

Deterioration of our
Native Pasture-lands
and Their
Remedies.

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Deterioration of our Native Pasture-lands and Their Remedies.

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Between the Mississippi River and the Rocky Mountains is a vast, almost treeless region known as "The Great Plains." It extends from Canada to Texas and within our own country is about 1500 miles long by 400 broad. It embraces a part or all of the Dakotas, Montana, Wyoming, Colorado, Nebraska, Kansas, Oklahoma and Texas. The very irregular eastern border, an irregularity due to the projection of timber belts up the river valleys, diverges toward the west from north to south, about the same as does the Mississippi River toward the east. The western border is formed by detached mountain ranges and outlying spurs of the Rocky Mountains.

While many level districts are found on the Great Plains it is by no means a level country. The surface is broken by mountains, valleys, plateaux, slopes, and bluffs. The general slope of the country is toward the east and southeast, the rise averaging 8 feet per mile. Kansas City has an altitude of 748 feet. In 100 miles west the rise is 252 feet; in the second 100 miles, is 350 feet; in the third, 1000 feet; and 1300 in the fourth. While Denver is 6100 feet above sea-level. The Arkansas River falls 500 feet from Larned to Hutchinson, a distance of 80 miles. In both the northern and the southern portions of the Plains the rise is more gradual. In general the surface is rolling, a succession of broad undulations rising 20-100 feet above the intervening hollows.

The chief drainage basins of this region consist of

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the Missouri, the Arkansas, the Red, the Brazos, the Colorado, and the Pecos Rivers with their affluents. All of these are streams from 500-2500 miles in length. The principal tributaries of the Missouri are the Yellowstone 500 miles, the Platte, 1000, and the Kansas, 300 miles in length. Those emptying into the Arkansas are the Cimarron and the Canadian 500 miles long.

This is a well-watered country. The many streams which drain the region and the large number of living springs testify to the fact. Wells furnishing water of a good quality are obtainable over most of this territory at no great depth. Some of the well water is impregnated with mineral salts but the areas in which such sources constitute the sole water supply are limited. In many places underground streams are found which should yield an abundant supply of pure water while at numerous points, artesian water may be obtained.

The greater portion of the Great Plains is overlaid with deposits of Cretaceous and Tertiary times. In the former period, the Plains were under water and great deposits of limestone, sandstones, and shales were laid down. Except for some parts which were covered by fresh water lakes, all this country was elevated in the Tertiary period. So that the deposits of the latter period are not so extensive nor so deep. But little of this region was covered by the glaciers.

The surface soil of the Plains is described by Scott as a fine, calcareous clay. In the southern part it is chief

ly a loam with some admixture of calcareous marls, in color varying from light gray or yellow to chocolate brown, red or black. In the eastern part it is a black loam while farther west it is clay like in color and appearance, a kind of bluff formation sometimes reddish or chocolate colored. In some cases chalk is intermingled, while over a large area the prevailing soil is sand washed from the mountains. Especially is this true of Western Kansas and Nebraska and Eastern Colorado. An analysis of the light colored soil made by the Missouri State Survey at 213° Fah. showed a composition of Silica, 77.02, Alumina, (Clay), and peroxide of Iron, 11.05; Potassium 1.05; Magnesium 1.63, Sodium a trace, Carbon dioxide 2.83, and water 2.43%.

The climate of the Great Plains varies considerably. The winters of the northern are longer and more rigorous than are those of the southern part. While in the South, the changeableness of the climate, the winter temperature being alternately cold and warm, make it almost as unpleasant as the colder winters of the North. Sudden lowering of temperature with severe storms known as "blizzards" or "northers" are characteristic of the country. The summer temperature in the South is a little higher and is more continuous than that of the North. In central Texas the temperature from April, 1898 to March, 1901 varied from 105° Fah., June 1900, to -6° Fah., February 1899. The mean was about 63° Fah. The Plains is a land of sunshine. While there are cloudy days, the larger number are sunny.

The rainfall is not so high as in the Eastern States. In the southern part of the Plains it is given as 20-34 inches so distributed periodically as to be sufficient for range purposes but inadequate for the best results in farming. In Central Texas the rainfall may be taken as about 2 inches per month usually highest in the spring and fall and lowest in the summer and winter. In Eastern Colorado the precipitation averaged 15.55 inches for a period from 1894-1899. It was heaviest during the summer months. The normal rainfall in the eastern part of the Plains is much higher. In the northern part, the snowfall supplements the rainfall.

This is a country of wind and storms. The air is generally in motion, often at a rate of 30-40 miles per hour. At times, especially in the late summer hot dry winds prevail. These dry vegetation very much. The rains come with wind storms often and in summer quite generally following a hot, dry period. Those dashing rains do not soak into the soil so as to be of great advantage, but pour in raging torrents down water courses which except at such times are prevailingly dry.

The vegetation of the Plains is mostly of the Xerophytic type. Almost all plants native to this region are well prepared for the retention of moisture. So that the various cacti and other arid region plants are characteristic of the drier part of the Plains. Trees are scarce being found chiefly along the streams and are mostly cottonwood, willows, and on higher lands, mesquite. Some of the various shrubs found here are capable of furnishing forage

for stock. Herbs, chiefly grasses but also many kinds of weeds and forage plants are the predominant plant growth. The vegetation in the more typical districts of the Plains tends to be bushed. This is noticeable in the grasses due probably to the scarcity of water rather than to their natural characteristics.

The chief grasses of the Plains are the Agropyrons, the Andropogons, the Aristidas, the Bromes, the Boutelouas, Buchloa, the Chaetochloas, the Hilarias, the Panicums, the Poas, the Setarias, and species of Sporobolus. The most widely spread are Buchloe dactyloides, our common Buffalo grass, the Andropogons; scoparius, the little bluestem, furcatus, big bluestem, and nutans, the bushy bluestem, and the Boutelouas, especially hirsuta, hairy gramma and oligostachya, blue gramma.

Buffalo grass forming a thick mat of short grass is found where other grasses have been trampled out. Hilaria cenchroides and Bouteloua curtipendula are common in the southern part of the Plains. Almost any grass will do well in the eastern part and most species are found. In the South, Panicum sanguinale, Panicum Crusgalli, Panicum texanum, Hilaria mutica, Aristida fasciculata, Poa arachnifera, and Bromus unioloides are the chief native grasses. Bromus inermis does well in the moist part of this country but is not well adapted to the dry region. Some of the Agropyrons do well in Colorado and the more arid portion of the Plains.

The Great Plains are preëminently the range country of North America. Here is a region long noted as a distinctively pastoral one. From the earliest known times live stock, first buffaloes and antelope, and, later, cattle and sheep, have lived upon these prairies and pastured on the luxuriant vegetation.

Some years since, owing to the low price of cattle a great deal of the range country was broken up and devoted to farming and crop production. While some parts of the Plains are excellent farming land, the greater part especially of the western half of the Plains is not well suited to such purposes. The soil is liable to blowing in times of high winds and the moisture is either scanty or not well distributed throughout the year. Thus these attempts at farming have not been successful and much otherwise valuable grazing land has lost in value. Success may be accomplished by means of irrigation or of the Campbell system of cultivation. However the slope of the land, the average slight rainfall, and the character of its vegetation stamp this as the range country par excellence. If it is allowed to remain in grass and a sufficient water supply is secured, together with forage crops the country will continue a very prosperous one.

As a range area the Plains are very important in the business of our country. The wool and mutton of the western sheep have a great influence upon the markets in America. The cattle industry of the Plains is the mainstay of our beef production. Many parts are well adapted to

dairying but the production of beef is naturally the leading one. The country may some day produce the feeds and fatten its own stock yet it will for long continue the territory from which comes the raw material. Stock are taken to the fattening pens in other parts of the country from here and hence the Plains remains the great cattle producing region. Because of its importance as such, its problems are amongst the greatest to be solved in American agriculture.

When the first settlers came to this country, the Plains were found to be covered with a dense growth of vegetation chiefly grasses of which the predominant type was the perennials. The grasses upon the Plains are naturally of a great variety of species appearing in succession from February to November. The very favorable climatic and other conditions encouraged the growth of these grasses which would ripen and cure in the fall into hay of the best quality. This was available for stock throughout the winter, providing, usually an abundant winter pasturage. The best grazing grasses were developed by a process of natural selection and survival of the fittest. The encroachment of weeds, thorny shrubs, cacti, and mesquite was prevented by the denseness of the grasses and to some extent by fires set by Indians in the early spring.

In those days the country was inhabited by a roving people, chiefly hunters. The country itself was naturally a great pasture, stocked with immense buffaloes.

deer, and antelope. With the advent of the settlers the Indian and the buffalo were driven from the country. For many years especially in the Southwest there was little stock on the ranges. So the grass grew luxuriantly. In the early '80's the grass was often 4-6 feet high even upon the dry uplands. In some places, at this time, the land would support 300 head of stock per square mile.

Conditions, however, have changed over this region. It is no longer one great range but is divided into countless pastures and ranches. It was believed that stock enough to destroy the grass could not be put upon the range. Here men were mistaken and as a result the grasses no longer grow so luxuriantly and the carrying capacity is greatly reduced. Land which in the '70's had a capacity of quite 160 head of mixed stock per square mile had so far deteriorated that in the latter '90's it was considered as having a capacity of 40 head of mixed cattle in the proportion of 10 cows with calves, 15 yearlings and 15 two year olds. This difference was produced by the heavy overstocking to which the land has been subjected. In another district the land which had been covered with abundant perennial grasses is now almost denuded save for some bushes and a few annual grasses.

At present conditions vary much according to locality and care of the pastures. In one district the capacity as reported by 300 stockmen was about 64 head per square mile.

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From eastern and central Kansas the capacity was reported as 125-200 head per square mile. The leading grasses are the bluestems, grammes, and buffalograsses. From Colorado, which is typical of the drier part of the Plains, the range is reported ^{as} dry. The grass is green but a short time in the spring and early summer, and the capacity is 40-60 head per square mile. The grasses are the bluestems, the grammes, buffalo, and June grass. The condition of the range is somewhat poor, short and often thin grass, and, in some places the capacity is but 16-40 head depending upon the quality of the soil. One observer believes that probably no species has permanently disappeared from the soil although for a time they seem to be eaten out. He reports that in the sand hills, bluestems and some drop seed grasses are the chief dependence for forages. The dominant grasses vary from year to year in any given area. Bluestems may fail to ripen seeds and thus disappear. Curly mesquite which endures drought and hard usage itself may be killed and rotted out by a cold, wet winter. Needle grass, a drought resister, may be destroyed by wood lice. And early autumn fires may burn the entire seed crop.

Since the Plains is and must naturally continue to be a distinctively grazing country, we are interested in studying the causes of the deterioration referred to in preceding sections. The one chief cause of the deterioration is the overgrazing of the land. In addition to this, animals such as prairie dogs, rabbits, gophers, and grasshoppers, and plants such as cacti, weeds, and shrubs, have contributed a share in the great destruction of grass lands. To some extent the question of a water supply enters in. All, however, are either consequent upon or related to the subject of overstocking the land.

So luxuriant were the grasses in early days that men thought enough stock to eat all the grass could not be put upon the land. So impressed were they with the wonderful growth of the grass that its possible destruction was simply incredible. And because the range was free they bought all the cattle they could and pastured them on this "free grass." There resulted an enormous development of the cattle industry. Some made fortunes and men seemed almost maddened by the desire to easily and speedily gain wealth. In a few years the capacity of the land had been reduced from 2-300 head per square mile to about 20-30 head. Such were the conditions in the Southwest and to a great degree all over the Plains.

The overstocking was caused chiefly by the fact that the early cattlemen could use the land rent free. And since cattle were at a good price it appeared to him a veritable bonanza. The land was owned either by the government or by non residents

who were in ignorance of its real value. The stockman, surrounded by free grass, with an uncertain tenure, made the most of his opportunity. He was not concerned about keeping up the condition of the land. Rather he sought to get all he could while he was the occupant. The land was therefore overstocked and the best natural grass country in the United States was well nigh destroyed. As the grasses became poorer and at the same time the price of land began to fall, he raised more stock hoping to make as high a profit as formerly. Finally there was a reduction of the stock upon the range due to the poor returns of the business.

Then followed a period when the land was occupied by the owner or by a lessee. The owner if not too ignorant and not like some cattlemen who believe they can use their land for a time, sell it to farmers, and move to new grass regions, gives some care to the land and does not overstock the grass. Cattle again rose in value and another period of speculation followed. Again the ranges were heavily overstocked. Much of the land was leased and the lessee gave the land but little better care than did the more transient occupant of the "free grass" land. He, too, seeks to make all he can from the soil with the least possible care.

In some parts of the Plains, there has been a great development of the hay industry upon irrigated lands. This provides winter feed for adjacent ranges and a larger number of stock may be kept. This increase has been too great for the land so that the grass has been killed out as it could not produce seed. In this way useless weeds and plants have been

enabled to come in.

Most stockmen are ignorant of problems connected with the soil, the grasses, and the conditions upon which their occupation depends. They study their livestock and appreciate the value of the study. But they are not only unacquainted with the soils and soil conditions, grasses and their habits of growth, and other agrostological conditions, they do not even care to learn. Thus without such knowledge they have continued overgrazing, believing that with another season everything would be more favorable.

Another cause of the deterioration of our grasslands has been the increase in pests which destroy the grass. Chief of these are rabbits and prairie dogs. So long as the grasses were not overpastured they were able to withstand these enemies. But in connection with the overstocking has come their increase, an increase due to the killing off of their natural enemies, the wolves and coyotes. These destroyed many sheep and young cattle and were therefore killed off. The destruction of the natural food supply of these pests has caused an increase in their attacks on grass.

With the extermination of the grass has come an increase of weeds. Their growth is thus favored as they are not liked by cattle and so have a better chance to survive. Cacti and mesquite trees have likewise increased freely and have taken the place of our more valuable grasses and forage plants.

The water supply has had a share in this destruction. So long as stock must go a long distance for water they will tend

to pasture closely the grasses near the water and neglect those some distance away. At the same time the grasses near the water holes are severely trampled. The upland grasses contain more real nutriment than do those of the swampy land but they will be neglected unless near water. Cattle had rather starve for food while near water than risk water starvation in a good grass country.

As a result of the deterioration of the range the capacity for live stock has been greatly reduced. A reduction of 50% is by no means uncommon while in some cases land is scarcely able to pasture more than 10-20% of its former capacity. Land which would afford pasturage to 150-300 head will now accommodate 20-60 head per square mile. Such a deterioration is a serious loss to our live-stock industry.

Stockmen were unwilling to give up their belief in the wonderful capacity of the land and the number of head pastured in many cases far exceeded the ability of the land to sustain. Naturally there were large losses of live stock. The pasturage lasted but a few months then became so short that stock could not gain a sustenance and died of starvation. Where feed for winter and droughts has been provided the losses have not been so severe.

The reduction in the capacity is occasioned by the injury to the grasses themselves. This injury may best be appreciated by a few instances. In one of the great grazing regions of Texas the early grasses were bluestems and sage grasses. These were overpastured and the needle grasses took the country. With further overstocking and trampling these gave way and the mesquites became the

chief grasses. These will endure a great amount of trampling and hard usage. Thus the occurrence of any of these as the dominant grass is one index to the state of the land and what stage overstocking and deterioration has been reached. If it be carried too far these grasses give way to weeds and practically worthless annuals.

While Arizona does not properly belong to the country under consideration yet its problems are little different from those of the Plains. One valley in Arizona had been covered with luxuriant grasses but ten years of pasturing left it almost bare of vegetation. The chief perennials here are Boutelouas which in this region are slow in getting a foothold. By overstocking they have been mowed down like timber before the fire. Where not overgrazed they are still in excellent condition. In the more arid regions this overpasturing has been especially disastrous. Present capacity and not permanent condition has been considered in pasturing stock. Thus the grasses are simply being eradicated. Some have held that with an increase in rainfall these grasses will return. This will require years with stock excluded. Since a growth of top is necessary to the roots, close pasturing results in the death of the roots and thus in the extermination of the grasses especially where no seeds are matured.

Investigations in Kansas showed that overgrazing at critical periods injured the pastures. While the grasses normally could withstand the weeds yet under overpasturing the weeds gradually encroached and sometimes well nigh destroyed the

grasses. Since stock do not relish the weeds their growth is unhindered.

Reports to the Department of Agriculture from the Southwest show that the heavy overstocking keeps the grass eaten so closely as to sap the vitality of the plant. It is therefore unable to withstand such extremes of temperature and shortage of water supply as when it grew better. The best grasses were eaten to the roots and the roots were badly trampled. So the grasses could neither ripen seed nor recover from the trampling and the exposure of the roots to the air and sun. Weeds came in and the perennial grasses died out. While the land in favorable years may be pastured more heavily it is better rather to undergraze than overgraze. The former increases the value of the land and its products while the latter decreases the value.

It has also been found that the destruction of the grass allows the land to wash badly just as does the destruction of a forest. The rainfall seems to be reduced and the droughts are more frequent. When the rains come they descend with greater force resulting in the erosion of the soil and in floods. The land becomes more like a desert, the home of prairie dogs and coyotes and unsuited to sustaining man and his possessions.

Since the stock growing industry of our country is of such importance to our welfare and since the Plains is a natural home for this industry we are concerned as to means of restoring and maintaining the range. There are a number of ways of improving the pasture lands and of meeting range problems. A few of these will be considered in this article since these problems are of such importance not only to the Plains but to our entire nation. "He who makes two blades of grass grow where but one grew before is a public benefactor."

If a permanent improvement is to be effected there must be a change in conditions. To bring this about may require amendment of the laws and their rigorous enforcement. We have seen that the user of free grass or even the lessee is but little concerned about the condition of the land he uses. It will be found necessary that the land be occupied by the owner or under his supervision. If a man owns the land or intends to make his home upon it he will seek to make it more productive rather than less so.

Since cattle will overgraze lands close to water and neglect grass farther away the solution of the problem will be furthered by improving the water supply. If the branches are dammed so as to form tanks and if wells are provided where it is some distance to water the situation will be much helped. When stock do not have to go so far they will graze these otherwise neglected spots. A more equal distribution of stock will benefit all. Thus a well reg-

lated water supply will help the range problem.

The actual improvement of the grasses themselves is of more concern to us. Since the principal cause of the deterioration is overstocking the chief remedy must be reduction in the number of head pastured. Notwithstanding there are many methods of improving the pasture lands, none of them will restore the range unless the number of head of stock pastured be reduced to the actual capacity of the land or even below that point. If there is but a partial deterioration simply reducing the number of head may allow its gradual restoration. As in some cases removal for all or a part of the season with possibly some cultivation may be all that is needed. In any case the first step is to reduce the number of head pastured upon the land.

The grasses require an opportunity for recuperation. This should come at the season when they are accustomed to produce seed. It will pay the landowner periodically to rest his pastures during this season. Thus, the grasses mature seeds which falls to the ground, and increases the number of grass roots. It will often pay the owner to remove his stock during the spring and to disc or harrow the land thus enabling the grass roots to spread more freely. Unless they do have such an opportunity of maturing seed we cannot expect our native grasses to perpetuate themselves and survive the contest.

To secure the desired rest one may divide the range

into a number of smaller pastures each provided with water and grazed for a period of two or three months each year. This alternate grazing and resting of the pastures is considered an ideal method of fostering and improving the natural pasturage on a large scale. It allows the grasses to mature their seeds and perpetuate themselves liberally. Those rested during the spring enable the early grasses to perpetuate themselves. Likewise the autumn and winter pastures may be improved. With this method, it is found that the range constantly improves while if all portions are accessible at all times there is a steady deterioration. It is claimed that land thus treated will carry more head, keep them better, and that the increased number of marketable stock more than repays the extra cost. This method is certainly worthy of trial by the ranchman in his attempts at range improvement.

Another important means of restoring the pasture lands is cultivation. This is done by means of disc and iron-tooth harrows. Not only does this not injure the grass roots but it gives them a better chance for development. This is accomplished, first, by making the ground looser beneath the surface; second, by providing softer ground in which the grasses and their surface runners may take root readily; third, by helping to save the storm waters. Instead of running off into the streams, the rain will more readily soak into the ground and go directly to the grass roots. Particularly is this valuable when done on slopes, in terrace fashion to catch the drainage waters. Again

a seed bed is made in which as grass seeds fall or are blown they will be arrested and find a suitable place of germination.

An iron tooth harrow to be effective must be heavily weighted. And so great is the improvement from cultivation that after the second year this is often incapable of stirring the soil. A better implement is the disc harrow. This is set at a small angle and weighted. As the grass improves from year to year the discs will need to be set at a greater angle and to be more heavily weighted. In the course of a few years the sod will be so heavy as to defy even the disc harrow. Cultivation should be given in the early spring. It will probably be better to do all the disking at one season and not to repeat it later in the year.

Many of these methods and others to be mentioned later, were tried in an experiment at Abilene, Texas, by the Bureau of Agronomy of the United States Department of Agriculture. The improvement was quite marked. With disking, it was found that the first year might show an increase in weeds but that eventually the grasses became so much thicker and so much more rank as to gain and hold the ascendancy. There was an increase in young grass roots and consequently in the grass crop. There was a greater variety of grasses, together with a brighter color, and a more vigorous appearance to the grass. At the beginning of the experiment the land had a capacity of 40 head of mixed cattle per mile. At the end of the first year this had increased to 64 head. A little later it was 80 head and when the experiment closed after three years it was about 100 head, a remarkable improvement.

The chief methods used were reducing the number pastured and cultivating the pastures. It was found that cattle could be pastured on the land while these improvements were being carried out. An increasing number might be pastured from year to year while there was a continued improvement of the grasses. Success will surely crown the efforts of the ranchman laboring for the improvement of his land.

Burning has not proved a success. Mowing, however, is an excellent method of range improvement. It helps in keeping down weeds. The chief weeds in Kansas are the thistles, loco weed, ragweed, ironweed, goldenrod, sumac, and spear grass. It is best to mow the pastures when the weeds have attained their growth but before they have gone to seed. In order that the grass shall be harmed as little as possible, the sickle is set high. This method is worthy of trial on our pasture lands.

The plowing of furrows some distance apart was found to be a practicable method of range improvement. They were plowed about 12 feet apart and at right angles to the prevailing winds. The idea was that the grass seeds would be caught by these as they were blown by the wind and lodging in the furrows would soon form a heavy stand of grass. Also that these furrows would assist in catching and detaining the storm waters, thus increasing the amount of soil water. Not only did the results justify the theory but the grasses near the furrows were of a better color and more vigorous.

The sowing of native grass seeds upon bare spots

is a good method. This involves some labor in collecting the seed but will repay the effort. The seed should usually be sown in the summer and fall, after the soil has been stirred somewhat. Native grasses will ordinarily be found superior to others for this purpose since our native western grasses are unexcelled for forage purposes. One should be acquainted with the grasses and know their habits and desirability before sowing. Quality is preferable to mere quantity. But of those of the desirable quality the heaviest producers are the more profitable.

Beside sowing native grass seeds we may do much good by transplanting grass roots and sods. This may best be done in the spring or fall just before a rainy spell. Many if not most of our native grasses will bear transplanting and are valuable for this purpose. Buffalo grass sod transplanted at this station in 1903 has in one year almost covered the ground in which it was set. The first sods were 2x2 inches square and were set 12 inches apart in rows 3 feet apart. This involves time and labor but will usually repay the effort.

With all possible improvement by any or all methods the value of the range will be greatly enhanced by the careful raising of hay and other forage crops. A number of these, chiefly sorghums and legumes, will grow readily under cultivation on the Plains. And for winter and dry weather feeding these are practically essentials. Deep fall plowing to catch and hold the fall and winter rains and to promote frost action is usually the best preparation. The forage crops will best be sown in drills

wide enough to allow of cultivation. For most of the Plains this will be sufficient. In some parts the Campbell system of cultivation may be more advisable. This method consists in deep plowing, subsurface packing, sowing in drills, and frequent and long continued surface cultivation to preserve a dust blanket. The man who grows on his own land the feed for his own stock comes nearest to realizing full value for his labors and investment.

The legumes are probably the most important of forage crops in real value both as feed and as crops. For the greater shore of the Plains region alfalfa is the best legume. It may be raised in good crops with or without irrigation. Thus it is worthy of the attention of every ranchman. From Colorado, soy beans, cow peas, field peas, and the hairy vetch are recommended, being in some cases superior even to alfalfa. From central Texas, these legumes together with Melilotus, Alsike, bur clover, the velvet bean, and Desmodium were reported as of value. In Kansas several species of Trifolium and the flat pea are found to be valuable members of the order. Lespedeza is said to be of importance as a leguminous crop. No ranchman can afford to neglect the legumes.

There are other plants worth cultivating as forage crops for winter and dry weather feeding. Chief of these are the sorghums and the millets, and where it can be grown, Indian corn. Of the sorghums, Kafir corn, milo maize, Jerusalem corn, and common sorghum are the best. The Pearl, German, Hungarian, and

Arizona millets are the best of the millets. These crops may be grown for fodder, as soiling crops to feed in early spring so as to give the grass a better start, or for silage. Perhaps a more useful method is to bale them. In this way the moisture is saved with the valuable juices and the chief food value. They are treated as hay crops, being cut, cured, and baled.

Hay crops are not impracticable in most of the Plains. Introduced varieties may do well and the native grasses may be used for hay if given proper care. The native grasses vary with climate, soil, and locality but the best have been mentioned in the discussion of the species of native grasses and their distribution. The best introduced species include *Phleum pratense*, *Agrostis vulgaris*, *Poa pratensis*, and *Dactylis glomerata* in the eastern part of the Plains. *Bromus inermis*, *Avena sativa*, *Avena avenaceum*, and some of the fescues are more widely grown. In the South, *Cynodon dactylon*, and *Poa arachnifera* are of value. *Andropogon halapensis* would be of high value as a hay grass but for the difficulty in eradicating it.

In looking ahead we may expect the future of the range country to be brighter than the past has been. Necessity will compel the stockraiser to face the problems of a deteriorated range or of giving up his business. He will be led to use judicious methods of range restoration, Their faithful use will give him success and an improved range. By using judgment in grazing and alternating them from one field to another his grass will always be good. He will if necessary cultivate his pasture lands and seek to secure a good stand of the best native and introduced grasses. Then with forage crops for winter and drouths he will not fear the starvation of his cattle. Thus he will have a range that amply repays the labor expended upon it.

The range of the future will either be occupied by the owner or be under his supervision. It will thus be well handled and instead of being simply a semiaridness will be the seat of homes and settled life. The ranches will be smaller and more numerous. Better grades of stock will be kept. With these conditions we may expect our range country - The Great Plains - to be one of the richest and most pleasant portions of our great republic.