) structure of sporocysts; (3) sporulation time; (4) specific immunities developed; and (5) length of time between inoculation and appearance of oöcysts. The following species are recognized at present: E. alabamensis, E. auburnensis, E. bovis, E. brasiliensis, E. bukidnonensis, E. canadensis, E. cylindrica, E. ellipsoidalis, E. subspherica, E. zurnii. Description of tissue stages and the relative pathological significance of individual species await further investigation. There is evidence, however, which indicates that certain species, notably E. zurnii, E. ellipsoidalis, and E. bovis, are of greater economic importance than the others (1, 3, 15, and unpublished data).

CONTROL AND TREATMENT

Control of coccidial infection and prevention of clinical coccidiosis are based upon two fundamental facts—(1) coccidiosis carriers are universally present, and (2) excessive exposure to coccidia is particularly harmful to young stock. Sanitary measures and management practices must be designed to prevent young calves from ingesting large numbers of infective oöcysts.

A very common serious mistake is to introduce young calves directly into a group of calves of various ages confined in close quarters. Such conditions are ideal for producing severe infections, as the following
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typical chain of events indicates: Since coccidia, distributed by carriers, are universally present, the first few calves in a given lot are bound to pick up a few stray oocysts. As a result, these calves develop nonclinical infections and discharge large numbers of oocysts. Calves subsequently added to the group are exposed to increasingly large numbers of oocysts, and their infections and discharges, in turn, raise the parasite population to a dangerous level.

Isolation of young dairy calves, as in individual box stalls, does much to prevent heavy infections. Daily removal of manure and wet, contaminated bedding is important. Precautions must be taken to avoid the introduction of fecal material from other places by the shoes of the caretaker, for example, at feeding time. The use of individual milk pails, cleaned thoroughly between feedings, is advantageous. Calves up to 6 weeks of age should not be removed from their stalls, even during the short period required for cleaning, unless special care is taken to prevent contact with other cattle and unsterilized objects.

Where isolation of dairy calves is impractical and the quarters are not cleaned daily, segregation of calves by ages is helpful. For example, separate pens for different age groups may be provided as follows: (1) For calves under 3 weeks old, (2) for calves 3 to 6 weeks old, (3) for calves 6 weeks to 3 months old, and (4) for calves over 3 months old. The two youngest groups require particular attention. The upper age limit of the third group is chosen more for convenience in caring for the animals than for any practical advantage in reducing coccidial infection.

The first pen, shed, or lot, assigned to the youngest group, is used exclusively for these animals, calves of all other ages being excluded at all times. Upon reaching the 3-week age limit, all calves are removed promptly from the first pen and placed in the second pen. Because oocysts are rarely discharged by calves under 3 weeks of age, the first pen can be kept free from large numbers of oocysts. Newborn calves subsequently introduced are spared severe infections, which have serious consequences in very young animals, and are given an opportunity to gain in bodily vigor and to begin normal growth before being exposed to the older animals in the second pen. Nonclinical infections may be expected to develop in the first few calves introduced into the second pen; the short stay here is designed to prevent the excessive accumulation of infective oocysts which might otherwise take place as the calves subsequently introduced become infected.

It goes without saying that sanitary measures are not to be abandoned upon the adoption of some such age-segregation plan. It is profitable to go to some pains to protect calves against severe coccidiosis in the early weeks of life, inasmuch as thereafter they are usually able to withstand the coccidial infections to which they will almost certainly be subjected.

Where large herds of beef or dairy stock are fed outdoors, the wet, muddy ground around haystacks, feed sheds, and watering troughs presents a special problem. Low spots should be filled in and proper drainage provided so as to permit the ground to dry out from time to time. Manure should be picked up daily if practicable. If con-
tamination proves to be excessive, a change of feeding place is indicated.

Treatment is entirely for the relief of symptoms and includes the judicious administration of astringents and intestinal antiseptics and measures designed to prevent reinfection and maintain bodily vigor. A specific drug for bovine coccidiosis is not known. The beneficial results claimed for various types of drug treatments that have been employed from time to time (6, 17) may often be due in reality to spontaneous cure under favorable hygienic conditions. Recent experiments made by the writer with sulfaguanidine, however, suggest that this drug holds promise for the future.

LITERATURE CITED

(2) Boughton, Donald C. 1937. NOTES ON AvIAN CoccidioidosIS. Auk 54: 500–509, illus.
(3) Christensen, John F. 1941. THE OCCYSTS OF COCCIDIA FROM DOMESTIC CATTLE IN ALABAMA (U. S. A.), WITH DESCRIPTIONS OF TWO NEW SPECIES. Jour. Parasitol. 27: 203–220, illus.
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(16) **Wilson, I. E. Donaker, and Morley, L. C.**

(17) **Yakimoff, W. L.**

(18) —— **and Galouzo, J. G.**