A Thesis

By

Carroll E. Brown

RANGE MANAGEMENT ON PRIVATELY OWNED LANDS

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Introduction

Wherever man has set foot on this globe the grazing of domestic animals - first the cow, then the horse, sheep and hog - has been the first form of agriculture practiced. As has been well said, "the cow has always been the advance agent of civilization".

Pasturage for livestock has always been an indispensable source of commodities essential to life. Today, in spite of all of our intensive agricultural practices, the production of meat, hides, and wool by grazing animals is the cheapest, most economical method known. Take from the farmers of the United States their pastures and livestock and our whole agricultural structure would fall.

To the uninitiated the word "pasturage" implies grass as the one food for the grazing animals. This is not always the case, however. Pasturage is defined by students of the subject as follows:

"Pasturage includes all herbaceous feed gathered directly by domestic animals. When the plants are shrubs or trees the pasture is called 'browse'. Feed consisting of acorns and other nuts that have fallen from the forest trees is termed 'mast'. This term is also extended to include the berries of palm trees and the seeds of pine trees. (1)

Probably the cradle of the range grazing business was in the great state of Texas, where the raising

(1) Refers to corresponding number in "Literature Cited".
of cattle and horses, and later sheep, on the wonder-
fully grassed plains that stretched for unbroken leagues
wherever one went, was undertaken on a business basis.
The business grew until there was a glut of stock all
over the state and it was almost worthless because of
the lack of a market.

In 1867 those great trails from the south through
the great plains, across the Indian Territory into Kan-
sas were established, which relieved the Texas ranges
of their surplus cattle. Thus, was brought about an ex-
pansion in the cattle business. Practically all of the
Western States awoke to the opportunities that were of-
fered for raising cattle and sheep upon the open ranges
that lay west of the Mississippi River, from the border
of Canada to that of Mexico. Great cattle companies were
formed in the east and also in Europe whose promoters
went into Texas and bought thousands of long horned cat-
tle and moved them north onto the vacant ranges. Mill-
ions of dollars were invested in the enterprise and for
a few years millions were made, principally in speculat-
ion, promotion and on paper. (2)

Soon the ranges became crowded and there was a con-
stant pushing forward farther and farther out into the
prairies. Eventually the advance guard from the far east-
ern coast met the tide of pioneers from the western coast.
In the Southwest they met along the Rio Grande in New Mex-
ico and Colorado, while in the Northwest those that crowd-
ed over the Cascades in Oregon and Washington met the advancing tide from the east pouring into the backbone of the Rockies, and - the frontier was no more.

Not an acre of land was left unoccupied, and ranges that for permanent and regular use would have been overstocked with a cow to every hundred acres were loaded until they were carrying one cow to every ten acres. Gradually the native grasses disappeared. As fast as a blade of grass showed above the ground some hungry animal gnawed it off. A few men sounded a note of alarm but the owners declined to realize the approaching disaster and drifted along in their fancied opulence.

Then came the inevitable. The winter of 1886 saw the almost extinction of the industry in the Northwestern states. Thousands of cattle went into that winter never to see the spring flowers again. Millions of dollars were lost beyond hope of recovery. Great cattle companies went out of existence. In 1893 the Southwest went through the same experience.

Then there came a gradual readjustment of the business. Companies operated on borrowed capital and went broke. A few with strong hopes still had faith in the business and carried on, but from that time to this, the cattle business has been a fluctuating one.

In the early nineties the sheepmen began to gain a foothold on the ranges, especially in the Northwest. They steadily forced the cattle back from their own ranges. The sheepmen were much more able to cope with the elements
than was the cattlemen. He had his herd under his eye at all times and could move it to better feed before the animals became too weak to travel. He also found out much earlier than the cattlemen that buying feed against a hard winter was money well invested. In many ways the sheepmen profited by the bitter experiences of the cattlemen and avoided many of their pitfalls.

No matter what class of stock was grazed, whether sheep, cattle, or horses, the owners gave no heed to the morrow. It was a clear case of first come first served and the devil take the hindermost. Nobody dared save an acre for future uses, knowing full well it would be sought out by some nomad with a hungry band of stock, and the feed eaten off to the grass roots in spite of protests of the party of the first part. "It's as much mine as yours" was the answer to such protests. Each man looked upon the range grasses as something which he must grab before anyone else could reach it.

Thus brought about bitter feelings between the cattle and sheepmen which soon terminated into bitter range wars. All over the west the conflicts between these two users of the ranges waged on, costing many lives, both human and animal, together with great financial losses. Armed men fought for the control of the ranges they had learned to call their own. Competition for the ranges became fiercer and fiercer. Many bloody conflicts took place in the Blue Mts. in Oregon, and in all other graz-sections.
Finally with government control of the ranges, the range wars ceased. It is with considerable pride that the Forest Service boasts that in the twenty-seven years they have controlled the lands, not one conflict has taken place between the sheepmen and the cattlemen.

It can be easily seen that the ranges were badly depleted. Much study was carried on as to the best method to improve them. Thus, it can be seen that the day of the all-year-round open range business has gone. In its place must come a proper utilization of the natural forage, in such a way that the native grasses will regenerate and bring on perpetual grazing on the ranges. (10)

Scope of this paper

This is not an original paper, but is a compilation of material from many sources, put into a compact form in one volume and presented herewith.

This plan is quite similar to the plans used on the National forest ranges, the main difference being that these ranges are situated in the higher elevation of the National forests while the privately owned ranges are generally situated in the lower altitudes. Also, the private owner in the range business is not concerned with preventing damage to tree growth to any certain extent. He wishes to graze his animals in such a way that they will gain the most weight and leave his ranges in such a condition that he can use them year after year as a source of feed for his stock.
Classification of the range

The classification of the range to determine the areas best suited to the different classes of stock is the first important step toward the best use of the grazing resources on the range. This cannot be overemphasized. It will be noted the importance of suitability of the range to the stock in determining the season of grazing, the grazing capacity, the management of stock, and losses from poisonous plants. (13)

The main factors to be considered in determining the suitability of the range to different classes of stock are taken up as follows:

Character of the forage: In general, cattle and horses use a grass range to better advantage than do sheep. By "Grass Range" I mean a range in which the dominant forage plants are true grasses, as distinguished from weeds and similar forage such as we find in the higher mountain ranges. Sheep relish the tender green leaves and also the seeds of many grasses, but they eat sparingly of the coarse or dry stems and leaves. Cattle, on the other hand, consume a much larger portion of the coarse grass. Sheep will eat part, or all, of most weed species on closely grazed ranges and often prefer the succulent weed to true grass. On the other hand, only a small percentage of weeds are palatable to cattle. Both cattle and sheep eat considerable browse but sheep eat more than cattle, although cattle reach higher than sheep and get more forage
from high growing browse species, such as scrub oak, *Quercus*, serviceberry, *Amelanchier*, and mahogany, *Cercocarpus*. For sheep to use brush range of large area readily, the brush should be in an open enough stand to enable the sheep to move about through it. They will gradually work their way through and fully use small areas, however dense the brush, if it is palatable, unless the area is too wet. This is sometimes the case where willow browse occurs in wet meadows. Cattle will use dense brush range, but prefer open grass range or open grass and browse range.

**Altitude:** Altitude alone makes little difference in the suitability of a range to cattle and sheep. The higher ranges, however, commonly run more to weeds and succulent forage of that nature and less to the true grasses, which fact tends to make them more suitable for sheep than for cattle. Also the higher altitudes may be less suitable for cattle because of their ruggedness and rocky nature. Cattle become footsore from the rocks more easily than sheep; hence a rocky range will be better suited to sheep.

**Distribution of water:** This is an important factor and should be considered along the following facts. Sheep generally can go from three days to several weeks without water, depending upon the amount of succulent feed, the temperature, and the amount of rain or dew. In areas where there is a small amount of succulent feed, water is needed oftener; during a period of high temperature and during a period of drought, more water is needed.
Cattle need water every two or three days, depending on the same factors listed above. In rough country cattle should not be obliged to walk over a mile for water. Over this distance they get weary, footsore, and careless in their choice of feed. This is especially true where poisonous plants are common. A weary and tired animal will walk along and consume anything that may be near.

Insects:— The presence of such insects as flies, gnats, and mosquitoes sometimes makes it impracticable to graze cattle or horses on ranges which otherwise would be suited to them. Sheep are annoyed by these insects, but much less than are cattle and horses.

Presence of other "varmints" such as coyotes, bobcats, etc., in eastern Oregon in the Blue Mts., especially, will make it necessary to run cattle on sheep ranges very often. It is in this region that many sheep are lost each year through some wild animal. As they are run in small bands and controlled by the use of fences, without the aid of a herder, they are an easy prey for the wild animals that are common in the surrounding foothills.

Poisonous plants:— The presence of poisonous plants on the range should be considered as follows:

Larkspur is very poisonous to cattle, but is harmless to sheep. Lupine and Death Camas, on the other hand, are very poisonous to sheep and cause serious losses, but they give little trouble with cattle. These are probably poisonous to cattle if taken in large enough quantities.
but in actual practice they seldom get enough to do any harm. These poisonous plants, and others, will be discussed in more detail under "Care of the Range".

**Common use:-** If a range can be fully and properly utilized by either sheep or cattle alone, there is nothing to be gained by grazing two classes in common; but where the range supports a variety of plant species, including a good deal of grass, or where there is an appreciable area of meadow range, cattle grazing, if not overdone, is a benefit rather than a detriment to the sheep interests. On the other hand, sheep grazing on a cattle range where there is a good deal of weed feed, or on small areas difficult for cattle to reach, not only is economy but aids in maintaining the cattle feed by keeping down the weeds. (13)

The old time belief that cattle will not graze on a range used by sheep is erroneous. It originated mainly when the ranges were badly overgrazed and there was little or no feed of any kind left for cattle after sheep grazing. Naturally, cattle would not stay on such a range.

The advantages gained from common use of a range by cattle and sheep are very beneficial to the range. In the first place it prevents a waste of forage that will not ordinarily be consumed by either cattle or sheep. Secondly, it maintains a normal balance between the different kinds of forage plants.

**Lambing range:-** On a range to be used by sheep, the location of a good lambing range is very important. The
young lambs need a range of low altitude, not subjected to storms and cold weather. Broken topography affords some protection from the winds. In addition, there should be ample green feed available for the ewes during the lambing period.

Grazing Periods.

In establishing grazing periods the first care should be to prevent damage to the range through premature use. The growing herbage might be called a laboratory where plant nutrients are prepared. Repeated removal of this herbage year after year during the early part of the growing season destroys this laboratory, and by so doing, robs the vegetation of nourishment. As a result, the vitality of the forage plants is lowered, the forage production is reduced, and the weakened plants are unable to produce fertile seed. Meanwhile, inferior species will be introduced as they are grazed very little by stock, and will eventually occupy the range.

The damage to the forage plants from grazing is greatest immediately after growth begins and decreases as the growing season advances. Little or no damage is done after the plant has matured seed. In a broad sense grazing at any time before seed maturity may be considered premature, but in actual practice it has been found that there is little damage done if the stock are not turned on the range until twenty-five percent or more of the heads of the earlier forage grasses begin to show, or are conspicu-
ous in the sheath, which development comes normally from ten days to two weeks after growth begins.

Grazing when the soil is very wet is another source of damage, resulting in packing the soil so that it hardens when it dries; but here again, the greatest damage from trampling and packing is usually over by the time the main forage plants have been growing for about two weeks.

The beginning of growth of grass for any given exposure is usually seven to ten days later for each thousand feet increase in altitude. There is, of course, a considerable variation in the time at which growth begins on different exposures at the same altitude, but on the whole, altitude in any district is the large factor in determining the date at which the first grass will appear and from this the time at which grazing may begin.

As has been stated above, the earliest date which stock should be admitted to the range is about two weeks after the growth has begun. It will be necessary to study the forage for several years to determine when the opening of the range should be. (7)

Seasonal Grazing After the Period of Grazing Begins.

The shortage of rainfall throughout the West makes the growing season on any one range very short, but fortunately variation in altitude and topography makes it possible to have grazing suitable for all seasons of the year, when the ground is not covered with snow.
Most of the stock, therefore, will spend the midsummer months on range perhaps two or three thousand feet greater in elevation than their winter quarters, which is not uncommon. In planning a cattle or sheep ranch, one must arrange for ranges of different altitudes and exposures, and, of course, the greater the differences in altitudes or exposures of the various ranges, and the shorter the drive between them, the better. (13)

Summer ranges are those on which the grazing is best in midsummer. Such ranges are found almost entirely in the mountains where the winter snows are deep, and since these higher elevations are mostly within the National Forests, a Forest Service map of the respective forest is a crude map of the summer range. The grass is very dry in the plains and valleys during July and August and during this season all of the ranchmen run their stock in the mountains, if this is possible. Green grass is helpful to all classes of stock in midsummer, but it is imperative for ewes and lambs. Owing to severe spring and fall storms in the mountains, the season on the summer ranges is from four to five months.

Winter ranges are those on which the grazing is best in the winter or in the spring and fall. The term "Winter Range" is used throughout the West, but about the only place where the grass is really best in mid-winter is in certain parts of Arizona and New Mexico. In other places "spring and fall ranges" would describe the condition more accurately, since outside of the mountains and high moun-
tain valleys the grazing is best at these seasons. If the grass is allowed to mature and the snowfall is light, it will furnish fair feed all winter. Usually the winter ranges, when supplemented with hay, bring the animals through the winter in good condition. The usual system is four months on hay in the winter, two months spring grazing on the lower altitudes or winter ranges, four months in the mountains on the summer ranges and then back to the winter range for two months of fall grazing. There are some exceptions to this, but in no case does the stock run on the same land throughout the year. (10)

Close of the Grazing Periods

The close of the late spring grazing period should be governed by the time that grazing on the summer range may properly begin. If the spring range will not carry the stock on it until this date there are too many stock. The close of a summer grazing period should be governed, as a general rule, by weather conditions and by the supply of fall and winter grazing grounds. Late grazing, when not accompanied by bad management of the stock, will not injure the stock. However, it is not advisable, as a general rule, to graze the range in the fall as long as the stock can get enough forage to live on.

The close of winter and spring grazing periods should be governed by the main growing period of the vegetation on the range in question. If a range is to be kept up and a normal forage crop produced over a period of years fol-
lowing, the vegetation must be given a chance to grow. This means that the stock should be removed at the begin-
ning of the main growing season.

The question frequently comes up of shortening an established grazing period and proportionately increasing the number of stock. If the established season is such that the best and fullest use is being made of the range in question, any considerable shortening of the grazing period will result in waste of forage or overgrazing of the forage plants preferred by the class of stock grazed. If the established grazing period is not such as to result in the best and fullest use of the range, the period should be changed and the grazing capacity redetermined after care-
ful inspection. It must be borne in mind that plants have their periods of highest palatability and that this varies for different important forage plants on the same area. To shorten a properly adjusted grazing period by setting a later date of opening would likewise result in waste of forage from many rapid growing plants drying up or reaching a stage of low palatability before grazing begins.

Grazing Capacity

Grazing capacity, as here used, means the number of stock of a given class or classes which a range unit will support for the period of grazing allowed. The ideal sought is the maximum number of stock which the unit will support each season over a period of years without injury to the range. If this ideal is to be realized, both overgrazing and unnecessary undergrazing must be avoided.
Overgrazing

Overgrazing may be defined as grazing which reduces the forage crop during subsequent years, or what results in a change of the forage to undesirable species. One of the most difficult things to do is to determine whether or not a certain range is being overgrazed or overstocked. The condition of the stock is not a reliable indication, because, if grazed prematurely, the stock, though coming off fat, may yet have done serious damage. If not grazed until the grass is quite dry and mature the stock may come off thin and yet have caused no damage.

The following more obvious "earmarks" are the most reliable indicators of overgrazing that has taken place prior to the year of examination.

1. The predominance of annual weeds and grasses such as knotweed, tarweed, mustard, annual brome grasses and fescues; a dense stand of such species and a lack of variety in the species. This condition is a severe stage of overgrazing such as occurs around bed-grounds which have been used for long periods each year and for several years in succession.

2. Predominance of plants which have little or no value for any class of stock, such as sneezeweed, niggerhead, yellowweed, snakeweed, and gumweed. These and similar plants frequently occur in abundance over large areas of range and indicate that the range needs careful management to give better forage plants a chance to grow.
3. The presence of dead and partly dead stumps of shrubs, such as snowberry, currant, willow, serviceberry, birch leaf mahogany, and Gambel-Oak. This condition usually indicates that the most palatable grasses and weeds have been overgrazed. There may be some exceptions to this, as in the case of dwarfed willows on ranges where grasses predominate above the timber line. Sheep sometimes kill the willow before the grasses are damaged.

4. Noticeable damage to tree reproduction, especially to Western Yellow Pine reproduction on sheep range and Aspen reproduction on cattle range. Provided the natural conditions are favorable to aspen reproduction, lack of this growth, on a weed sheep range indicates overgrazing. On a sheep range where grass predominates, severe injury to Western Yellow Pine or aspen reproduction may indicate that the range is not well suited to sheep.

5. Erosion and barrenness, accompanied by a network of stock trails, where formerly there was a cover of vegetation. These are typical of areas where overgrazing has reached the extreme stage.

These conditions are perhaps more typical of overgrazed sheep range than of overgrazed cattle range, but the general appearance of the two does not differ greatly when overgrazing reaches a stage to be recognized by one or more of these "earmarks". The main difference is that the weeds eaten by sheep are often found in abundance on overgrazed cattle range, while coarse grasses palatable to cattle are often abundant on overgrazed sheep range.
Prevention of Overgrazing.

It will be noted that all of the above are indicators of damage already accomplished. Unfortunately, there is no way in which we can ride over a range and in one inspection be sure that no damage is taking place. On the other hand, the man in charge of the range can be sure on this point. If he has followed a few simple precautions to prevent it, there will be no cause for overgrazing. These precautions are:

1. No range should be used before the grass is two weeks old or until the soil is reasonably dry.
2. No range should be grazed so heavily that there is mechanical injury to the grass through trampling or close cropping.
3. In all the normal years the stock should come off in good condition with some little feed left on the range.
4. The grass must have a chance to form seed at least every three or four years, and the following spring the seedlings should have a chance to grow, as will be more fully discussed under the subject of "Deferred and Rotational Grazing". (See page 45, Pasture Management)

If these simple precautions are followed over all parts of the range, the stockmen may be reasonably certain that his range will retain its productive capacity, or even improve, and that the indications of overgrazing, as described above, will not appear. If these precautions are not followed we may feel sure that overgrazing is taking place although the direct evidence may not appear until later. (5)
Undergrazing

A general failure to secure full utilization of forage where a range is accessible is usually due to an insufficient number of the class or classes of stock to which the range is best suited. One class of stock might utilize fully the forage suited to them, while forage suitable to another class of stock was being wasted. Additional stock of the class already on the range would result in overgrazing. The solution is common use by the classes of stock to which the range is best suited. (8)

Carrying Capacity.

The western ranges are generally of a low carrying capacity. Outside of the heaviest timber and roughest mountains, about thirty to forty acres of mountain or forest range are needed for one cow for one season during the summer grazing. Spring and fall grazing must be provided for on the lower hills and plains. In regions of fifteen inches or more of rainfall, it requires from ten to fifteen acres for one cow during the season, or from twenty-five to fifty acres for one cow if the rainfall is around ten inches. If no hay is used for winter feed it will require an additional twenty-five to fifty acres to carry a cow through the winter. Under favorable conditions one ton of hay and forty acres of grass will support a cow through the grazing season. Selected tracts might do better. Generally, a fair ratio between sheep and cattle is five to one. That is, five sheep will consume about as much as one cow.
Management of Cattle on the Range

The first step is to see that the range in question is suited for cattle and that it may be reasonably expected to afford satisfactory grazing for the number on hand for the entire season from the time the cattle come off of hay in the spring until the snow falls in the winter and forces them to go on hay again. This may require quite a little adjustment, but the business cannot be on a permanently profitable basis until it is done. There has been entirely too much buying and selling of land on a speculative basis, but there needs to be much buying and selling with a view to build up ranches on which stock can be handled efficiently and profitably for the entire twelve months of the year.

The number of cattle must be adjusted to the capacity of the range. A range will produce the maximum amount of beef per acre when there are barely enough cattle on it to consume the grass. If there are any more than this, the total amount of beef produced will be less, while if the number of cattle is doubled they will live but make no gains. In view of the fact that the crop of grass is always uncertain, more beef will be produced in the long run if we carry a few less stock than the range will support on average years. In this way, a higher quality of beef can be produced. A steer, on the average range, should gain at least one pound a day for every day he is out. One hundred steers should make one hundred pounds of beef a day. Put one hundred and fifty steers on the same range
and they will gain one-half a pound a day, or seventy-five pounds for the one hundred and fifty head. Put two-hundred steers on the same range and they gain nothing. Similarly thirty pounds of alfalfa a day fed to an eight-hundred pound steer will make one pound of beef. The same amount fed to two steers will keep them alive, but will make no gain. Many of the ranges would produce more beef and cheaper beef if they were stocked less heavily.

After these adjustments have been made the next thing to consider is the control of the cattle while they are on the range without the use of any more fence than is absolutely necessary.

The number of cattle that can be successfully run together in one herd seems to be very elastic and is in nearly all cases larger than any one cattleman is likely to possess. The Forest Service has found that cattle may be run in herds of from one-thousand to three-thousand head with entire satisfaction from the standpoint of grazing management. The majority of herds are somewhat under one-thousand, thereby causing a subdivision of the range to reduce the number of cattle running together in one herd. Regardless of the size of the herd, however, the first move toward better management of cattle, as every stockman will agree, is the separation of the steers from the breeding stock. This apparently can be done only by running them on entirely separate ranges, or by fencing.

It is already apparent, however, that a herd of cattle, even though all steers, or all cows and calves, can-
not advantageously be turned loose on a range early in the spring and left to hustle for themselves until snow comes. Cattle often form bad grazing habits. They select the lower meadows, in the spring, where the grass and water are the best at that time and there they stay; staying at first because the best feed is there, but after that staying from habit and encouraged by the common practice of salting the cattle where they are, rather than where they ought to be.

Salting Plans

Cattle have a natural craving for salt, which may be used as a convenient means to put the cattle where they are wanted, instead of encouraging them to stay on old stamping grounds. Most cattle ranges contain areas of widely different altitudes and exposed, and in fact must do so if satisfactory grazing is to be provided for the entire season. It therefore becomes advisable to arrange the salt troughs in several series; one series on the lower or earliest range, another on a somewhat later range, a third on a still higher range, and so on as far as may be necessary.

Within each series some care should be taken as to the placing of the troughs. The salt troughs should practically always be fixed on the ridges and a considerable distance from water, so as to counteract the habit of standing around the water holes. The range should be carefully inspected and the troughs placed on the areas that are undergrazed. This will require more work in distri-
buting the salt than where it is dumped at the nearest waterhole and it will also require some work to see that the cattle find it. Usually, however, it takes but little driving or calling to bring the cattle to a new salting place, and when once there they usually remain.

In distributing salt the main object should be to secure uniform utilization of range between salt and water over the entire range unit. The distance of salt from water will depend upon water distribution and topography. No set rules can be laid down. The problem must be worked out on the individual range unit so as to secure the most uniform grazing possible and limit, as far as practicable, congregation of stock and overgrazing around water holes, salt grounds, and natural passes. Ordinarily, salting places should not be more than one mile apart, and occasionally salting places well chosen at distances less than one mile apart will result in the use of range which otherwise would not be grazed until the more accessible parts are overgrazed.

As the season advances and it becomes desirable to work the cattle back to later ranges, the first series of salt troughs should be abandoned and the salt placed in the second or higher series. Here again, some driving and calling will be necessary that the cattle may learn the new salt trough and at the same time the new range. This work will be made easier, however, if care is taken that all of the salt in the first series of troughs has been consumed and the cattle allowed to become a little
salt hungry before being moved to the second range. All this requires work and attention, but it is well repaid by the better distribution of the stock and the consequent better use of the range. It is also much cheaper than fencing into small tracts.

Many of the old time range riders take pride in pointing out areas where "the grass looks good to a tender-foot, but the cattle will not eat it". With the exception of pine grass and one or two other species of very minor importance, this is a mistaken idea and these undergrazed areas are usually in that condition because they are too far from salt or water, and because the cattle have formed the habit of grazing elsewhere. Likewise, the overgrazed areas are not necessarily areas of more palatable grass, but are areas on which the cattle have become accustomed to grazing. Much can be learned from a study of the natural habits of cattle, but too much dependence should not be placed upon it.

It now seems fairly well demonstrated that cattle can be handled to maximum advantage in many cases through the distribution of salt and water, and without fencing, except for the outside boundaries of the range and for the separation of steers and heifers. Not only does proper handling of salt and water enable the grazing men to prevent local overgrazing and undergrazing without fencing, but it offers him an economical and satisfactory way of putting into practice rotational grazing.
Salt and water have their greatest effect on the distribution of cattle where the ranges are large and of low carrying capacity and where fencing would be very expensive. On the other hand, this method is least effective where the carrying capacity is large and a large number of cattle are run on a small area, but under these conditions fencing is usually possible without prohibitive expense. Fencing, however, does not eliminate the necessity for care in salting. There are many hundred-acre pastures where moving the salt trough would be a very great improvement.

Proper salting alone cannot be expected to bring about a perfect distribution of cattle on the range, but, everything considered, it offers the greatest possibility for immediate improvement with a minimum of expense and delay.

Amounts and kinds of salt. Cattle should have two pounds of salt a month while the grass is very green, and one pound a month during the remainder of the season.

All kinds of salt have been successfully used for range purposes, but the general preference is for a coarse granulated salt of the kind commonly called crystal sack salt or rock salt.

Salt Containers. Salt is usually placed in long log troughs or in board troughs. It is often placed on the ground, but this requires more frequent salting and wastes considerable salt. On level or prairie ranges the troughs can be made of two inch lumber and hauled to the place where needed, while in mountain and timber ranges troughs made of logs are more economical. It does not take a great deal of work with a
sharp adz and axe to make a good trough, and it is generally possible to find logs in suitable places so that they need not be moved. On large ranges where the salting is done by hired labor, it is a great advantage to number or name the salt boxes. The owner may then give definite instructions as to where to put the salt and will know when those instructions have been carried out. A map of the range showing the location of the troughs is a great convenience.

Storage of Salt. Many ranges are almost inaccessible to a wagon in the spring. In such cases salt should be hauled and stored the previous season, as it is especially important to have a good supply of salt on hand during the early spring months when the cattle need it most. It is not difficult to build small cabins or storage boxes in which a considerable quantity of salt may be stored for future use.

Water

The water supply influences the distribution of cattle and the consequent utilization of forage more than any other single factor. Unfortunately, the control of watering places on a range is limited, but improvements can usually be made at a reasonable expense. Springs or seeps which naturally furnish water only in small puddles or cow tracks will furnish clean water for a number of cattle if fenced and the water piped to a trough. In some places water for midsummer is obtained by collecting into storage tanks early in the season, water from small meadow areas which dry up in the midsummer months. Range is valuable. It cannot be used by cattle without water. It should not be considered permanently
usuável until exhaustive considerations has been given to possible ways of water development.

Fences

Very often fences are the most effective and most economical means of controlling cattle on the range. In fencing, however, the first consideration should be given to fences to provide control which is vital to the range as a whole. The important objects of fences within the unit are: 1. To make possible seasonal grazing and deferred and rotational grazing. 2. To segregate breeding stock from dry stock. 3. To protect stock from poisonous plants. 4. To hold pastures for stock during a round-up. 5. Reserving pastures for saddle stock. 6. To provide economy in handling the stock and in supervision of grazing. These possible needs should be considered in working out the fencing plan for each unit. Protection and the best use of the range resources should be given first consideration. (8)

Riding

The riders should see that salt is always available, and that watering places and fences are in serviceable condition. After this they should see that the stock are kept well distributed and that they use all parts of the range. Occasionally it is necessary to herd stock away from dangerous poison areas, and attention may be needed to keep the bulls properly distributed with the breeding stock. Losses from any cause should be watched for, the cause determined if possible, and preventative measures taken. Carcasses of dead animals should be burned or buried as a
protection to the health of remaining animals.

The number of stock one rider can look after varies from about two hundred and fifty to one thousand head, depending upon the range. The ideal to work toward is about two hundred and fifty, or three hundred head of high grade stock accustomed to being worked. One man can then distribute the stock in small bunches where feed is best, see that bull service is adequate, and look after the general welfare of the stock so that losses are negligible and net returns per animal are at a maximum. (9)

Management of Sheep on the Range.

In the handling of sheep with a herder, the problem of preventing overgrazing and of practicing rotation grazing is comparatively simple, since the sheep are always under the control of the herder and may be grazed wherever he wishes. The general principles are of course the same as with cattle and further discussion of these factors is not necessary except to say that a well thought out plan of grazing is essential and that it is especially helpful to have maps showing the various camps and watering places. The very fact that sheep are in charge of a herder, however, brings about certain problems not encountered with cattle. As early as 1909 investigations conducted by the Forest Service showed that mountain summer range grazed by sheep, under fence, supported from 25 to 50% more sheep than were being grazed on the same acreage of similar range on which the sheep were herded by the met-
hods practiced at that time. It was also found that the pastured sheep gained from five to eight pounds more in weight than the herded sheep. From four years study of the actions of the sheep both in pastures and under different methods of herding on unfenced range, it was concluded that the great difference in grazing capacity and in the growth of the sheep, as between pasturing and herding, was largely due to the following conditions:

1. In the pasture the sheep were bedded down where night overtook them instead of being trailed for a considerable distance to an old bed ground with consequent damage to both the sheep and the grass.

2. In the pasture the sheep did most of their grazing early in the morning and late at night, while the herded sheep commonly had to spend much of this time in camp.

3. In the pasture the sheep tended to bed on the open ridges instead of down in the canyons where the herders usually prefer to camp.

4. The sheep in the pasture grazed quietly in open formation instead of being crowded together and disturbed, which interferes with their grazing and needlessly tramples the grass. (4)

These important benefits can fortunately be obtained through the adoption of better methods of herding and without resorting to fencing, which is always expensive and often impossible. In addition, the herder may give more attention to keeping lambs and ewes from being separated, keeping off predatory animals, and giving assistance in
many ways. These better methods of herding have been tried out in many experiments and perhaps fifty percent or more of the sheep grazed within the national forests are now herded under improved methods.

Herding

The essential things to be accomplished in better herding have already been indicated in the comparison of herding with pasturing; namely, 1. Do not bed more than one, or at the most, two or three nights in the same place. 2. Permit the sheep to graze early in the morning and late at night. 3. Bed the sheep on the ridges rather than in deep canyons. 4. Do not crowd them together in a close, compact band.

In many localities, especially in the Southwest, these things are accomplished through what is known as the "burro system", in which the herder remains with his sheep all the time, carrying his entire outfit on a burro that has been trained to stay with the sheep. American herders, however, often do not take kindly to this system, and where feed is good and the range not too heavily timbered, or brushy, good results are obtained by what is known as the "blanket" or "bedding out" system. In this system the herder has a central camp where he does most of his cooking, and which is moved by the camp tender every few days, but every afternoon he puts his bed and tepee on his saddle horse and moves out to the place where the sheep are to be bedded. He thus stays with the sheep all of the time except for a few hours in the middle of the day.
The sheep are allowed to begin grazing soon after daybreak so that they will fill up before the heat of the day. Their course of travel is directed by the herder, and if necessary, the leaders are checked so that the herd will spread out quietly over an area sufficient to provide forage for the morning. The herder moves quietly around the outside of the herd, keeping track especially of the leaders, but not disturbing them except where necessary to check them or change their direction. Special care should be taken to prevent crowding the sheep together, and the use of dogs is really not necessary except in cases of emergency. Open herding is not more difficult than close herding, and the saddle horse largely replaces the dogs.

Between seven and nine o'clock in the morning during the summer the sheep usually settle down to rest. They will not move far during the warm part of the day and need not be disturbed, but the herder goes around the outside of the band occasionally to see that none of the sheep are straying off.

While the sheep are resting, the herder has several hours, during which time he returns to the supply camp and does his cooking and camp work for the day. Herders who follow this plan usually eat two meals a day at the supply camp, one upon arrival in the morning and one before leaving to round up the sheep for the night. The supply camp should be close enough so that the herder will be able to go around the band occasionally while they are resting, which means that the camp will have to be moved frequently. During these
scouting trips a bedding place for the night is selected and the tepee, bed and salt for the sheep are moved to the new location.

The site for the bed ground should be comparatively open, free from down timber and brush, and larger than the actual bedding space required. On an open site the lambs can find their mothers with the least difficulty, there is less danger from attack by predatory animals, and there is less danger of a "pile up" or of crippling of sheep in case the band is frightened during the night.

High dry mounds or ridges make the best bedding grounds. Sheep bedded in canyons with adjacent open or fairly open country have a tendency to leave the bed ground and drift to the ridges, but, on the other hand, they rarely drift far from a ridge into a canyon. Where there is much heavy timber and brush, small openings are of vital importance, and their locations should be known and grazing so planned as to use them to the best advantage.

In gathering the sheep in the evening it is important that the herder circle the outermost tracks made by the sheep during the day. From this outer circle the sheep are turned toward the site selected for the bedding grounds. Stragglers and isolated sheep are collected into a loose band near the bed ground. They may then graze in this formation until they bed for the night. Meanwhile, the herder moves about them constantly counting the bells and markers and watching the ewes and lambs. Lambs that cannot find their mothers, or ewes that cannot find their lambs, in a reasonable time,
are indicators that the sheep are not all in. Care in rounding up the sheep at night cannot be overemphasized. The greatest losses occur from leaving small bunches away from the band, subject to attack by predatory animals. There is, however, less loss from this source when the sheep are bedded but one night in a place than where a central bed ground is used. Predatory animals seem to gain courage with familiarity and are more apt to attack after the sheep have been bedded a few nights in the same place. Also sheep are more apt to stray away when bedded on an old ground where the grass is all gone.

We recognize the fact that on some ranges the topography is such that it is difficult or impossible to handle the sheep in the most ideal manner. Also, many sheepmen have been unable, as yet, to persuade their herders to adopt new methods. The fact remains that the best lambs are obtained only when the conditions above outlined are met to at least a reasonable degree. The extent to which the best interests of the range and of the lambs are to be sacrificed to the convenience of the operator is a matter for discussion in the individual case.

Watering

The length of time sheep may be away from water depends upon the character of the forage and the weather. On high mountain summer ranges, within the National forests, sheep have been grazed successfully during the entire summer without water, but they must be handled very carefully, and they do no make the best gains under these conditions. Ordinarily,
when the vegetation is succulent, the weather cool, and heavy dew is frequent, sheep do not require water oftener than every three or four days. However, during the hot, dry days, they will do best where shade, forage and water are convenient, and such places should be reserved for this period. Cool weather and storms ordinarily make watering oftener than every three or four days unnecessary, and barren stretches at some distance from water can be grazed to advantage. (3)

If the sheep are herded as suggested in the preceding paragraphs, watering oftener than every few days is not only unnecessary but may not be for the best interest of the sheep, especially if they can reach water only by traveling several miles into deep canyons. In going to water they should be grazed, rather than driven, and should reach water in the late morning or midafternoon. An hour on water during these periods of the day is sufficient. After this they are moved away so as to avoid unnecessary contamination of the water.

Salting

About one-hundred pounds every five days for twelve hundred ewes and their lambs should be the minimum. Salting every night on a new bedding ground helps to make the sheep contented during the night and is to be advised wherever possible. In any case, salt should be given at least every five days. It should be distributed, one or two handfuls in a place, on rocks, clean ground or grass. Sand or gravel in the salt may result in marked injury to the teeth. If salt is distributed in small piles, before the sheep arrive at the salting ground, there will be comparatively little waste, and all of the sheep will get salt in a short time.
Stock Poisoning Plants and Their Control

The annual toll of the poisonous plants is surprisingly heavy, and with the increase in livestock values the seriousness of these plants becomes greater. On the open ranges the losses from poisonous plants is much greater than that from infections and contagious diseases. Losses from these plants are also said to be much greater than those caused by predatory animals.

Every stockman should know the leading poisonous plants, finding out where they grow and why they cause poisoning, then so manage his stock that they do not have access to dangerous plants. This is an underlying principle of a rational policy in stock management to avoid losses from poisonous plants. Cure must not be relied upon. They are too uncertain even if poisoned animals are discovered before death. Fully half of the deaths due to poisonous plants occur before the suffering animals are discovered by the owners. (11)

Conditions Affecting Stock-Poisoning

The condition of the poisonous plant, the condition of the animal, the season of the year, and abundance of feed are the big factors in the stock management problem. These factors vary so much in different localities and from year to year that the farmer should regard his own problems as demanding his own personal study. Some of the most important points to be kept in mind may be discussed here.

The Plant. It is not enough to know that a certain plant contains a violent poison. One must also consider
whether plants are likely to be eaten in the pasture or on the range, or at the season of the year when dangerous, and whether the poison is contained in the part of the plant usually eaten. For example, larkspur is most dangerous before blossoming time; the poison in the water hemlock is mostly in the rootstock.

The Animal. Young animals are more susceptible to poisoning than old ones, and animals new to a locality are more likely to eat poisonous plants than those familiar with the region. Sheep are thought to be immune to larkspur poisoning. Cattle are probably just as susceptible to death camas poisoning as sheep, but because of their larger body-weight the cattle seldom get a sufficient amount to cause poisoning. Hungry sheep or a band driven hurriedly through lupine are more likely to eat a large amount of the conspicuous plant than if they were well fed, or allowed to drift slowly through and select their feed more carefully.

Scarcity of Feed. The presence of good grass and forage in fields where poisonous plants are known to grow explains the absence of poisoning when it might otherwise be expected. It is known that larkspur, water hemlock, wild cherry, and milkweed are all more likely to be eaten when there is little else to eat or where they form the conspicuous vegetation. (12)

Prevention of Poisoning

Since scarcity of feed is by far the most important reason for the eating of poisonous plants by stock, every possible effort must be made to avoid the conditions which are likely to cause feed shortage such as over-grazing,
overstocking of the ranges, leaving stock on the range after the feed is eaten, using the same driveways or bedding grounds too often, or turning stock onto the range too early in the spring or when the snowfall has covered the grass. Special care must be observed during the dry season which yield a poor growth of forage. Cattle must be prevented from acquiring the common habit of feeding in certain sections of the range and depleting the forage there in spite of the presence of better pasturage on the same range at no greater distance. The best rules to be observed in managing stock so as to minimize the danger of poisoning may be summarized as follows:

1. Use the range when the plants are least poisonous. Death camas dries up after blossoming and fruiting time, so that the danger period has passed by May or June. Larkspur may persist until late summer or fall. The lupines are most dangerous in late summer or fall.

2. Graze areas infested with poisonous plants with stock not affected by these plants. Cattle are not affected by death camas and sheep are not affected by larkspur to any certain extent.

3. Supply additional feed if range is short; handle stock quietly; avoid excessive driving or rounding up with dogs; avoid grazing in mass formation.

4. Use a new sheep bedding ground each night.

5. Eliminate the fixed driveway, wherever practicable.

6. Eradicate poisonous plants or fence the area.

7. Inspect all your fields and pastures for the presence of poisonous plants. (11)
This is the most common of the low larkspurs, extending from Colorado to the Sierras, and causes heavy losses of cattle.
The Principal Poisonous Plants

Lack of space will prevent a thorough discussion of all poisonous plants found on the ranges. However, the major ones, causing the greater amount of damage will be taken up and discussed.

Larkspur - *Delphinium menziesii* and other species.

The larkspur species of the western ranges can be divided into two groups, the tall and the low larkspur. The former species prefers the moist, sheltered gulches and canyons of the higher ranges. The low larkspur grows on open hill-sides, in drier localities than the tall species, and at somewhat lower elevations.

It is probable that more deaths among cattle on western ranges are caused by larkspur than by any other poisonous plant. So far as observations and experiments show, sheep are never poisoned by larkspur; on the contrary, the plants are considered to be good forage for them.

All the parts of the plant above ground are poisonous; most of the trouble is caused by the leaves, but sometimes by the flowers also. The seeds contain more active poison than the rest of the plant, but they hardly ever cause death as they are readily disseminated upon reaching maturity and are not sought for by stock.

Experiments with feeding larkspur show that an animal must eat about three per cent of its own weight in order to be fatally poisoned. Thus, an animal weighing 800 pounds would have to eat about twenty-five pounds of the plant, although the fatal dose varies with the age of the plant, and the condition of the animal.
Tuber Water Hemlock (Cicuta Vagans)

The species of Cicuta growing in the northwestern part of the United States. Cicuta, commonly known to stockmen as parsnip, is the most poisonous of all our native plants, and grows in damp valleys and along irrigating ditches.
TUBER WATER HEMLOCK (CICUTA) VAGANS

Young plant with the rootstock, and a longitudinal section of the rootstock. By the transverse chambers shown in the longitudinal section of the rootstock the Cicuta can readily be distinguished from any other plant growing in the same locality.
Larkspur poisoning always causes constipation, and recovery usually follows if this condition can be relieved. Bloating occasionally occurs, and sometimes death is caused by choking. Animals poisoned by larkspur fall in a peculiar manner; the fore legs give way, and the animal supports itself by its head, and by spreading its hind legs. The entire body quivers, there is a lack of muscular control, excessive salivation, weak, rapid pulse, and evidently extreme pain in the abdomen, probably due to constipation.

The larkspur can be eradicated by grubbing, cutting or grazing the area by sheep. The grubbing can be done for as low as four dollars per acre or as high as fifteen dollars per acre, depending on the costs of labor. Hungry cattle should not be driven over infested areas. (4)

Water Hemlock - Cicuta vagans and other species.

This plant is found only in moist or wet localities, as along the banks of streams and irrigation ditches, in swamps, and on wild, moist hay land, usually in isolated patches.

Although there is a considerable difference of opinion among investigators as to the number of animals poisoned by water hemlock, there is no doubt that all of the higher animals, including man, are susceptible to the poison. A large proportion of the animals poisoned by water hemlock die, for there is small chance of saving them.

Investigators differ again as to the toxic properties of the stems and leaves of the water hemlock. The general opinion, however, is that the whole of the plant is poison-
DEATH CAMAS (ZYGADENUS VENENOSUS)

The Meadow species of death camas growing most abundantly in the Pacific States
ous, at least during the early stages of its growth, although there is much less danger in the part above ground. Most of the poisonous principle of *Cicuta* is contained in the root, which is so virulently poisonous that a very small amount appears sufficient to kill any of the higher animals.

Symptoms of *Cicuta* poisoning are frothing at the mouth, excessively urinal flow, very violent convulsions, arching of the back and evidence of severe pain. The breathing is apparently labored and the heart action irregular. The action of this poisoning is very rapid. Cattle have been known to die within fifteen minutes after the first symptoms appear.

Because water hemlock grows in wet soil, and the roots are only about six inches below the ground it is an easy matter to eradicate the plant by grubbing. If for any reason grubbing is impracticable, it is not difficult to fence stock away from infested areas, for it is almost invariably confined to isolated patches. (12)

Death Camas - *Zygaenous elegans* and others.

Species of death camas are frequently found in shallow depressions or ravines along the slopes of hills and mountains and grow either as scattered specimens mingled with other vegetation, or in masses, sometimes covering several acres.

Most of the losses of stock from death camas poisoning occur among sheep, taking place early in the spring, before other forage plants are abundant, and on ranges which have been overgrazed.

The entire plant is known to be poisonous although the bulb contains a large amount of active poison, though evi-
This is the most destructive of all the loco weeds, not because of its greater toxicity but because of its wide distribution, extending from northern Canada to central Texas, and from the Continental Divide to the western part of Minnesota. It poisons horses, cattle, and sheep.
dently less than the seed. Whether or not the bulb is eaten by sheep depends upon the condition of the ground and the ease with which the bulb can be pulled up.

The amount of death camas required to cause death depends upon the size of the animal and whether or not it is hungry. A mature sheep must eat from one and a half pounds to five pounds of the plant to cause fatal poisoning and lambs correspondingly less.

The more pronounced general symptoms of poisoning from this plant are frothing at the mouth, vomiting, restlessness, weakened heart action, irregular, spasmodic breathing, convulsions, bloating, weakness of the muscles, and general paralysis. Animals sometimes lie unconscious for several hours before death.

The best known means of combating death camas poisoning is prevention. All stockmen should become acquainted with the plant and take every precaution to keep their sheep away from it, especially in early spring before an abundance of nutritious feed is available. (11)

Loco Plants - *Oxytropis* and *Astragalus*

Loco plants are members of two genera - *Oxytropis* and *Astragalus*. The most destructive of these plants is the so-called Lambert's White, or rattleweed loco, so called because the rattling of the pods as one touches them when the seed is mature resembles the sound of a rattlesnake.

Loco weeds are among the most destructive of all the poisonous plants. Losses in regions where the purple loco is the only poisonous weed are almost entirely confined to
horses, mules, and sheep. Cattle seldom crop the plant. The effects of eating loco depend largely upon the animal itself. Some animals eat a limited amount of the plant at certain times of the year for a number of seasons without apparent harm, but others die within a few months or in a few weeks. Losses from loco poisoning are heaviest among young sheep and horses, as older animals rarely acquire the loco habit except where good forage is scarce.

Loco poisoning may be acute, resulting fatally within a few days, or it may be slow, working for months or even as long as a year. The effects of the poison are cumulative; animals never become immune to it. The first symptoms are stupidity and general loss of condition. The animals show marked lack of muscular control and become very nervous and excitable. The gait is irregular and staggering, the eyes are glassy, and the sight is impaired or lost altogether. A rough shaggy coat is characteristic. The loss of muscular control causes the animal to act in an abnormal manner, apparently seeing things incorrectly or as the exact opposite of what they are. For example, a horse will leap high over a rut in the road or crouch to pass under an imaginary barrier. It shies at nothing and runs up against obstructions. Cattle are similarly affected. They jump, start, and tremble, tossing the head violently. They become crazed, lose flesh, and death results from starvation.

The symptoms in sheep and goats are less violent. They usually become very weak and stupid, and stumble and fall, rising with great difficulty. Locoed sheep are difficult
to herd, for they tend to stray away from the flock and are often very stubborn. The fleece comes off in patches. The animal is unable to take care of itself and is liable to fall in pools of water and drown. Death results from the exhaustion following the severe convulsions. Constipation is a general symptom of loco poisoning in all animals. This can be relieved by giving a dose of Epsom salts. The dose for mature cattle is about one pound, given as a drench; for calves, two ounces; mature sheep, four ounces. Food of a laxative character such as alfalfa and oil meal should be given.

As loco plants do not reproduce from rootstocks, they may be killed by cutting off the root two or three inches below the ground. The plants are very stubborn, and the seeds long-lived, producing a continuous crop. These seeds are not carried very far by the wind; hence there is little danger of new plants starting on lands adjoining loco-infested areas.

Special care should be taken to keep young animals away from loco-infested areas, particularly where other forage is scarce. As all domestic animals are more or less imitative, those having the loco habit are likely to teach others the same habit. Therefore locoed animals should be pastured by themselves or, better still, disposed of. If grubbing out the loco plants is impracticable, either the badly infested areas should be fenced against stock, or the animals should not be herded on these lands.
SILKY LUPINE (LUPINUS SERICEUS)

Many of the species of lupine are poisonous, and are the cause of the larger part of the heavy losses of sheep during the late summer and fall months. Sheep are poisoned by eating the pods and seeds.
Lupines - *Lupinus*

The lupines are given many common names. The more common of these are blue-bean, blue pea, Indian bean, old maid's bonnet, Quaker's-bonnet, and sundial.

Lupines are found in practically all western grazing regions. They grow so abundantly in some localities that solid tracts of the blossoms are visible for miles. There are only three species in the Atlantic States and these are neither so widely distributed nor so abundant in the west, where about twenty-five species are represented. The species do not usually occur in cultivated soil or in swamps, nor often on river flats. Most of them prefer the slopes of hills, or portions of mountain ranges at moderate elevations. Most lupines are fairly good forage plants if not eaten at the poisonous stage of their growth.

A few cases of lupine poisoning of range cattle have been reported, but the majority of cases are those affecting sheep. Many heavy losses of sheep from this cause during late summer and fall are on record. One report states that one-hundred-fifty sheep out of two-hundred died from lupine poisoning. These animals were very hungry and ate the plants when the pods were developed, but the seeds not entirely ripe.

The fruit of lupines is frequently the cause of fatal sheep poisoning. Post-mortem examinations of the stomachs of poisoned sheep which have been found to contain a large quantity of the pods and seeds of lupine, prove that lupine
hay is very dangerous to stock if it is cut when the pods are fully developed and filled with ripe seed. Sheep are fond of the green pods of lupine, which have a sweet taste.

Animals poisoned by lupine become crazed, move about with an irregular staggering gait, froth at the mouth, and butt at any object in their way. Flow of urine is increased, frequently containing blood.

Lupine should not be cut for hay until the pods are ripe enough to shed their seed before the hay is stored. This may be done about the middle of August; but, if there is any doubt in the matter, one or two sheep should be fed with the hay as a test before it is given to all of the flock. It is best, however, to cut the plant when it is in bloom or not to use lupine for hay until more is definitely known about the time when the plant may be eaten with safety.

The above named plants are the major poisonous plants causing most of the damage on the western stock ranges. There are a few other minor species that cause little damage that will be mentioned here. (4)

Milkweed - Asclepias. Causes losses of sheep, cattle and horses throughout its range, and in some sections these losses have been known to be very great. It occurs in the foothills of Arizona, New Mexico and Southern Colorado. Laurels - Ericaceae. Heavy losses from "laurel poisoning of sheep are not uncommon on western ranges where other forage is scarce. The principal species are; Smooth menziesia (Menziesia glabella), black laurel (Leucothoe Davisiae), Labrador tea (Ledum glandulosum), and white laurel
For a long time the rubber weed has been believed to cause losses of sheep in northern New Mexico and southern Colorado.
This plant, especially in Utah, causes serious losses of sheep.
(Azalea occidentalis). White rhododendron (Rhododendron albiflorum), mountain laurel (Kalmia latifolia), and stagger brush (Neppieris mariana) are other species causing some damage.

Woody Aster - *Xylorrhiza Parryi*. This plant is found in abundance in Wyoming and is reported to be the cause of heavy losses of sheep. There is no doubt that it is poisonous, but, because of its tough, fibrous quality, sheep are not fond of it and will not eat it unless they have no other forage.

Western Sneezeweed - *Helenium Hoopesii*. This plant occurs readily in the Rocky Mountains, from Wyoming to Arizona, and westward to California. It causes the so-called spewing sickness in sheep. Many sheep die from this disease each year and experience has taught the stock owners that prevention is the only reliable method of remedy. As the range is built up this plant is replaced by good forage species. (12)

Pasture Management

Seeding Requirements.

An overgrazed range may be so depleted that natural revegetation will not take place. In this case it will be necessary to artificially reseed the area. Then with proper management, the range can be brought back to a profitable basis.

The best results of seeding are obtained in regions having from fifteen to twenty inches of rainfall, and a growing season of about one-hundred days, and below timber-
line. The soil should be of a fine texture, with lots of organic matter, and fairly deep.

Sowing in the fall gives the best results as the seeds germinate quicker, there is a uniform development of seedlings, and the loss of seedlings is least as compared with spring planting. By sowing at this time of the year the seed is allowed to lie dormant until the following spring when they can germinate with the warm spring rains and have a full growing season to build up plant tissue to guard against the following winter.

Seeding by means of broadcast sowing or with a small hand seeder has been proven very satisfactory methods to use. If possible, the seed should be harrowed in or if this is impracticable, merely driving a band of sheep over the area will trample the seed in sufficiently.

The species giving the best results are the common brome grasses, Kentucky-blue-grass, Timothy, Orchard-grass, Redtop, and several wheat grasses. (6)

After the area is seeded extreme care should be taken to prevent the plants from being damaged by any source. They should be protected until they are able to withstand the effects of grazing to a large extent. In mountains it may be necessary to keep the stock off the area the entire first season. On any seeded area the practice of deferred and rotational grazing should be adhered to so as to prevent another cost of reseeding the area due to overgrazing.

In order that a plant may successfully establish itself and produce seedlings, it should produce forage in the spring, and have a good supply of seed to establish seedlings with
which to reproduce itself. The practice of deferred and rotational grazing makes these things possible in the application of this method.

The essential principles of deferred and rotational grazing are:

1. An overgrazed area that supplies forage from time of seed maturity to end of grazing season, is protected from stock invasion until the seed crop has matured.

2. When the seed crop matures, the forage is closely grazed during the first season, but not to an extent which will cause injury to the seed crop.

3. The same area is protected to about the same date the next year, until the plants have become thoroughly established, before the stock are turned on it.

4. When the area is reseeded, it is grazed early in the season, and a second area of sufficient size is protected from stock until the forage has matured and the above steps followed out for this second area.

5. Alternate the grazing after seed maturity from one area to another. This allows a seed crop to mature.

The advantages of deferred and rotational grazing is that there is no lost forage while the land is being reseeded and the planting of seed insures a satisfactory establishment of seedlings. (14)

Burning of Pasture Lands.

There are many people who still have the old mistaken belief that the burning of the pasture lands every year
increases the forage production on these lands. This practice is becoming less and less each year but these few persistent stockmen cause a few words to be said at this time in the fallacies of this belief. They persist that burning is beneficial because of the following misbeliefs:

1. Burning improves the character of the forage. This is true for the first year but after repeated burnings the land is devoid of mineral nutrients and will not produce an adequate supply of forage.

2. It brings early spring growth thereby allowing an early opening of the spring grazing season. For the same reason as in number one above, the land will not produce this very long and the early grazing season is no more.

3. The burning increases the productivity of the soil due to the liberation of lime. It is true that lime is liberated, but, the valuable mineral nutrients that the plant is dependent on for growth, are also liberated.

4. The greater density right after a burn helps the watershed protection by decreasing the surface run-off. What actually takes place is that the fire destroys the valuable forage and makes it unavailable for livestock. On the other hand, grazing utilizes the forage, and prevents it from becoming a fuel for fire. The vegetation on the ground adds humus to the soil, increase the water holding capacity, and lessens the evaporation of the soil.

After a burn it is not very long until the area is covered by undesirable species such as, milkweed, fireweed,
a few shrubs such as hazel, scrub oak, and other unfavorable species. The desirable grasses are crowded out by these plants and inside of five years, as a rule, the land is covered by these undesirable plants. When this occurs the stockmen generally move to another range and repeats his malicious burning in the same way on this area until it too is no longer able to produce the valuable grasses. Thus he keeps on moving and, by taking the cream of the crop the first year after each burn on a new area, he naturally believes that the burning has created these favorable conditions. If he could just go over his area behind him he could readily see the damage he has wrought. (4)

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LITERATURE CITED


2. Barnes, Will C., Western Grazing Grounds. 1913


