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EARLY GESTATION

After the highly structured and somewhat labor-intensive time of breeding, the early gestation period is very peaceful indeed. The ewes will have altogether lost interest in rams, and the rams themselves will be thin, weary, and not a little bedraggled looking. After some antediluvian combat in a pickup truck or small pen, the warrior males will go back to eating and sleeping for the rest of the year, the social structure of the world of rams having once more been established.

For their part, the ewes will be united into one or a couple of groups again and will have a wonderful time seeing old friends and doing some ewe-style head butting to reaffirm old pecking orders.

The shepherd will have to face the problem of cold weather a bit more seriously in the northern states, and the first snow or rain may signal the approach of winter. The shepherd and his family may become concerned with firewood supplies, Christmas presents that have to be made, the last bit of garden produce that needs canning or freezing, and a million other things that command attention, but the sheep are heading into their favorite time of year.

What more could a sheep ask for? The hot weather is finally out of the way, and they are at last comfortable in their wool wraparounds. The flies that have been after them all summer long have vanished as quickly as they came, along with those pesky mosquitoes that sought out the bare spots. There is no longer thunder and lightning to terrify the flock into huddling together. To be sure, there is no more tasty pasture either, but that is more than made up for by the fragrant bales of hay the shepherd opens to feed to them. Fresh, moist pasture is great, but there is really something special about hay. There is nothing quite like exploring with lips and tongue for the softest and most tender alfalfa leaves before getting down to the serious business of eating the stems. Yes, this is a pretty good time to be a sheep.

NUTRITION

“Living Off Their Backs”

The ewes have been on a highly nutritious ration since the start of flushing and should have come out of breeding in good condition. The high feed level during the early part of pregnancy was to maintain pregnancy, but once the ova are firmly implanted in the uterine wall, the ewes can be put on almost a maintenance diet while cell division is starting to make a lamb out of that speck of life called a fertilized ovum. After fertilization the ovum undergoes cell division, and moves from the oviduct to the uterus at about day 4–6. By day 11 the embryo is about 1 to 1.5 mm in size. At about day 12–13 the embryo becomes attached to the uterine wall. From about days 11 to 34 is the period when major organs and tissue develop from the beginning mass of cells. That is a time when one must be especially careful about medications or poisonous plants that can cause deformities. For example, the wormer albendazole administered at this time can cause fetal deformity. From that time on, the fetus just very slowly grows larger and there is less danger of deformities developing because of external causes.

For the first three months the ewes will live off a ration that will require them to use some of their stored resources. This so-called living off their backs means that they will lose some weight during early gestation even though the fetus is growing inside their wombs. The purpose of limiting feed at this stage is to ensure that the ewes do not go into the last four to six weeks of gestation in a fat condition. Female readers may recall being given the same advice during a pregnancy of their own.

Ewes can be put on a diet at this time because most of the growth in the size of the fetus does not take place in the early stages of gestation. The fetus grows in complexity as cells become differentiated, but a large increase in weight of tissue does not accompany the specialization of the cells. One might say that there is a big qualitative change in the fetal tissues but not much quantitative change.

As a result, the flock will get by just fine with about three to four pounds of average-quality hay per head per day. If hay is not fed, a suitable ration can be calculated from the NRC tables. This should provide adequate but not excessive total digestible nutrients and the right balance of energy and protein. This is the time to begin to serve up your hay in the correct order. Start with your poorest hay (which should be a little leafy and have at least 8 percent protein) and gradually change over to better and better quality as gestation progresses, saving the better stuff for late gestation and the very best, the highest protein hay, for lactation.

Bred lambs should not be put on the weight-loss diet. You want them to gain some weight in early gestation. Many of them wouldn't consume three to four pounds of hay anyway without wasting a lot of it, so feed them about two pounds of hay and two pounds of corn to keep them growing.

Provide all of the ewes with a mineral mix or salt plus dical (dicalcium phosphate) and keep the water available.

Depending on prices in your region, you might want to replace part of the hay fed with corn for the older ewes too. Corn has roughly double the nutritional value of hay, and in some areas can cost about the same per pound. Also, protein needs of ewes in early gestation are low. A couple of pounds of average-quality hay and a pound of corn will handle an average-sized ewe just fine, and will save hay and possibly money as well.

Crop Residues

Some sheep owners (I won't call them shepherds) think that a ewe can get by during gestation on feed that is practically no feed at all. That is taking the idea of a ewe's living off her back a little too literally. For example, some people turn the flock into a field of cornstalks and hope for the best. What will happen in such a case is that the ewes will seek out the spilled grain first and this may result in some deaths from acidosis. The survivors from that episode will then gradually lose condition as they try to endure on a diet that

contains only about 2 percent protein. A 150-pound ewe would have to eat between eight and nine pounds of cornstalks a day to get along. Even if she could manage to stuff that much into herself, which is doubtless impossible, digestion would be slow because the rumen flora need a minimum amount of nitrogen from protein to digest the stalks. The same thing can be said for straw, especially wheat straw. In either case, the roughage of stalks or straw would need to be supplemented because of a lack of energy and a big lack in protein.

If straw is considered as a feed, there are two things to evaluate. First, is the straw actually a cheap feed on a per-pound basis? Straw may be cheap by the bale, but straw bales don't weigh very much. Second, is the combination of straw plus a grain and protein supplement actually cheaper than just feeding hay instead? Get out that calculator and pencil and paper.

If straw is inexpensive, it can be used as a sort of filler to blend with more nutritious feedstuffs to give a mixture that can be fed free choice. Chopped or ground straw mixed with hay, grain, and oilseed meal gives a mixture that fills up the ewe before she can overeat. Some experiments with straw mixtures at the Hettinger Experiment Station in North Dakota, in the heart of wheat straw country, have indicated that they are a practical option to reduce the labor of feeding during gestation, although mixtures with too much straw gave poor results. A grower would have to experiment a bit to get the right blend.

Another thing that can be done with straw is to treat it with anhydrous ammonia to add some nitrogen and thus increase its feed value for sheep. Stacks of straw bales can be covered with six-mil plastic sheeting and edges sealed with soil, tires, lumber, or other weights. Ammonia is then introduced at a rate of 60 lb/ton over the course of twelve to twenty-four hours, after which the stacks are left to react with the ammonia for three to four weeks.

In a trial at the Colby, Kansas, Experiment Station, ammoniation increased crude protein of the straw from 6.5 to a final 11.2 percent, a whopping 72 percent increase. Digestibility as measured in the laboratory increased from 30 to 48 percent. Ewes fed the ammoniated straw in a forty-day trial had average daily gains of 0.28 pounds compared to 0.18 pounds for ewes fed untreated straw and 0.47 pounds for ewes fed a control diet of silage, grain, and hay. If you raise sheep in an area where straw is inexpensive, ammoniation might be a worthwhile consideration.

Stockpiling

Stockpiling means letting standing pasture mature for later grazing. In much of the United States if a pasture or hayfield can be kept ungrazed from early August, then there will be enough growth for winter grazing. Fescue, red clover, alfalfa, and trefoil are all good stockpile crops. Grazing of the stockpiled feed should be controlled by portable electric fencing to limit intake. Inquire locally for practices in your area.

Hay Feeders

If hay is a major ingredient of your feed, some consideration has to be given to how to feed it. One very important thing to keep in mind is feeding in such a way as to minimize contamination of the ewes' wool with leaf and other vegetable debris from the hay, the bane of fleece cleanliness. Feeders that allow the ewes to burrow into the hay are to be avoided at all costs as the neck wool will fill with trash, reducing the value of the fleece for any purpose and making it altogether worthless for handspinning. In a lot or confinement setup the feeders should be designed so the ewe has to eat down into them over a barrier. She also should have to stick her head under a board or something else that discourages her from lifting her head up with a big mouthful of hay and dribbling leaf into her neighbor's neck wool.

If feeding is done in pastures, consideration can be given to feeding on the ground, even though many authorities tell us that we shouldn't do that. Here in Minnesota, pastures are snow covered for up to five months a year during a time that coincides with gestation, so we feed hay on top of clean snow. While there is theoretically a hazard of disease transmission if the sheep urinate and defecate over the feed, we have experienced no such problems. Feeding on the ground does give very clean wool, which for our flock is of great interest. In other localities, or with other flocks, feeding on the ground might not be desirable.

Feeding Schedules

During early gestation when the sheep are given less hay than they would eat free choice, feeding them is a daily chore. Not that checking the flock every day is not a good idea, but it is nice to stay inside sometimes and let the critters take care of themselves. Bob Jordan and others at the University of Minnesota had the same idea. They had to hire people to feed the sheep on weekends, which was an added expense, so they tried feeding only on Monday, Wednesday, and Friday of each week. Their formal feeding trial compared the



This common type of hay feeder encourages burrowing, which the center sheep is doing. Burrowing results in vegetable-matter contamination of the neck wool.

three-day group with a control group fed the same total amount of hay, but fed every day. They found that not only did less frequent feeding make no difference, but that the group did even slightly better on average in terms of weight gain of both ewes and lambs.

We have fed our flock on an every-other-day basis for many years and are very happy with the program. We just feed double the daily ration on alternate days. The sheep quickly learn the new schedule and adapt readily. In fact, they seem to be more content than with daily feeding. The big eaters get full and have to quit, which gives the slow and shy ones a crack at their fair share. When we now and then give them a one-day ration in order to shift our schedule for some other reason, the sheep miss their double shot and complain loudly to let us know their objections in no uncertain terms. If we are feeding grain for some reason, we feed it daily even if hay is fed every other day.

With cold weather, in many parts of the country the shepherd has to get busy keeping water from freezing. Floating tank heaters can be used, or there

are various types of enclosed waterers and demand waterers that can be equipped with heaters. Check local suppliers and ads in sheep magazines for choices. Any heated waterer will cost something in electricity to operate.

Another solution is to let the ewes get by on snow alone. If clean snow is available in your pastures, it can make a fine substitute for water. The sheep will use a little extra fuel to melt the snow inside their bodies, but the cost of the extra feed needed can be shown to be less than the cost of the electricity to heat water in a tank. In a formal study at the University of Alberta, A. A. Degen and B. A. Young found that lactating ewes fared equally well on water or snow, even in the frigid environment of Edmonton. If you use snow as a sole source of water, be sure there really is plenty of clean snow accessible to them, and not only dirty, icy drifts in fence corners.

I can report from personal experience that sheep prefer snow over water when given the choice. I have learned the hard way never to fill their water tank if they have fresh, clean snow to eat. It is disheartening to fill a tank at ten below and then have to bail it empty before it freezes solid because the sheep prefer to eat their natural sherbet.

ENVIRONMENT

The choice of where sheep are kept during early gestation is pretty much a matter of the shepherd's convenience, with some preferring to drylot them while others will leave them in conveniently located pastures. Given a choice, I think pastures are preferable because crowding is never a good idea. In a confined area, spread of disease is encouraged and the wool gets dirtied and contaminated by vegetable matter, mud, and excrement. In pastures, the sheep can move about to get exercise and also can eat or pick at dry grass that isn't buried by snow. Convenience of feeding can be enhanced by pasturing the flock close to hay storage if the layout allows this.

We are strong believers in keeping the sheep out of the barn for most of the year. They are well equipped to cope with cold weather and thrive in it. We know sheep raisers who keep their ewes confined in the winter, and most of their flocks have persistent respiratory problems as a result. In a barn their feet don't wear down very much either, unless an expanded metal floor is used, with the result that hooves need more frequent trimming or the risk of foot disease is increased. I could go on for pages describing the health prob-

lems that arise from confinement, but I think it suffices to say that a shepherd should provide for the sheep just what a physician would prescribe for a human patient: plenty of wholesome food, fresh air, and exercise.

Confinement

Sheep in confinement are not necessarily doomed to be in a state of poor health at all times. A well-designed confinement facility can provide a healthy environment. The average farm barn is not a well-designed confinement facility, however. Sheep housing for total confinement must provide lots of fresh air at optimum humidity without buildup of pollutants such as ammonia, and it must be free from drafts. Such a goal is easier to set than to achieve, as many a farmer and agriculture experiment station has discovered.

The naturally gregarious nature of sheep makes them good candidates for confinement raising from the point of view of their psyche. However, the lack of exercise and the ease with which communicable disease can be spread makes health care a far more critical factor than with a pastured or even a dry-lotted flock. Nutrition must be provided and monitored much more skillfully than with a free-ranging flock that has a choice of a wide variety of plants and other materials to eat. Vitamin D that would be provided by sunlight to an outdoor flock has to be given to the indoor group in some other way. Trace elements that might be present in the pasture setting must be provided in the confinement barn. In addition, the shepherd is faced with the necessity of keeping a confinement facility in constant use because of the large capital investment in the fixed costs of the building and its support facilities, plus the cost of skilled personnel to operate such an artificial environment successfully.

Confinement animal raising is to an outdoor environment what a greenhouse is to a garden. Or, put another way, would you rather raise bass in a bathtub or a pond? Some people raise commercial vegetables in greenhouses, and others grow market fish in artificial rearing facilities, but only the experts make a go of it. At present, the main advantage of confinement sheep raising is that it can be used as a tax shelter. I know that there are those who argue that protection of sheep from predators justifies confinement. According to my calculations, guard dogs, electric fences, and alert shepherds are a lot cheaper.

Others argue that confinement permits raising of sheep in climates where they otherwise would do poorly. In Canada, for example, Agriculture Canada

built a large, well-conceived experimental facility that is a model of its genre. The justification is partly the cold weather over most of Canada. I happen to think that cold is more a problem for shepherds than for sheep. At the other end of the spectrum, excess heat can cause troubles such as heat exhaustion, infertility, reduced resistance to disease and parasitism, and reduction of wool growth. One solution is to confine the sheep and to cool the building with air conditioning, as is done for pigs. A better solution is to breed the sheep to tolerate heat as Leroy Boyd of Mississippi State University has done. When he read a report by some agricultural engineers who stated that a new pig building needed better air distribution and cooling because 70 percent of the pigs were doing poorly in the building, Boyd commented that he personally would cull the 70 percent and keep the 30 percent to produce more pigs who could tolerate the heat.

My personal bent is to want to control every stage of sheep raising, and I find the concept of confinement very appealing. However, that is just a day-dream, and I know in my heart that raising sheep outdoors is the most reasonable approach. Our flock, when given the choice, will choose the outdoors over shelter almost every time and the more open the better. In really fierce blizzards they will bed down in the lee of a building or other windbreak, and they will seek the shade of a grove of trees on a scorching day, but otherwise they cast their votes for the unconfined life.

Maintenance

Early gestation is an undemanding time for the shepherd, so it is a good time to repair and clean equipment. Gates and panels for the lambing area should be mended, disinfected, and otherwise put in order. The barn itself can be cleaned and disinfected, and bedding laid down. Inexpensive and effective disinfectants for equipment and barn walls are diluted household bleach (Clorox, Hilex, etc.), made by mixing the straight bleach with an equal amount of water, or a commercial product called DC&R that is also mixed with water before application. The bleach releases chlorine and monatomic oxygen, and the DC&R releases formaldehyde. Either is a good choice for spraying all of the equipment to get it ready for lambing. The floor of the barn can also be heavily limed with slaked lime (calcium hydroxide, hydrated lime, $\text{Ca}(\text{OH})_2$), before bedding. The lime is a mild disinfectant, and it also encourages breakdown of the manure and bedding by keeping the pH "sweet" or alkaline, which in turn reduces odors and harmful gases in the barn

atmosphere. Do not use the plain ground limestone that is sometimes sold under the name of barn lime, as it is useless as a disinfectant. If you have reason to believe that the barn harbors pathogenic organisms such as the one that causes foot rot, you might consider liming with quicklime (burned lime, CaO, unslaked lime). Quicklime is much more caustic and reactive than slaked lime and should be treated with respect. Wear gloves, a face mask, and eye protection when applying it, and bed the barn and leave it empty for at least a couple of weeks after use.

As long as you have the slaked lime bag open you might want to consider mixing up some whitewash to paint the inside of the barn. It brightens things up considerably and has a mild disinfectant effect too. Directions for mixing and using whitewash should be on the bag of slaked lime.

With the barn in order, the start of lambing won't catch you rushing around in a panic trying to clean things up and trying to locate all the equipment you need at the last minute. Also, by bedding the barn down well ahead of time, you will give the straw or other bedding material ample time to settle. This is particularly important if the barn is to be used for shearing. A freshly bedded barn results in a lot of straw pieces in the wool, and this greatly reduces the value of the fleece, even to the point of ruining it for handspinning. If the barn is to be used for shearing, let me suggest using coarse grass hay rather than straw for bedding. We use hay (locally called swamp hay) that is mostly reed canarygrass and other similar species. Dry cattails are as good or better, if available. If you don't do your own shearing, now is a good time to arrange for a shearer to come.

HANDLING

Moving Sheep

Moving a flock of sheep where you want them to go can be simple or it can be very difficult indeed. Corrals, pens, sorting chutes, and a border collie make the job somewhat easier, but understanding a sheep's mind is the most helpful single element. Sheep don't do a lot of reasoning or thinking, but they do have a full stock of instincts and good memories. If you can use their natural behavior to your own benefit, you will have an easy job. If you try to make them do something that doesn't fit with their instincts, you'll have a terrible time of it, and you probably won't get the job done.

Sheep have a few strong instincts that are fundamental to their unique character. They are gregarious for the most part (with the exception of many of the British breeds). They are fearful of the unfamiliar and of aggressive dogs. A familiar environment is their favorite, although a ewe with wanderlust will now and then lead the whole flock on a voyage of exploration. Identify that individual and sell it to someone you don't particularly like, or send it to market.

Sheep are followers, and the shepherd should try to establish himself as the leader whom they will follow. To begin with, call to them in some simple way and carry a bucket of grain. If they are not accustomed to a grain bucket, spill some grain on the ground so they get the idea. They will catch on quickly and follow you anywhere you want to take them — at least almost anywhere. Keep your back toward them and walk away. If you stop to look at them, they will stop to look at you. Once they get used to following you, the grain becomes unnecessary.

The flock will avoid places where they feel trapped, such as fence corners or inside buildings. Here again the use of a food bribe is most helpful. A sheep dog is worth its weight in gold when trying to make a flock go into a building, though a couple of people clapping can do a fair job. Sheep like light too, so if the barn has an open door at the far end, they will enter more readily.

The most important factor in moving sheep is practice. The more they are moved in the same way, the easier it becomes. As I type this part of the manuscript I am watching Teresa out the window as she moves about 150 lambs from a small pasture back to their drylot. They have done this every day for weeks, and they know that the feeders will be full of freshly ground feed when they get back, so all she does is clap her hands a few times and talk to them, and they all rush, leaping and cavorting to the gate and into the yard.

Once trained to follow a given shepherd, sheep won't want to be shooed away by the same person. Our flock is trained to follow me as leader, while our border collie or a family member brings up the rear to encourage stragglers. This is a fine system except for the times when I am in the truck alone and want to go through a gate that is blocked by some sheep. I have a terrible time because they are predisposed to follow me, and all my clapping and shouting has little effect because every time I turn my back to go back to the truck, they follow me.

The problem of getting through the gate is compounded by another ele-

ment of sheep behavior: they love to go through gates. Never mind what is on the other side of the gate, they want to go through. A road to a gate is almost equally compelling. With enough strategically placed gates, you can do almost anything with a flock. I always find it amusing to call sheep to a gate and let them crowd together for a moment, then open the gate and watch them rush through madly. Then, having gone through, they all stop and look back as if to say with some sort of collective puzzlement, “Now why did we do that?”

General Physical Condition

During the early gestation time, individual sheep should be examined for their general physical condition at least once. This can be done when they are being handled for some other reason such as worming or immunization. Feel their backbones and hip bones. A backbone that is a half inch or so above the flesh is normal, but a more exposed one that is accompanied by knobby hip bones means that the ewe is not getting enough food. These individuals should be removed and placed on a higher feed level. Take special care with the old ewes and the best milkers for they are the ones most likely to be in thin condition.

At the opposite extreme, ewes with their backbones and hips buried in flesh and fat should be put on a more restricted diet. If facilities allow, the flock can be divided into three groups and each subflock given an appropriate diet. The thin ones and the bred lambs can be given extra feed, the normal group left alone, and the fatties put on a reducing plan. Be sure to check hooves as you examine the sheep, and trim them if needed.

Pregnancy Checking

Many producers check their ewes at some point to see if they really are pregnant. If a teaser ram with a crayon was placed with the flock after breeding, then some indication has already been given, although remember that all this tells you is that the ewe did not come into standing heat again, not that she is pregnant. She may not come into heat because of pregnancy, but she may have also quit cycling for some other reason. Conversely, a ewe who shows heat after breeding may actually be pregnant, although this is not usually so.

It is a good management practice to check the flock for pregnancy during early gestation. There are a number of reasons to do this, but they all boil down to saving money. If a ewe is not pregnant, she is not performing her primary function. One option is to try to rebreed the open ewes, as one

would do with year-round lambing. Another, more common one, is to ship her. An open lamb might be kept and given a second chance at another breeding season, but the ones who have bred before and are open now should be disposed of. Any open ewes that are retained should be kept separate from the pregnant ewes because they require less food and are too playful to be kept with ewes who are in the later stages of pregnancy.

There are a variety of techniques that can be used to check ewes for pregnancy. This was not the case a few years ago, and pregnancy evaluation was limited to larger species such as horses and cows. With such animals, a veterinarian could insert a gloved hand into the rectum and palpate (feel) the uterus to determine whether or not a fetus was present. A ewe is too small for this technique.

The first commonly used technique for sheep was to tie the ewe in a sheep "chair" and make an incision in the abdomen that allowed the veterinarian to insert his fingers and palpate the uterus. The ewe was then stitched up and turned out with the flock. It is a testament to the resilience of a healthy ewe that complications from this major surgery were rare.

Later, a less drastic technique was developed that included use of a probe that was inserted up the rectum and used to nudge the uterus against the abdominal wall so that it could be palpated from outside the belly. This approach, sometimes called the broomstick method because of the use of a broom handle as a probe by some rough-and-ready practitioners, is not without problems. The main problem is the chance that the wall of the rectum can be punctured, resulting in peritonitis and almost certain death of the sheep.

Electronics came to the rescue, and there are now simple and effective instruments to check pregnancy. The first electronic method used a probe that emitted an ultrasound signal that reflected from the fetal heart. The operator could then detect the heartbeats of the lamb or lambs as separate sounds from the ewe's heartbeat. This gadget had the disadvantage of high cost and risk of perforation of the rectum, as with the rectal probe.

Current instruments use a probe that is placed against the wool-free skin under the right rear leg and aimed up and forward at the uterus. The high frequency sound then travels through the tissue and reflects from the fluid-filled uterus of a pregnant ewe. The echo is detected by the probe, and the instrument gives a signal to indicate pregnancy. If no echo is received, the instrument signals an open animal. These gadgets work after about the sixtieth day



A helper holds the hind leg of a ewe as the shepherd uses a handheld pregnancy checker.

of pregnancy, and are about 85 to 95 percent accurate. The highest accuracy is achieved if the open ewes are rechecked. We have found that our instrument is better than 95 percent accurate with our flock. We did not achieve such accurate results with another flock that was run through rather hurriedly.

The electronic pregnancy detectors have steadily dropped in cost since their introduction and can now be had for less than \$300. This may seem like a lot of money, but consider their value carefully. Also consider sharing the cost of the instruments with another shepherd or two. The money that can be saved by purchasing a pregnancy detector is substantial. A ewe checked at sixty days and found to be open has about eighty days left before lambing time when it would be discovered that she was not pregnant. During that time she'll eat about 250 pounds of hay and about 70 pounds of grain. With hay at about \$60 a ton and grain at \$0.05 a pound, that's \$11 worth of feed that is wasted, not to mention the medications and time spent on her care. Even just finding a few open ewes a year, shipping them and saving their feed

costs pays for a pregnancy detector pretty quickly. I'll refer to the economics of pregnancy detection in ewe lambs a bit further on, under Evaluation.

Better yet, use ultrasound to actually see how many fetuses are in the ewes. This allows one to feed those with singles less than average, and those with three or more, more than average. It is also preferable to have ewes separated into groups before lambing to minimize doing lots of sorting after lambing, which disturbs new lambs. The average producer will not want to buy the equipment to do this, because it costs many thousands of dollars and requires considerable skill to use effectively. There are persons who are in the business of doing ultrasound scanning and who will come to your farm to do the work. The charges can be high, but you will probably come out ahead by feeding correctly based on solid knowledge. Give it serious thought, and base your feed program on the results. Ask your vet or other producers for names of technicians who do scanning.

MEDICAL

Abortion

The threat of abortion is a constant worry for the shepherd. It should be realized that abortion is a symptom, not a disease, and every effort should be made to avoid the conditions which can bring it about.

One cause is mechanical damage to the ewe, although this is not a major problem in early gestation. Crowding through gates or doors is a major cause, as is roughhousing among the ewes. Open ewes are a lot more mobile and may be overly playful and aggressive with their pregnant colleagues. They should be kept apart.

Feeding of moldy feedstuffs is another cause of abortion. Some molds are harmless, but others produce toxins (poisons) called mycotoxins that can stimulate abortion. In an ideal world, the shepherd would never feed moldy hay, but of course in real life there is usually some mold in all but the most perfect hay, at least in areas where the rainy season and the haying season coincide. As any farmer in such areas knows, the advice to make hay while the sun shines is a wonderful idea that he does not always achieve in spite of avid listening to weather forecasts and careful planning. Each producer will have to decide what to do with less-than-perfect hay. I freely confess to having fed

some moldy hay each year as a matter of expedience, but not without some nervousness. The practice is not recommended.

Abortions are also caused idiopathically, as any veterinarian can tell you. I hope the vet will tell you this with a twinkle in his or her eye because it means that the cause is unknown or, literally, that the condition is generated by the ewe herself and not attributable to an external cause. We have had an average of one abortion a year. We always send the aborted fetus and some associated tissues and a blood sample if we have one to a veterinary diagnostic laboratory. The lab has never yet determined a cause, which our veterinarian tells us is par for the course. This does not mean that the lab personnel are incompetent, it just means that many abortions are of undetectable, and therefore unknown, origin. In spite of this dismal track record, I still think the lab examination is well worth the effort and expense, because a single abortion could be the first of a major outbreak that might be stopped by early detection.

Worms

The life cycle of the common sheep worms was outlined in the Building and Rebuilding chapter. An important part of the cycle is the deposition of oocysts in the sheep's feces on the ground. With warmth and moisture, larvae hatch and grow and reinfect the sheep when eaten with grazed forage. If gestation coincides with a cold or dry time of year, the oocysts may not hatch, or if they do the larvae soon perish. In addition, if the flock is eating just hay and grain, the risk of reinfestation is greatly reduced. Either way, the reproductive cycle of the worms is effectively broken.

Many people survive the rigors of winter by moving temporarily to a warmer region. Sheep worms don't have this option, so they winter over in a dormant or arrested state in the sheep's gut. There is no reason that a sheep should be expected to provide winter housing to these scoundrels, and parasitologist Dr. Rupert Herd of Ohio State University has found that a single worming with levamisole kills 98 to 100 percent of the susceptible dormant worms. If reinfestation can be avoided, the sheep will remain worm free until they eat larvae in a pasture the following spring or summer. The worms will be in this dormant stage for flocks in early gestation that were bred in late summer or early fall in cold climates. Worming can be combined with vaccinations for vibrio, enterotoxemia, or other diseases. If levamisole is used, combining the worming with vaccination has an added advantage because

levamisole is a so-called immunopotentiator, which means it causes the animal's immune system to react more strongly and faster to the vaccination. Thus, the effectiveness of the vaccine is enhanced.

If reinfestation prior to lambing is a possibility, a second worming just before lambing is recommended (as will be discussed in the next chapter).

In climates where winter dormancy is not part of the life cycle of the worms, worming is not so simple. In climates such as that of the southeastern United States, worming has traditionally been done very frequently, as often as every two weeks. At that rate, the cost of wormer alone approaches ten dollars per ewe per year, an expense that cannot be tolerated if profit is one of the motives for raising sheep. Such frequent worming also encourages development of resistant worms, so is a losing strategy in the long run.

Professor Leroy Boyd of Mississippi State University has found that his flocks that are adapted to local conditions need to be wormed only five or six times a year. Descendants of the original sheep brought to the southeast by the Spaniards are essentially totally worm resistant, and a flock at the University of Florida has not been wormed for over thirty years. Similarly, the Barbados Blackbelly sheep is highly worm resistant. Selection for worm resistance can make sheep raising a practical enterprise in almost any climate, even though the shepherd in the northern United States and Canada does have the advantage of being able to catch the worms napping, as it were, during their winter dormancy.

Vaccinations

Early gestation is the time to give the second vaccination for vibrio to ewes who were vaccinated for the first time at breeding time. If you give an annual booster, you should also have vaccinated at breeding. A shot can still be given in early gestation for some protection. Some producers who have never had trouble with vibrio wait to vaccinate until an outbreak occurs. This is really far too late because immunity takes a couple of weeks to develop, and many ewes already will have been infected when the first abortions happen.

Vaccination against vibriosis is not mandatory because the disease is not present in all regions. A closed flock that is not located near other sheep flocks may be safe even in regions where the disease is endemic. The decision whether to vaccinate against a given disease is ultimately that of the producer who must make the judgment based on discussions with a veterinarian and area sheep producers. It is a matter of cost effectiveness. Is the cost of

the vaccination greater or less than the possible economic loss from the disease? That is the question you'll have to answer. One cannot vaccinate against every disease.

Early gestation is also the time to vaccinate unprotected ewes against *Clostridium perfringens* types C and D. If replacement ewe lambs were vaccinated one or more times during their first six months of life, no additional vaccination is needed at present. Purchased ewes of unknown medical history should be vaccinated now to build their immunity for maximum response to another vaccination in late gestation. In my opinion, vaccination against *Cl. perfringens* is not a matter of choice or judgment but a matter of necessity. This bacterium probably causes more deaths of lambs and yearlings than all other diseases, with the possible exception of pneumonia. A single dose of vaccine costs about seven cents, so do use it.

If tetanus is a problem on your farm, the flock can be vaccinated against *Cl. tetani*. The vaccine is fairly expensive, so don't do it if it is not called for. If you have experienced losses, you may have little choice but to vaccinate. The spores of *Cl. tetani* are present in most soil, although rarely in the northern Rocky Mountains, for some unknown reason. If you have horses on the farm, horse manure is especially rich in spores, so keep sheep away from the horses or vaccinate.

OBSERVATIONS

During early gestation the flock doesn't require a great deal of care, but be alert for any signals of illness such as a ewe going off feed. Almost any illness can be the cause of abortion or death and resorption of the fetus. Pull out any sick ewes and treat them in a sick-bay area for a few days until they brighten up.

Be alert for any vaginal discharges that might indicate trouble in the reproductive system. Walk quickly along behind the ewes while they are eating to give the rear ends a quick appraisal. Also, be sure to be on the lookout for aborted fetuses. This is easier said than done because the fetus is often covered with dirt or snow or tucked against a fence. The ewe who aborted is probably a better clue. She will act very upset, running about and baa-ing frequently. She will usually have some placenta hanging out of her vulva or at least may have wet or dark stains around the vulva area. If you find such a ewe, isolate her immediately and try to locate the fetus and any associated tissues or fluids

and dispose of them by burial or burning. The curious ewes will sniff or lick at the aborted fetus and tissues or at the aborted ewe's rear, and may become infected if there are any abortion-producing organisms present. Remember that the aborted fetus and tissues can be sent to a diagnostic lab if you wish to do so.

Be on the lookout for limping sheep who might have foot rot. It is more common in fall and winter when sheep are confined closely in wet, muddy lots.

If silage is fed to your flock, you should be alert for a disease called listeriosis. Listeriosis is sometimes called circling disease because affected sheep often walk around in small circles with their heads turned to one side. The ill animals also get a fever, sit or lie down, and may drool out of one corner of the mouth because of paralysis of facial muscles on that side. This condition is caused by a neurotoxin (nerve poison) produced by a bacterium called *Listeria monocytogenes* that thrives in fermenting plant matter. It grows in silage that is improperly packed so that air can reach the growing bacteria. Properly made silage ferments anaerobically, that is, in the absence of oxygen. *L. monocytogenes* can grow in any aerobically fermented plant material, and we experienced the disease in a sheep that ate old, mowed grass in a pasture, although this is not a common source.

The only treatment for listeriosis is sulfas or broad-spectrum antibiotics, but the treatment is usually futile because by the time symptoms appear the disease has already done irreparable damage to the brain and nervous system. One problem with treatment is that it is very difficult to get high levels of an antibiotic in the brain because the sheep has protective mechanisms that inhibit transfer of medications or other chemicals from the body to the brain. Prevention by not feeding spoiled silage and keeping affected animals from contaminating feed and water is the best approach. Low levels of antibiotics in feed are used by some farmers. Exercise care in handling affected animals and tissues because listeriosis can affect humans. If you suspect that listeriosis might have been the cause of death of a sheep, leave the necropsy to the lab rather than risking infecting yourself.

EVALUATION

Rams

With breeding over and pregnancy checks made, decide which if any rams should be culled. A ram who settled only a few ewes or none at all should be shipped right now. If a ram is not fully sterile, but just of low fertility because of age or general health, he should be shipped unless he has unusually valuable genes that justify his staying on even at a reduced performance level.

Ewes

A ewe who didn't settle is a prime candidate for the truck. Even if she is one of your old favorites she probably should go unless you can afford to keep nonproductive animals in your flock.

Ewe Lambs

Open lambs present a different case. Many growers do not believe in breeding lambs, which is one way of avoiding the issue altogether. If, however, you do breed ewes as lambs, and they show open at a pregnancy check or are repeatedly marked by a cleanup or teaser ram, then what do you do?

The simplest thing is to keep the lambs over until next year and try again. This is a bit of a nuisance because they will have to be kept separate from the bred ewes so their youthful boisterousness doesn't cause mechanical abortions in the pregnant ewes. In this situation you could have as many as four different groups of ewes if you have already sorted as to feed requirements.

Another possibility is to keep the open ewe lambs with a ram until they do settle. That extends the lambing period way beyond the normal time and may mean that you will have lambs arriving when you are busy with seasonal activities such as haying or tending crops. If, on the other hand, you are trying to spread lambing out, it may be the best solution. The fact that a ewe bred for the first time in February doesn't mean that she will ever do it again. Unless your open ewe has a lot of Dorset, Merino, or Rambouillet blood in her, she will probably not recycle in late winter as her next breeding season but will hold over to the following fall, so no long-term gain is made by the late breeding. If her first lamb was weaned very early, you might be able to get the ewe bred in her second fall.

The third possibility is to cull the lamb from the flock. As I mentioned in the chapter on flushing, culling the lambs that don't settle means selecting replacement ewes on the basis of early maturity. If this is what you want, then



Some hungry ewe lambs follow a wheel rut to a meal of hay served on a pristine bed of snow.

that's fine, but be aware of what you are doing. If you already selected the larger ewe lambs to breed, then you have also selected for rapid growth. Some breeders also select their replacements only from a pool of twins, triplets, and quads. This adds still another factor you are selecting for by your choice of replacements. It may be that you really should be selecting for wool type, or meat conformation, or resistance to hot weather, or any one of hundreds of heritable characteristics. If you selected a ewe lamb for some important characteristics before she was put with the ram, you may want to keep her in any case rather than cull her on the single issue of early sexual maturity.

For purely short-term economic reasons you should ship open ewe lambs. (Notice that this means ignoring the other factors if that is your choice.) First of all, you will save feed money. A lamb should be kept on a growing diet her first year, so she probably would get some extra feed such as grain during early gestation. If she was given a pound a day of grain at five cents a pound, she would eat about five dollars more feed than an older ewe who would eat about eleven dollars worth of feed in the same period. By lambing time you

would have put a total of sixteen dollars of feed into each open ewe lamb, and yet get no lamb from her to justify the feed cost.

You should also consider the selling price of the lamb. If she is shipped as a lamb in early gestation, she will command the market price for slaughter lambs. If you wait until after lambing to ship her as a yearling, then she'll get the yearling price, which is ten to twenty dollars less per hundredweight than the lamb price, which means up to twenty-five dollars less per lamb.

Add the feed cost and the loss in market value and you get a thirty- to forty-dollar advantage for pregnancy checking and early shipping of open ewe lambs. Of course, if you want to keep them, that is fine, but be aware of what it costs you. Looking back at the cost of a pregnancy checker of less than three hundred dollars, you can see that as few as eight open ewe lambs can pay for the pregnancy checker, in money saved and earned.

The Lambs

Shepherds who are raising sheep on a once-a-year lambing schedule should be shipping the last lambs from the past season now during the early gestation period. If they are not to market weight yet, they may never get there, or at least they won't make it as lambs and you'll take the losses described in the above paragraphs. As it happens, lightweight, finished lambs are often in short supply in winter, so put your late ones on a lot of free-choice grain, get them finished to grades Choice or Prime (see appendix 2), and ship them. This is no time to fool around feeding lambs on hay. Get them fat and out.