Infectious keratitis is usually introduced into herds by newly purchased animals that have been exposed to infection while in transit. Sometimes the disease appears, but no source of infection can be found. It is possible that cattle that have recovered from the disease may be able to spread the infection for several months after all symptoms have disappeared.

Beef cattle affected with pinkeye usually lose weight because they cannot find their way about the pasture to graze. The milk flow drops. Nursing calves lose weight. Young calves may become temporarily blind and unable to follow their dams. Cattle, unable to see where they are going, may hurt themselves by falling in ditches, ravines, and waterholes.

Production in dairy cattle may drop 25 percent or more.

CONTROL MEASURES consist of good herd management. There are no specific vaccines, bacterins, or serums that will prevent the disease. Affected herds must be given daily attention to see that they get feed and water and are kept out of ditches and other places where they may get hurt. Because flies and gnats probably spread the disease, spraying the herd with fly repellents and insecticides at regular intervals will help reduce the number of animals affected. Newly purchased animals should be kept isolated for at least 60 days before being allowed to mingle with the rest of the herd.

Herd treatment of wild pasture cattle is not practicable. Handling the cattle through chutes daily would do more harm than the treatment would do good. Individual animals that are tractable or halter broken should be placed in dark stalls and treated by a veterinarian.

Mild antiseptic eyewashes and antibiotics have proved of value in individual cases. Argyrol, a 2-percent solution of zinc sulfate, mercuriochrome (2 to 4 percent), and a 1-percent solution of silver nitrate have been used. The antibiotics usually used are Chloromycetin ointment (1 percent), Terramycin pellets, and penicillin solution or ointment.

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Bovine Coccidiosis

LEONARD REID DAVIS AND GEORGE W. BOWMAN

Coccidiosis is an extremely common but usually overlooked disease that weakens or kills many calves before they are 6 months old.

Coccidiosis is a parasitic protozoan disease. It is produced by small, one-celled organisms of the genus Eimeria (Protozoa). Eleven species have been reported in cattle in this country. Most of these species are found in varying numbers on routine examinations of young calves. As a result of a natural infection on the farm, sometimes as many as eight species may be found in one examination.

Coccidiosis has been considered the third most important parasitic disease in cattle, even though some investigators have overlooked it as one of the causes of scours in calves. It has been reported that coccidiosis in cattle may produce as great an economic loss as
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that caused by coccidiosis in poultry.

Coccidiosis usually affects calves between 3 weeks and 6 months of age when they are placed together in unsanitary lots contaminated by older cattle or other infected calves. Occasionally it attacks mature cattle when they are brought in from large pastures and are crowded into small feed lots or barns. It is extremely rare to find cattle manure entirely free of these parasites.

Calves that appear to be free of coccidia may pass low numbers of oöcysts (the cyst stage of coccidia passed in the droppings) without showing clinical symptoms and thus may build up greater numbers in susceptible calves, which, in turn, will pass dangerously high numbers.

The infection in a previously uninfected calf may be subclinical (without symptoms) or clinical, depending on the amount of infective oöcysts swallowed, the age of the calf, and the species of coccidia involved. Species such as *Eimeria zurnii*, *E. bovis*, and *E. auburnensis* may produce pathological symptoms when relatively small numbers of oöcysts are ingested, but ones such as *E. ellipsoidalis* and *E. alabamensis* may produce no observable symptoms unless large numbers are swallowed or unless the calf is weakened from other conditions.

The oöcysts that are passed from an animal are not infective for the host or other calves until a process called “sporulation” takes place. The rounded material inside the oöcyst shell has to undergo cell division, dividing into four round bodies, each of which lengthens and then splits lengthwise into two early stages of the parasite, called “sporozoites.” The presence of these eight sporozoites in an oöcyst shell indicates that sporulation has been completed and that the oöcyst has become infective. The time required for sporulation may vary from 1 to 14 days or more, depending on the species, surrounding moisture, oxygen, temperature, and other environmental conditions.

When outbreaks of coccidiosis occur, microscopic examinations will show that infective oöcysts usually can be found in the litter, in the upper layers of soil, on contaminated troughs or buckets, and on the ears, body, and tail of calves in the pen. The ever-inquisitive, searching tongue of a young calf can pick up the infective oöcysts by licking or sucking its own body or other calves.

The coccidia in cattle do not attack other animals, and vice versa. There is no scientific foundation for the commonly encountered belief that cattle coccidiosis can result when rains wash oöcysts of poultry coccidia into calf lots from a poultry house and lot situated higher on a slope. However, chickens, other livestock, and man can step in manure of infected cattle and then carry the contamination on the feet into places used for raising calves.

The symptoms of coccidiosis may include rough coat, weakness, listlessness, nervousness, poor appetite, diarrhea, and loss of weight or poor gains in weight. The general weakness may cause the calf to defecate without rising, thus soiling its tail, hindquarters, and lower part of the body.

When standing, the calf may attempt to defecate and not be able to pass feces; the intense straining results in an arched back, raised tail, and a “pumping” of the sides. The diarrhea may be watery or only slightly liquid, being quite unlike the “white scours” of calves less than 3 weeks old. Diarrhea caused by coccidiosis may contain many strands of gelatinous mucus and splotches or streaks of blood. In infections with *E. zurnii* and *E. bovis*, it may be extremely bloody and may even include shreds of intestinal tissue or occasionally short lengths of the tubular lining of the damaged intestine.

When a susceptible calf swallows infective oöcysts, the sporozoites are released from the oöcysts in the stomach or intestine. The sporozoites penetrate the cells lining the intestine and begin to divide into multitudes of in-
termediate stages. The stages continue to divide, and each division produces parasitic cells that cause damage to the host cell in which each lives. Many male and female parasitic cells are produced eventually in the intestinal lining. They unite to produce the oöcyst, which is covered by a resistant shell to protect it from the surroundings in the outside world. The oöcyst is then passed out of the animal's body in the feces. The life cycle is started again after sporulation occurs and the oöcyst is swallowed by a susceptible calf.

Calves may sometimes die from coccidiosis without passing blood. The only positive indication of the presence of the disease in cases like this would be the discovery of the parasites during a careful microscopic examination of scrapings or sections of the intestinal lining.

The temperature of the calf may be elevated during an attack of coccidiosis, but it may be below normal before death. The presence or absence of fever, therefore, would not be a good indication of coccidiosis.

Treatment is not effective in many cases when the digestive tract already is severely damaged. Some of the reports of so-called cures attributed to drugs may have been due to the removal of cattle from contaminated areas during the time of treatment. If a calf does not continue to swallow oöcysts, those already swallowed soon complete development and the disease terminates. Unless untreated control animals are used for comparison, it is impossible, therefore, to evaluate objectively the therapeutic value of a drug used to combat coccidiosis.

Sulfaguanidine, sulfaquinoxaline, and sulfamethazine have shown promise in the treatment of bovine coccidiosis. When equal amounts of sulfamethazine or sulfaquinoxaline were compared, sulfamethazine gave more protection than the other drug. Sulfamethazine was given in a course of four daily treatments—1 grain per pound of body weight on the first day and half that amount on each of the next 3 days. Two weeks should elapse before repeating the course of treatment.

As in most diseases, it is easier to prevent clinical coccidiosis than it is to treat it. Because several days are required for sporulation, the oöcyst stage is the weakest link in the life cycle of the parasite.

Separating the calf from its accumulation of manure interrupts the cycle and controls the disease. It is nearly impossible to remove all traces of oöcyst-contaminated feces from stalls by scrubbing, and the remaining water furnishes perfect moisture conditions for sporulation. That explains some outbreaks of coccidiosis in concrete-floored stalls under conditions normally considered "clean."

Raised isolation pens with wire mesh or slat floors permit most contamination to pass down away from the calf and are useful for reducing clinical coccidiosis, but they must be used inside a building.

Segregation into three or four age groups will reduce gross contamination of young calves by infected older ones, but when calves are raised in groups, respiratory troubles may be encountered occasionally and may spread to others in the same age group.

A practical system of raising calves without clinical coccidiosis has been developed. Detailed plans are available at the Regional Animal Disease Research Laboratory of the Agricultural Research Service, the United States Department of Agriculture, Auburn, Ala.

The method involves the outdoor use of individual portable pens that are moved to a clean site once each week. The calf is left with the dam for not more than 24 hours, so that it receives some colostrum. Calves left with the dam longer than 3 or 4 days develop more coccidia and worm parasites than those removed after only 1 day. The
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Calf is placed in an individual pen, 5 by 10 by 3 feet, where it remains until it is 4 to 6 months old, depending on the size of the calf.

Moving the calf and its pen, preferably uphill, once each week, takes the calf away from its contamination before too many of the oöcysts sporulate. The calves are not completely freed of infection, but they swallow enough oöcysts to get slight, nonclinical coccidiosis and to develop sufficient immunity to be resistant when they are placed on pasture, unless the pasture is heavily contaminated by older cattle.

Calves raised in portable pens and then placed on pasture are no more susceptible to coccidiosis and other parasitic diseases than are calves raised in individual stalls in a conventional calf barn.

Besides preventing clinical coccidiosis, portable pens reduce the transmission of worm parasites and many other infectious diseases of calves. As compared with barn-raised calves, those raised in portable pens remain remarkably free from respiratory troubles and invariably make better weight gains and have fewer deaths. The portable pens are recommended primarily for use in Southern States, but they have been used successfully in milder weather in some Northern States.

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Diseases of Calves

CALF SCOURS is perhaps the most important of the diseases of calves. It is known also as diarrhea in calves, calf septicemia, and 3-day calf disease.

It takes many different forms and therefore is hard to define. Here, though, I describe the types that are seen a few hours after birth and those that appear later.

The most fatal form of calf scours appears at birth or within 6 to 72 hours after birth. The calf is found soon after birth in a cold, weak, and dying condition.

Sometimes there is little or no evidence of actual passage of watery feces, and several calves on a farm may be "found dead" unless they are closely watched following birth. In other herds a few calves may scour mildly or severely during the first 10 to 30 days of life and recover with little assistance. Oftener, however, calves with severe diarrhea become unthrifty and potbellied, show poor growth, and get pneumonia.

The middle ear, joints, and umbilicus in rare instances become seats of localized infection in beef or dairy calves when they are a few days to several weeks old.

We do not know all the factors that favor development of the various forms