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**AGRICULTURAL EXPERIMENT STATION**

AGRICULTURAL COLLEGE, N. M.

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**THE RANGE PROBLEM**  
IN  
**NEW MEXICO**

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**BY**

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## Introduction

"The conservation of our natural resources and their proper use constitute the fundamental problem which underlies almost every other problem of our national life. Unless we maintain an adequate material basis for our civilization, we cannot maintain the institutions in which we take so great and so just a pride; and to waste and destroy our natural resources means to undermine this material basis."—Roosevelt.

The duties of Experiment Station Botanist have caused the author to make a critical first-hand study of the range problem in New Mexico—an examination extending over several years, and taking him over the greater portion of the Territory in a wagon or on horseback. He has thus come in close contact with the ranges and the stockmen and has endeavored to see the situation from as many points of view as possible. Being in no way financially interested in the industry, there was little chance of personal bias; the large view tends ever to fairness to the greatest number.

No small part of the work of examination was done in collaboration with the division of Farm Management of the Bureau of Plant Industry, Washington, D. C., and the author desires to acknowledge the assistance of all kinds which has been received from the officers of that division. But for their aid in many ways the following bulletin could not have been as complete as it is, and the author thoroughly appreciates their efforts as well as the individual kindnesses of these gentlemen, and is grateful for them.

The difficulties arising from the present methods of conducting the business on an open public range were apparent on every side, and each individual was able to see clearly those immediately affecting himself and less certainly those of "the other fellow." The author endeavored to get the point of view of each, hoping to summarize the different ideas into something valuable not only to stockmen, but in some measure to all the citizens of the Territory. Such con-

clusions must be in some degree applicable to similar conditions in other states and territories of the union, where stockraising on the public domain is now carried on.

Stockraising is one of the most important industries of the Territory and probably always will be. It is a large part of the "material basis" of our territorial civilization, and is therefore of vital importance not alone to the men engaged in it but to every citizen of our civilization. Whatever will improve the conditions of the stock business and increase the output of beef and mutton, fat cattle and lambs, wool, mohair, and hides, or horses and mules, is bound to increase the general prosperity of the Territory, and make our social conditions better and life more worth living.

This bulletin is an attempt to present a statement of the factors affecting the industry; it is concerned most with those factors due to the natural conditions under which the industry is carried on, and those social and economic conditions which may have arisen as the result of the application to one region, of land laws and customs designed for and properly applicable to another and very dissimilar one.

The author believes that a better method of treatment of our public domain is not only possible, but has already been devised,\* and that all now necessary to cause the adoption of this plan is the complete understanding of it by the general public, and stockmen in particular. Certain individuals will be opposed to it for purely personal reasons, but the fair-minded citizen, be he financially interested or not, will, if the subject be properly presented to him, see the inherent fairness of the proposed plan and recognize the many advantages it possesses over the method of management now in operation.

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\*It was hoped at one time that valuable information upon the subject might be obtained from owners of some of the large grants in the Territory, but it was found on inquiry that the grants had been treated as the public lands because the titles were vested in so many people that managerial authority had been given to no one. The grants have therefore been treated as common property and not cared for at all. Recently a few have been leased and fenced, but data as to results are not yet available.

It seems especially desirable to call the particular attention of the average citizen to this subject. The valley farmer, the business man, the professional man, are all directly interested in the development of the Territory and thus indirectly interested in the advancement of every important industry now forming a part of our territorial civilization.

Much of what is included herein is already known to stockmen, but it is hoped that a plain statement of the situation and its possible ameliorization may be of benefit to many who have thought little or narrowly of the subject. Although the conclusions herein expressed have mostly been reached independently by the author, he makes little claim of originality, since it has all been worked out by others from a number of different standpoints; but all have arrived at very similar conclusions, by the very nature of the case.

Credit cannot be given here for all the ideas received from others, though the author would gladly acknowledge them. The literature of the subject has been consulted as fully as possible, and where quoted full credit is given. But many men are working on the subject and a consideration of it is in the air. A prominent speaker\* has gone so far as to express his belief that some form of government control was not only desirable and right, but that it would be established in the near future. The author is heartily in sympathy with this idea and is sure it can be done with advantage to the stockman, the range, and all others concerned. With this idea in mind the following statement of the case as found in New Mexico is submitted.

#### Area and Apportionment

The total area of New Mexico is about 122,580 square miles, or something over  $78\frac{1}{2}$  millions of acres—an area equal in extent to all the New England States, New York, and New Jersey combined; almost as large as Norway, the

\*Dr. Gifford Pinchot, Chief Forester of the United States, at the Public Lands Convention, Denver, June, 1907.

Philippines, or Italy and Switzerland combined, and more than half as large as France or Germany.

Data obtained from various sources show that the lands are apportioned approximately as follows:

1. Lands held under grants from the Mexican government and confirmed by the authorized U. S. land courts, about  $9\frac{1}{2}$  millions of acres.

2. Lands granted as subsidies to transcontinental railroads, about 4 millions of acres. Some of these holdings have been surrendered for lieu land scrip, and much of the land has been sold.

3. Lands granted to the Territory as an endowment for its schools, charitable, penal and other institutions, about 5 millions of acres. These lands are in charge of a territorial land commission and managed by a commissioner.

4. Lands held under patent from the U. S. government, obtained as homesteads, desert claims, mineral claims, etc., about  $2\frac{1}{2}$  millions of acres.

5. Lands included in forest reserves, Indian and military reservations, and reservations made for the reclamation service, in all about  $8\frac{1}{2}$  millions of acres.

6. Unappropriated or public lands, nearly 50 millions of acres.

It will be seen from the above that there is now open for entry in this Territory about 55 millions of acres of public land;\* and that there are about  $4\frac{1}{2}$  millions of acres now in Indian and other kinds of reservations which may be and probably ultimately will be thrown open for settlement. Probably not over ten per cent of this land ever will be cultivated as agricultural lands. It is safe to say that much the greater part of the arable land as well as that having permanent water upon it is already held under some sort of title.

Mr. F. H. Newell\*\* has classified the lands of the Terri-

\*Agricultural lands within the forest reserves may be homesteaded by bona fide settlers.

\*\*Irrigation, p. 55, 1902. Recent development has increased the amount of improved and irrigated lands very materially.

tory as follows, giving the areas of each kind in millions of acres:

Grazing lands, 57; woodlands, 16; forest, 4; improved, 1/2; irrigated, 1/5; water supply, 4.

This being interpreted, means that we have a water supply which, if it were all conserved, would be sufficient for the growing of crops on 4 millions of acres. Of all this vast domain 73 per cent is recognized as good for grazing only. But 25 per cent more of it, though properly classed as woodland and forest, is also grazing land, and there is hardly an acre of it which doesn't have stock upon it. So we see that in whatever hands the control of our lands may lie, whatever the crops they may produce, by far the greater portion of them (certainly not less than 90 per cent and probably even more) produces a crop of forage, the gathering of which each year by range stock is an important source of legitimate income to the people of our Territory and probably always will be.

### Topography

Geographically New Mexico is to be considered as a high plateau about 350 miles square, sloping gradually from an elevation of about 6,000 feet above sea level on the northern end to about 3,500 feet at the southern end. It has been correctly spoken of as a part of the roof of the continent for it slopes gently eastward and westward from a north and south line which crosses it just west of the middle. Upon this plateau stand numerous masses and ridges of mountains, generally trending north and south, while through it and between the mountains wind the Rio Grande and Rio Pecos in relatively narrow valleys. Other smaller streams which rise in the mountains flow into these two, out of the Territory, or are lost in the dry sands of the mesas.

The mountains of the Territory are of two classes which I have chosen to speak of as "ridges" and "masses." By

"ridges" are meant long, relatively narrow ranges, which stand out by themselves and are not of sufficient size and elevation to cause any large increase in precipitation. Such ridges are usually rocky and dry; they produce more forage than the plains, but much of it is composed of low bushes and scrubby trees. Few trees of any size grow upon such mountains and those which do grow are found on the upper, cooler slopes and in the less accessible canyons. Much the greater number of named mountain ranges of the Territory are of this type, which is well exemplified by such ranges as the Florida Mountains, the Organ Mountains, or the Big Hatchet Mountains. The permanent watering places in such mountains consist of springs, seeps, and small streams rarely more than a mile long. Almost all the land upon which permanent water exists is patented and many such claims are occupied by the owners who have stock upon the surrounding public domain. By "masses" of mountains I have attempted to characterize such areas as the Mogollon-Black Range area, the Sacramento-White Mountain region, or the Glorieta Mountains. Such areas consist of numerous more or less parallel ranges or high plateaus which are twenty-five, fifty, or more miles across and of even greater length. The valleys between the ridges are all at high elevations above the sea and some of the peaks of such a mass usually extend above timber line. They are thus of such size and so high above the surrounding plains that they receive more precipitation, a goodly portion of which is snow. Such mountain masses are usually covered with timber from about the 5,500 feet contour, though the actual line at which timber begins is dependent to some degree upon the exposure. Above 6,000 to 6,500 feet altitude there is normally a good stand of coniferous timber, which extends on up to the timber line, found at from 11,000 to 11,500 feet in most places. The climatic conditions found in such mountainous areas are certainly not truly arid, though they are to some degree affected by the surrounding aridity. There are many fertile little valleys winding through the



forests and watered by streams of clear water supplied by snow-fed springs. Open glades or parks are not uncommon and furnish excellent pasturage. Most of the arable lands of such valleys, and to some extent the parks, have been patented and are occupied by small farmers who make a comfortable living. Their stock runs on the surrounding public lands.

The typical agricultural valleys of the Territory are narrow strips of land, rarely more, and usually considerably less than ten miles wide, lying along the larger rivers—the Rio Grande, the Rio Pecos, the San Juan, the Gila, and several streams of much less size. The agricultural development of such lands is wholly dependent upon the irrigation water supplied by the streams they parallel.

In the most fundamental sense, the climate, and the topography of a land determine the industries of its inhabitants. The cultivation of farm, garden, and orchard crops is carried on in this Territory wherever there is sufficient tillable land associated with sufficient water to grow marketable crops. But such areas, though in the aggregate amounting to over 1,000,000 acres, constitute a relatively small portion of our vast domain.

There is very little absolutely true desert in the Territory and this consists mainly of relatively recent lava flows, gypsum dunes, and salt flats. A certain small part of the area consists of inaccessible rocky peaks upon which little grows.

Mountains, forests, and dry plains suggest the correlated ideas of mining, lumbering, and stockraising, and the relative importance of each industry is dependent upon the abundance and character of the mineral deposits, the standing timber, and the native forage crops with the relative areas occupied by each. Fortunately for the stock raisers the presence of the natural resources of the other two industries interferes but little with him, for forage plants grow in the forests and over the mineral wealth.

## The Forage Plants

### Grasses and Sedges

Any plant which stock will eat is to be classed as a part of the forage crop of the Territory, and probably 90-per cent of the native plants are eaten more or less. Nearly all kinds of shrubs, most herbaceous annuals and perennials, and not a few trees form at least some part of this crop.

Of course, the most important members of this assemblage are the grasses and their near relatives the sedges, the latter being considered as grass by the stockman. The species differ very much in value for a number of different reasons. Some species are abundant in quantity, good in quality, and are naturally preserved as hay where they stand. These, of course, are by far the most valuable kinds. Some are good only while green and succulent; some are able to grow in unfavorable situations and so produce a crop upon land which would otherwise be barren. These are apt to be relatively poor feed but much better than none. Many of them are produced so scantily as to be of little importance as forage. A few grow in places more or less inaccessible to stock. There is only a single species of grass, the "sleepy grass" (*Stipa Vaseyi* Scribn.) which is not eaten at all upon the range.\* Several species are let alone by stock until hard pressed, but this is usually due to the unpalatable nature of the grass. A few of the species found in the cultivated fields are trouble-some weeds, among which the sand-bur is probably the worst.

Approximately 300 species of grasses and sedges have been reported from the Territory, but the great bulk of the forage is furnished by not more than 25 or 30 of these, which are abundant in quantity and good in quality. It is even likely that fully half of the grass crop is composed of a smaller number of species than this.

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\*Cattle and horses learn to leave this grass alone after having experienced its narcotic effects. Whether or not sheep and goats can eat it, I have been unable to learn.

A detailed discussion of the various species would be out of place here, but an attempt to show something of the distribution and, by this, the importance of some of them, is made in the sketch map which accompanies. (Fig. 2) As will be seen by consulting this map certain species of grasses are more or less commonly associated together because they are adapted to similar climatic conditions. Such assemblages of species might be termed grass societies.

Of first importance are the societies which occupy the open plains of the Territory. Attention has already been called to the difference in altitude of the plains and these differences naturally affect the distribution of the grasses. At elevations of from 5,500 to 8,000, or possibly 8,500 feet, any place in the Territory, the most common grass is likely to be the bluegrama (*Bouteloua oligostachya* (Nutt.) Torr.). While probably the commonest, it is also one of the best grasses, if not the very best, for all purposes, and it is correspondingly highly prized by the stockman wherever he may run stock. It is the dominant grass on the high plains of the northern and central portions of the Territory where it is most luxuriant. It is also found in the forest and woodland areas wherever the altitude and climatic conditions are favorable. Along the western side of the Territory it is usually associated with the galleta\* grass (*Hilaria Jamesii* (Torr.) Benth.), which is sometimes known as black grama, and is also an excellent, though coarser, range grass. These two together form the bulk of the plains grasses of the northwestern part of the Territory. On the northeastern side both are more or less replaced by buffalo grass (*Bulbilis dactyloides* (Nutt.) Raf.) and the combination is a very difficult one to surpass in an arid region. Other grasses of much less value commonly occur with these, adding slightly to the forage crop. None of them are sufficiently assertive to drive out the better grasses, so they are rarely the dominant species of a range, except when that

\*Pronounced gah-yet'-ta.

range has been badly overstocked. Several species of needle grass (*Aristida* spp.), a small tufted grass without a common name (*Muhlenbergia gracillima* Torr.), Colorado blue-stem (*Agropyron occidentale* Scribn.) to some extent, and a few others of less importance belong to this society.

On the plains of the southern end of the Territory, occupying approximately one-fifth of the total area, is another grass society closely related to the preceding. The grasses of this society are the true black grama (*Bouteloua eriopoda* Torr., sometimes called woolly-jointed grama), which occupies the place on the sandy, hotter, and drier plains that is filled by the blue grama farther north; the tobosa grass (*Hilaria mutica* (Buckl.) Benth.), the drier region equivalent of the galleta grass; and a small grass which in several respects suggests the buffalo grass\* of further north—sometimes called needle grass (*Scleropogon brevifolius* Phillippi). Ranges occupied by these grasses are not as valuable as those producing the first named society because the grasses are not such good feed nor are they so abundant upon a given area; but for all that, these ranges feed thousands of head of stock. Associated with these dominant species are five or six species of needle grass (*Aristida* spp.), two or three drop-seed grasses (*Sporobolus* spp.), several six weeks grammas and other annuals (*Bouteloua* spp., *Munroa squarrosa* (Nutt.) Torr.), vine mesquite grass (*Muhlenbergia Porteri* Scribn.), and several others. The ranges of this character suffer more quickly and more permanently from overstocking, because the better grasses are more easily killed out and are harder to replace.

The forested areas have the most diversified grass flora, but even here a few species are almost always prominent. Blue grama is nearly always present and usually dominant in the open parks and valleys of the forests below 8,000 feet. A prominent member of the society is the Colorado blue-stem (*Agropyron occidentale* Scribn.), and two other species of

\*The buffalo grass occurs with this society in places in the southeastern part of the Territory.

this genus (*A. tenerum* Vasey and *A. pseudorepens* S. & S.), are common along little streams. The brome grasses (*Bromus* spp.),—the “wild oats” of the stockman—and the spear grasses (*Poa* spp.)—relatives of the Kentucky blue grass—, June grass (*Koeleria cristata* (L.) Pers.), the bulbous panic-grasses (*Panicum bulbosum* HBK. and *P. virgatum* L.), Eaton's grass (*Eatonia pennsylvanica* (DC.) Gray), Arizona fescue (*Festuca arizonica* Vasey), and a number of others form a noticeable part of this society.

On the upper slopes of the high mountains above timber line or in the open “burns” often found at elevations of 8,500 or 9,000 feet, is another grass society whose dominant member is nearly always the Arizona fescue (*Festuca arizonica* Vasey). Associated with it are species of brome grass (*Bromus* spp.), the wheat grasses (*Agropyron* spp.), and a number of other grasses which grow luxuriantly only where it is cool and water is abundant. Such areas are about the only true summer ranges found in the Territory. They are accessible only to sheep and goats but are very valuable summer pasture for such stock.

Not infrequently in the mountainous regions there occur relatively small basin-like areas, into which considerable of the water of the surrounding slopes drains. Small marshy or swampy areas are thus formed (generally referred to by the Spanish word for marsh, *cienea*, or some corruption of it), which are occupied by the various sedges (*Juncus* spp., *Carex* spp., *Eleocharis* spp., and *Cyperus* spp.), as well as several water-loving grasses, such as *Hordeum nodosum* L., *Agrostis exarata* Trin., *A. stolonifera* L., and the wheat grasses (*Agropyron* spp.). Generally such places are enclosed, partly drained, and the crop cut for hay.

The areas classified by Mr. Newell as woodlands are in-between the forested areas and the plains. They are normally rough ridges and mesas covered with a more or less scattering growth of low trees and shrubs, such as junipers, piñones, oaks, ash, hackberry, mountain mahogany, and

the like. The grasses common in such localities are mainly those of the plains, with a few others. Blue grama, hairy grama (*Bouteloua hirsuta* Lag.), side oats grama (*Antheropogon curtispendus* (Michx.) Fourn.), mutton grass (*Poa Fendleriana* (Steud.) Vasey.), several species of *Stipa*, and some few *Aristidae* go to make up the society.

The river valleys, where not in cultivation, are usually occupied by bunch grass\* (*Sporobolus airoides* Torr.), and, if moderately moist, by the true salt grass (*Distichlis spicata* (L.) Greene). Occasionally aparejo grass (*Muhlenbergia utilis* Torr.) occurs, forming, as does the salt grass, a tolerably thick sod in favorable localities. In certain places along these valleys the land is so low as to be kept saturated with water which may either come in as backwater from the river or come up from below. In such places the bunch grass is replaced by sedges and rushes. None of these grasses is a particularly valuable forage or pasture grass, but they are frequently fenced as pasture, for lack of anything better. Both the bunch grass and the salt grass have been reported as killing stock under certain conditions. Nevertheless some ranges contain little else over comparatively large areas.

Bunch grass and salt grass, a sedge (*Juncus mexicanus* Willd.), needle grass, and tobosa not infrequently occur on alkaline flats. With the possible exception of salt grass, none of these absolutely requires an excess of alkali in the soil in which it grows, but all of them will endure relatively large quantities of it. Hence while they are not necessarily indicative of alkali in the soil, they suggest the desirability of an examination for the quantity of those salts present.

Associated with such alkali flats in parts of the Territory are ridges and dunes of almost pure gypsum. A few grasses seem to be restricted to such locations, among which may be mentioned *Sporobolus Nealleyi* Vasey and *Bouteloua ramosa* Scribn. Bunch grass, indian millet (*Eriocoma cuspi-*

\*Sometimes called salt grass and sometimes sacaton, neither of which is correct.

*data* Nutt.), *Muhlenbergia pungens* Thurb., and a drop seed grass (*S. cryptandrus* (Torr.) Gray) occur upon sand dunes whether they be gypsum or not, being associated in such localities with the grasses of the region in which the dunes oc-

Certain barren, rocky ridges have a grass society that is tolerably characteristic. The members are usually black grama, side oats grama, some needle grasses, some of the coarser blue - stems (*Andropogoneae*) *Pappophorum Wrightii* Wats., members of the genus *Tridens*, and *Lycurus phleoides* HBK. The relative numbers of each present would vary with every ridge examined.

#### Other Range Plants

Of the annual herbaceous plants which come each year at their appropriate seasons, those which appear early in the spring before the grasses have commenced to grow, are very important. There are many of these, but some of the early borages and plantains are probably most important because of their abundance and wide distribution. During the summer months the different pigweeds (*Amaranthus* spp.), the lamb's quarters, burro weed, greasewood, salt bushes, and other species of the Goosefoot family are of much importance on the drier and hotter plains, while in the forests and wood-lands are species of clover (*Trifolium*), peas (*Lathyrus*), vetches (*Vicia*), lupines (*Lupinus*), beans (*Phaseolus*), and many more which form a very important part of the forage crop. A root-perennial, known to sheep herders as "estafiata" (*Artemisia frigida* Willd.), is a very important part of the early summer forage and saves many sheep in the lambing season whenever for any reason the grass is late in starting.

But the shrubby plants, whose leaves and young stems are eaten, are much more important, because this part of the crop can be depended upon each year whether there be the customary amount of rainfall or not. In practically all the mountains there occur species of oaks whose leaves are eaten

by all kinds of stock, and they form a very important part of the forage crop. A shrub common in the opener more barren mountains and in the arroyos leading from them is the Apache plume\* (*Fallugia paradoxa* (Don.) Endl.), which is browsed extensively. The mountain mahogany (*Cercocarpus* spp.) is another plant which is much used in the more barren mountains, along with a near relative, sometimes called "wild crape myrtle" (*Holodiscus australis* Heller. It has no af-filiation and little resemblance to its namesake.) In the val-leys and to some extent upon the mesas of the southern part of the Territory, mesquite (*Prosopis glandulosa* Torr.) is quite abundant and a very important addition to the early summer forage. The shad scale† (*A triplex canescens* (Pursh) James) occurs widely scattered all over the Territory, and is eaten extensively, while on thousands of acres in the north-ern part there is a thick stand of one or more of the sage brushes (*Artemisia* spp.), which are highly valued by stock-men. In times of scarcity cattle will eat the leaves of the Spanish daggers (*Yucca* spp.), the bear grass (*Nolina* spp.), and even the spiny cacti. It is believed that the carrying ca-pacity of our ranges may be much increased by growing cacti upon them and burning the spines so that stock can eat them. This has been profitably accomplished in a number of places and has been especially profitable when other feeds were scanty and stock too poor and weak to drive off the range. Under such conditions cacti will save the lives of many animals which would otherwise perish.

### Weeds and Poisonous Plants

Besides the plants which are valuable upon the range, there are a number of others which are more or less undesir-

\*This is a common name originating with Mr. Jas. K. Metcalfe, who has studied the native forage plants of New Mexico for many years. It is particularly apropos, and since I can find no other name in use for this rather common plant I use it here.

†This is a near relative of the Australian salt bush. It is not infrequently called sage brush but is not closely related to the shrubs which bear that name.



able. Some of these are actually dangerous to stock, causing, as they do, considerable loss by poisoning, while others are undesirable only because they occupy land which might produce a forage crop, while they themselves are practically use-less for any purpose whatever.

Of the poisonous plants a number are of considerable importance. The loco weeds (*Astragalus* spp. and *Aragallus* spp.) are probably of first importance as causing loss of stock. These plants are usually found in the foothills of the mountains or on the high plains at elevations of from 5,500 to 8,000 feet. Just what the poisons are has not yet been learned, and the only remedy yet found is to take the stock off the range and feed good nourishing food. Not infrequently it is cheaper to lose the stock than to feed. No steps have been taken to eradicate the loco weeds, as yet, though it is probable that in most places this might be done relatively easily.

In the higher mountains occur several species of Larkspur (*Delphinium* spp.), Lupine (*Lupinus* spp.), the Swamp Camas (*Zygadenus elegans* Pursh), and the Cowbane (*Cicuta occidentalis* Greene), all of which are responsible for the loss of stock each season. The Sleepy Grass (*Stipa Vaseyi* Scribn.), already referred to, is also a possible cause of loss. Some of these plants might be disposed of easily, but others would be more difficult to eradicate. The Rayless Goldenrod (*Isocoma heterophylla* (Gray) Greene), which grows in the lower valleys of the southern part of the Territory, has been reported as the cause of the death of range cattle and milch cows, and is believed to have caused the death of people who used the milk of the cows affected. This subject has not yet been thoroughly investigated, but will be in the near future. The trouble occurs only at a certain time of year after the plants have been frosted.

The possibility of weeds on the open range seems rather strange. If weeds could get a foothold, it would seem that they would ultimately take the whole range. But the grasses

are sufficiently assertive to maintain themselves against the inroads of nearly any other plants, unless their competitors are given some advantage. So it happens that in many places where the grasses and other valuable forage plants have been eaten and trampled out, other species, which live in such situations but which are not eaten by stock are thus relieved of competition and allowed to grow luxuriantly. Hence an area occupied by plants which stock will not eat, in a region where good forage plants should grow well, tells something of the past history of the area. Of the valueless plants thus occupying good land and telling of the past suffering of the range, several are quite characteristic. The prickly poppy or poppy thistle (*Argemone* spp) and the wild tobacco (*Nicotina attenuata* Torr.) not infrequently occupy large areas, from which everything else has been driven out; they particularly like open arroyos and draws, which have resulted from too rapid running off of the rains and melting snows. Two others of equal importance and frequency are the Rocky Mountain bee plant (*Cleome serrulata* Pursh) and *Croton texensis* (Klotzsch.) Muell. Perhaps the most important weed of this kind, which is taking thousands of acres of our higher plains, is what is known in various localities as sheep weed, snake weed, or *verba del vibora*. It is a low, herbaceous perennial, which stays green nearly all year long. Its flowers are yellow, very small, and borne in small clusters at the ends of the very numerous, slender, resinous stems. Several species of the genus (*Gutierrezia*) have adapted themselves to the different climatic conditions of our Territory, where they are found in greater or less abundance on nearly all ranges. Lamb's quarters and pigweeds sometimes cover large areas, from which the grass has disappeared, but their presence is not altogether detrimental, for they are themselves eaten freely by stock. The Russian Thistle (*Salsola Tragus* L.) has been introduced practically all over the Territory and seems to be taking possession of some ranges where

the grass is badly killed out. Whether or not it will do more than this remains to be seen; it is now too late to hope to eradicate it, as might have been done years ago.

Certain areas of the Territory are occupied by plants which are valueless for forage. These plants can hardly be called weeds, for they are not displacing better plants, but their room might be occupied by others of value if these latter could once be introduced.

### The Condition of the Range

The author has had occasion to talk with many of the stockmen of the Territory and with a number of the "oldest inhabitants," relative to the character and condition of the particular range that each was conversant with. The almost invariable reply to questions as to the past condition of a range was a statement that much damage has been done to the range by overstocking. They all say that years ago the ground was level enough to drive over with a wagon where it is now almost impassable for a horseman. They also claim that certain areas were once cut over for hay, while there is now little or nothing on them, much less a hay crop.

The second report of the Public Lands Commission\* shows that of 118 stockmen of New Mexico reporting upon the ranges they know, 102 believed that the carrying capacity of these ranges had diminished while only 16 reported that their ranges had increased in carrying capacity. Of this number 69 believed the diminution was due to overstocking and 33 to drought. Since overstocking tends to produce drought this second answer may be at least merely another way of saying that overstocking probably produced most of the loss in carrying capacity.

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\*Senate Document 189 (1905), p. 7, and the reprint in Forest Service Bulletin 62, p. 13.

Attention has already been called to the value of range weeds as indicative of the degree and kind of overstocking to which a range has been subjected. Wherever the perennial grasses have been replaced by the annual six weeks grasses, a certain degree of overstocking is indicated. This is apt to occur within a mile or so of the watering places and shows the need of more watering places. Arroyos and washes occupied by poppy thistle and wild tobacco as well as flats covered by the bee plant show ranges badly overstocked by cattle. The arroyos show where trails have been and where not only the grass but even the soil is gone as the result of the overstocking. Level areas with much of the *Gutierrezia* on it show some degree of the extinction of the grasses due to overstocking by sheep. Thus it is possible by looking at a range to tell how it has been treated. The number and kinds of range weeds, the kinds and abundance of grasses, the condition of the shrubbery, the amount and character of the erosion features, all taken together with an appreciation of the common or typical condition of the locality in question, tell the story of what the range has been, and hence what it may be again by proper treatment.

### Why the Effects of Overstocking Are Cumulative

Stock of all sorts eat the kind of forage they like best *first*. Such forage is perforce the most valuable upon a range. If so much stock has access to it that the growth of each season is all eaten before it can seed, the best forage is bound to diminish in quantity every season, for some of it is continually being killed under even the most careful management. Thus it will be seen that, from this reason alone, the carrying capacity of a range is gradually reduced.

Plants maintain their relations to each other, in any plant society, in the same way that animals do. Those plants best fitted to live in a given region become the dominant species

by crowding the weaker species out. But the introduction of a new enemy to the dominant species may make it possible for another species of much less vigor to become the dominant one merely because its more powerful enemy has been displaced and itself allowed to grow and reproduce. Thus it always happens that a range which is overstocked, first loses its most valuable grasses, and the range becomes poorer; and finally, if the overstocking continues, everything which the stock will eat is destroyed and only those plants which they will not touch remain.

The effects of overstocking are to be seen around most of the watering places, because stock go just as short a distance away from water as will supply them with food sufficient to appease their hunger. Where watering places are but short distances apart the country around them is not "skinned" so closely of its vegetation. The perfectly bare condition of the land surrounding the watering places is undesirable for two other reasons. It becomes packed hard by the trampling of many feet; and, radiating from the troughs, are scores of well marked paths which become little gutters to carry off the water which falls upon the packed and un-protected land. Thus other effects of overstocking are to make the land so that it will not absorb the water that falls; to hasten the run-off of the water and give it little opportunity to soak in; to use the force of this run-off to carry away the loose and lighter parts of the soil, thus rendering the region less able to grow forage; and at the same time to render the surface more uneven and better fitted for occupancy by range weeds. The careful observer is able to tell pretty accurately the treatment the range has received by simply riding over it and seeing the kinds of plants present, the relative abundance of each, the condition of the trails and roads, and the number and size of rocky or gravelly arroyos. Each tells its own story of too much stock.

We have all become more or less familiar, largely

through the efforts of the Bureau of Forestry, with the effects of removing the forests from a region, and vigorous efforts are being made, especially in the arid districts, to protect such regions from the effects of deforestation. Little attention has as yet been paid to the effects of overstocking upon the run-off of flood waters, though examples of it are common in our Territory. A particular instance, the history of which is known to the writer, will illustrate the point.

The Mangas Valley is a narrow valley about 35 miles long, heading in the Burro Mountains, 15 miles southwest of Silver City, and running nearly north through a hilly country to the Gila. Until four years ago there were, about half way down the valley, a number of springs (Mangas Springs), which formed a marsh of several acres and supplied a little stream probably not over two feet wide, which ran down the valley. Years ago two or three settlers homesteaded claims below the springs and used the water of the little stream for irrigating their farms. They brought in some stock, and later large numbers of cattle were run in the valley and on the hills which drain into it. Wells were driven at several places above the springs, and, since the grass was abundant and of the best, the cattle lived mainly in the valley and on the nearby hills. Shortly thereafter the run-off of the summer rains began to come down as floods, small at first, but getting larger and larger as the seasons passed, and more grass disappeared. The floods commenced to cut out a deep channel, through which their waters were carried to the Gila. In fifteen years these floods, coming probably not oftener than one or two a year at first, cut out a channel about three-fourths of a mile long, 75 feet wide, and 18 to 20 feet deep, which completely drained the swamp and put the water at such a level and diminished its quantity so much that the little farms are ruined. The owner of the springs assured me that such a thing as a flood was not known at his ranch until after stock had been on the range for years, but

that now larger or smaller ones come down within an hour or so after it commences to rain. Figure 12 shows what was cut out in one night as the result of a tolerably severe thunderstorm, lasting about two hours, over the head of the valley. The hills to the west and mountains at the head of the valley are covered with scrubby timber, but little or none of it has been cut off. The erosion here referred to is the result of overstocking and nothing else, and shows very conclusively how the removal of the grass and other small herbage will cause the run-off of a region to change from a gentle seeping into and through the soil to a surface flow, which becomes in the end rapid, violent and destructive, and even dangerous to life.\*

The rapid run-off of the waters when they fall, or of melting snow causes the permanent water in springs and streams to gradually diminish in quantity and in many cases ultimately disappear. Thus the watering places, upon which the whole grazing industry depends, are destroyed.

### The Carrying Capacity

The approximate grazing area is known as well as the total number of stock now on the ranges. From these data it is possible to obtain the average carrying capacity under the present form of management. The following table gives the number of cattle, horses and sheep reported on the ranges of the Territory for a number of years.

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\*One or two persons have been drowned at the Mangas crossing in summer floods.

Year	CATTLE		SHEEP		HORSES	
	Number of Head	Average Price per Head	Number of Head	Average Price per Head	Number of Head	Average Price per Head
1880	137,314	.....	2,088,831	.....	14,547	.....
1882	375,000	\$19.26	3,960,000	\$1.50	16,640	\$42.92
1883	690,562	20.01	4,435,200	1.70	17,139	43.50
1884	959,881	18.83	5,410,944	1.64	17,996	37.69
1885	1,151,857	18.00	4,328,755	1.60	19,796	39.37
1888	1,257,597	15.04	3,623,168	1.09	40,533	34.46
1889	1,383,357	13.48	3,516,473	1.14	42,560	33.52
1890	1,383,357	11.25	3,097,736	1.25	52,350	29.66
1891	1,341,856	11.01	3,123,063	1.69	33,504	31.02
1892	1,288,182	11.01	2,967,480	1.54	93,000	29.09
1893	1,249,537	10.03	2,730,082	1.50	91,140	23.31
1894	1,224,546	9.44	2,921,188	.....	92,963	15.80
1895	979,637	7.49	3,008,824	.90	86,456	15.37
1897	753,831	11.76	2,683,269	1.06	84,701	14.65
1898	731,216	16.06	2,844,265	1.89	83,854	18.18
1899	659,849	18.64	3,973,439	2.17	83,184	20.21
1900	996,990	.....	.....	.....	.....	.....
1901	.....	.....	3,360,000	.....	.....	.....
1902	872,471	17.45	5,677,156	1.72	118,298	22.69
1903	916,095	14.55	3,860,466	1.93	115,932	17.52
1904	851,968	13.84	2,856,745	1.98	112,454	22.68
1905	903,086	14.84	3,999,443	3.15	113,579	30.29
1906	948,240	17.00	4,558,365	2.95	119,258	42.00
Average	1,027,205*	\$14.20	3,956,586	\$1.70		

Omitting first two records, when the ranges were just being stocked. The table is as complete as it was possible to make it with the facilities at command and is sufficiently extensive to be valuable for present purposes. It is compiled from the annual reports of the Secretary of Agriculture, the Yearbook of the U. S. Department of Agriculture, and the reports of the Governor of New Mexico.

Custom varies considerably in the matter of the number of sheep or goats which may be taken to be equivalent to one cow when considering the acreage necessary for each per year. Prevailing usage in New Mexico seems to be to figure four sheep as the equal of one cow in their effect upon the range. In other places five or even six head of sheep are considered as equal to one cow. Horses are generally considered as equal to cows, and goats to sheep in such estimates. The statistics given in the table relative to horses are not so arranged as to show the number of head which run on the ranges; all kinds of horses are included. It is probably fair



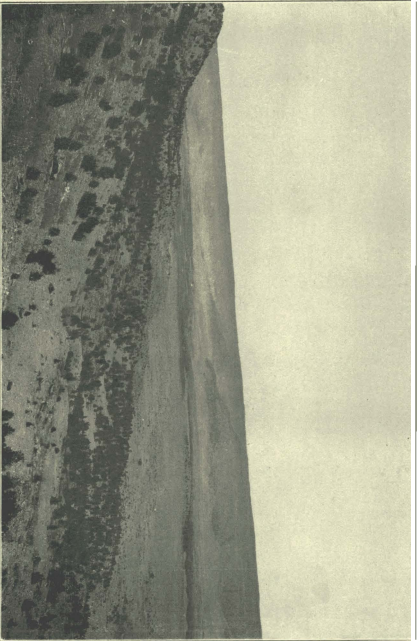


Figure 7. Range Conditions in the Northeastern Part of the Territory. Photographed by Dr. David Griffiths.

ing the plains and mountains together as they occur, is 40 acres per head\* per year, or 16 head per section. The whole south central portion taken as a whole is not even as good as this. Probably 50 acres to the head is as much as it can carry. This is due to the fact that much of this area has little or no forage on it at all. Thousands of acres have little vegetation on them except creosote bush (*Covillea tridentata*), *Flourensia cernua*, *Acacia constricta*, etc., none of which stock eat. Hence areas that stock do run upon have a carrying capacity higher than that given. The average carrying capacity is still further diminished by the absence in some well-grassed regions, of sufficient water to render the forage available. This condition may be changed by developing water.

The southeastern part of the Territory, including the Sacramento and Guadalupe mountains, their eastern slopes, the plains through which the Pecos flows, and the "staked plains" further east probably have an average carrying capacity not far from 25 to 30 acres per head. Much of the mountain region has a higher capacity than this, but in the higher parts of the mountains stock move out in the winter time, thus reducing the actual carrying capacity considerably. The forage is there but it is not utilized since much of it is good and palatable only during the summer when it is green, and portions of the high mountain ranges are snow-covered and uncomfortably cold during much of the winter. Neither of these conditions obtains on the open plains to any extent: though cold and snow both occur, they are rarely of long duration.

The carrying capacity of the large basin lying between the Mogollon Mountains and the Black Range and including the eastern and western slopes of these mountain ranges respectively, has been estimated at an average of 30 acres per head, but this might be materially improved by control. Some

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\*Estimates in terms of cattle.

of this region is probably capable of being cultivated by dry farming methods, and feed so produced could be used for winter feeding, thus making possible a more complete utilization of the summer forage. The region west of the Mogollon range has been estimated at 60 acres per head, but the author believes this is an underestimate, and would really apply to but a small part of it. The land is very broken and has been badly overstocked for several years, but the carrying capacity is more like 40 acres per head, and could be increased to 25 acres per head without much difficulty under proper management. Cattle and sheep wars have been fought over this region and, while some stock have been crowded out and some have been voluntarily moved out, the range has suffered seriously in the conflict.

Regions like the San Augustine Plains, the plains of the Puerco and San José, the Estancia plains, and those east of the Pecos and north of Roswell for 100 miles or more, have normally a high average carrying capacity, probably from 20 to 25 acres per head or 25 to 30 head per section. These regions have been occupied mainly by sheep for a long time and largely through carelessness and laziness of herders the ranges have been overstocked. They are eroded very little, but are very weedy, the "sheepweed" (*Gutierrezia* spp.), being very common in these regions and in some places almost re-placing the original blue grama grass (*Bouteloua oligostachya*). The mountains which surround these plains and separate them from each other are inferior in carrying capacity only on account of their winter climate. They probably have an average carrying capacity of not less than 30 acres per head.

Overstocking with sheep is particularly exasperating, because it is so unnecessary, and is chargeable generally to pure laziness on the part of the herders. The sheep are held too long in one place—so long that they kill everything which they can eat. Then when they move on there is nothing left to grow but the undesirable plants of the region. This may

not be and usually is not done all at once, but the habit of staying too long in one place, if persisted in, will ruin the best range, even if it has more than sufficient capacity to carry the stock upon it. A range so treated cannot recover when the stock are moved, because there is nothing but weeds left to recover, and once they are given possession the valuable plants are crowded out.

The high plains and mountains south of the Santa Fe Railroad, west of Grant, constitute an area of relatively large carrying capacity, certainly not less than 20 to 25 acres per head, and the mountains and high plains of the north central and northeastern part of the Territory are fully as good or better. It is possible that these regions may be much improved by dry farming methods. That part of the Territory lying northwest of Grant between the Santa Fe Railroad and the Colorado and Arizona borders is a region of rather poor carrying capacity, and has been badly overstocked by sheep for years. It is now able to carry not more than about 16 head to the section, or an average capacity of about 40 acres per head.

In the opinion of the author there is hardly an acre of range land in the Territory the carrying capacity of which may not be improved by a very small amount of effort and the use of ordinary judgment. Such improvement will amount to from 20 per cent to over 100 per cent on nearly any of the ranges; those which are now in the worst relative condition, will, of course, respond with comparatively the greatest gains. There is but one way in which this desirable result may be obtained. Men will make the necessary effort to improve and protect the range only when they are absolutely guaranteed that whatever of benefit may come as the result of their efforts shall become their own gain. The whole matter may be summed up in the one expression, individual control and individual responsibility.

An increase of 20 per cent in carrying capacity *such as has been obtained by control and good management*, if obtained all

over the Territory, would have a pronounced effect upon every industry. And such an increase is entirely possible if stockmen are given control of their ranges and required to take care of them or turn them over to someone who will.

### The Financial Value of the Range

What is the actual value which the stockman gets from each acre of his range each year? Of course, this is the difference between total expenses and gross receipts. If the figures assumed in another place be used, we have the problem stated thus: If 40 acres be sufficient to carry one cow, and the rate of increase be 50 per cent, and the yearling be sold at \$15, what has the stockman gotten from the 40 acres? The gross receipts are \$7.50 for the 40 acres, but from this must be deducted the interest on the proportional part of all money invested in the cow, fences, pumps, troughs, corrals, buildings, etc., the cost of all service necessary in caring for the cow and yearling, and all other running expenses. It thus becomes evident that the rental value of such land per acre is not very large. But any increase in carrying capacity makes a corresponding increase of income per acre of land.

Much of the land belonging to the Territory and managed by the Territorial Land Commissioner is now rented for grazing purposes. The prices charged are not less than two or three cents\* per acre for lands without water and five cents per acre for lands with sufficient water for stock: rental for one year payable in cash in advance, balance by properly secured notes. On land having a carrying capacity of 40 acres per head of cattle per year, the Territory is now charging from 80c to \$1.20 or over per year per head for land without water and \$2.00 or more for land with stock

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\*Minimum rental depends upon whether the land is public school land (sections 16 and 36 in each township) or lands belonging to other Territorial institutions.

water.\* It is likely that some of the land having water upon it is rented at such a price because it controls the public land surrounding it. There is no doubt, however, that for much of such land as this, the carrying capacity is greater than the above estimate and hence the cost per head is less.

Agents on some of the Indian reservations have given grazing permits to stockmen who have stock in the region. In one case the rental charged was \$1.00 per head for year-lings and older cattle per year. Both parties were satisfied with such an arrangement and it is likely that this is near what the business can carry. Any rental based upon the acreage of land must take into consideration the carrying capacity, while a rental per head must also assume it. In the one case the stockman must know the carrying capacity in order that he may estimate the annual cost of pasture per head. In the other the renter must know something of the capacity or he may get his range overstocked or not get as much for his pasture as he might in perfect safety.

The fees charged for the use of the pasture upon the national forest reserves are shown in the "Use Book"\*\*\* for 1907. They range from 20c to 35c per head for the summer season, for horses and cattle, to 35c to 60c for the entire year; and from 5c to 8c per head for sheep for the summer season to 10c to 18c for the year, with a charge of 2c extra per head for the privilege of lambing in the reserve. Goats are charged a little more than sheep. All stock over six months old is charged for pasture. Having no information as to the carrying capacity used in making charges in the forest reserves, it is not possible to determine what the equivalent rate per acre is. From this it may be seen that there is no attempt to charge more for the use of the pasture in the national forest reserves than a nominal fee which is used for maintaining the full effectiveness of the reserves

\*Land with water sufficient for irrigation is classed as agricultural land and rents for more.

\*\*Page 104.

in all particulars and in a condition of legitimate use. The fee is considerably less than actual value received as well as less than what men have shown themselves willing to pay private parties for similar privileges.

The minimum rental for grazing lands in Texas is 3c per acre.\* The usual rental charged for grazing lands without stock water in Wyoming is 2½c per acre.\* Whatever fee might be charged for the public range it would be such as would result in placing the public property in the hands of responsible parties who would appreciate the value of the trust and would be willing to make reasonable efforts to maintain the pasture in its best state.

### The Method of Management

It has been the author's privilege to travel over a relatively large part of the Territory in a wagon and make definite examination of the condition of the range. Almost without exception, wherever he has gone, he has seen the evidences of bad management. The practically uniform policy of the men getting the benefit of the range has been to get all they could in the shortest possible time without the least consideration for the range.

This method of management is explainable in one way only. The open range is public property, and being a gift to no one in particular, and every citizen having a right to use it, he who takes all he can and takes it most quickly, gets most of it. Since this gift is valuable, there is considerable competition to get it and there is no longer enough to "go around" among those who wish to take it. The result of this struggle for the "eggs" of the "goose that laid the golden egg" is a marked decrease in the "egg" supply and sad inroads upon the physical vigor of the "goose."

The stockman cannot even protect the range from him-

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\*Forest Service Bull. 62, p. 49 and p. 56.

self, because any improvement of his range is only an inducement for some one else to bring stock in upon it, and he thinks he had better put the extra stock on himself. Hence stockmen run all the stock on a given range which it will possibly carry at the time, with little thought for their own future and practically none for the future of the range. There is no one authorized to take care of the public range, and the present form of management has tended to make the beneficiary careless of the source from which he gets his livelihood, merely because he does not have legal control of the range he uses.

The lack of legal control acts detrimentally upon the range in two ways. Those men who, for their own benefit or from more altruistic motives, might care for and improve the range they are using, dare not do so for fear that their labors may only bring them competitors; hence there is no inducement for the desirable kind of an occupant to do what he otherwise would do gladly. For those individuals who are carelessly or consciously ruining the ranges there is no possibility of censure, much less of punishment, since they have no definite legal authority and consequently no definite responsibility.

Such a plan of management, or more properly speaking, such an absolute lack of plan or proper management, could produce little but poor results. The very greed of the users of the range and the periodic occurrence of dry seasons have been the only form of protection the ranges have had. The former causes overstocking and almost complete destruction of the forage crops. Then a dry season comes and the stock must be taken off the range or they will die off. Usually a large part does die and while the stockman is recovering from the financial loss and getting the range restocked, the range is itself recovering to some extent from the effects of the previous overstocking. And this cycle of changes is continually kept up, but each round of change



leaves an ever increasing permanent impairment of the range behind it.

### The Desirability of a Better System of Control

There can be but one conclusion to be drawn from these conditions. Every interest at stake—the stockman's interests, the best interests of the range, and the interests of the general public demand that the range be given into the control of such citizens as desire to use it and use it properly, and who may be given definite legal rights with respect to it and held personally responsible for the proper use and care of what is really public property. An *ideal* division of this public domain would place it in the hands of as many individuals living upon it as it is capable of supporting; but the existing land laws are of such a character that one may not acquire title to a sufficient quantity of this land to make a living upon, and control by title is the only form of control now possible. The land is good only for grazing and its carrying capacity is so small that from 2,500 to 7,500 acres of land (4-12 sections) would be necessary to support a family expending \$1,000 a year, assuming cattle worth \$15 per head and that the normal increase of such stock would be 50 per cent (carrying capacity 20-60 acres per head). These assumed values are a little low for normal years, but probably not far from the average. Non-resident or corporation control is not ideal but is much better than the present method of management, because the right to control brings responsibility with it, and, what is even more important, it renders careful management profitable to the parties in control.

### The Results of Control

The most important result of granting control to the user of a range is that he is then able to plan for a definite length of time in the future. He is able to ask himself how he had better conduct his business so that he may get better returns

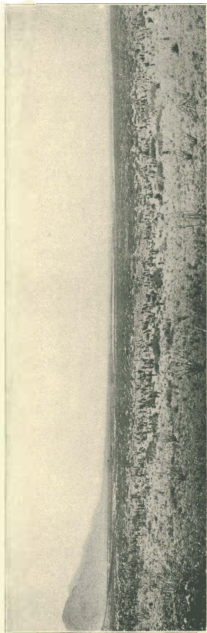


Figure 11. Black Grama, Tobosa, *Yucca radiosa*, Mesquite, Southwest of Hachita.

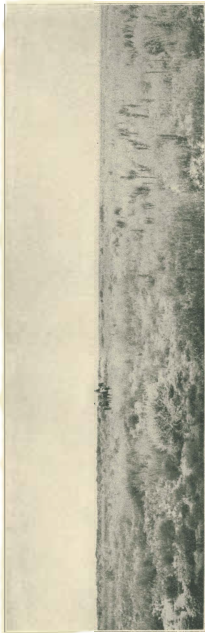


Figure 12. Typical Black Grama Society. Near Tularosa.



Figure 3. Poppy-Thistle (*Argemone* sp.) Taking a Range.



Figure 4. Good Pasture in the Mescalero Indian Reservation. The Owners Were Paying One Dollar Per Head Per Year for the Cattle.



Figure 5. Cattle Near Watering Places. Note the Absence of Vegetation.

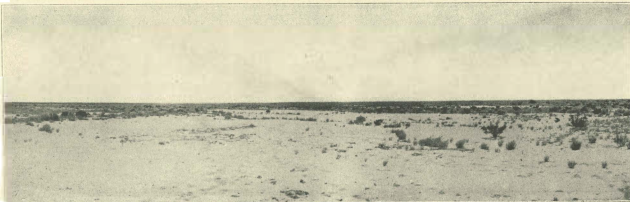


Figure 6. A Bare Spot. Not Uncommon in the Southern Part of the Territory.



Figure 9. A Bird's-Eye View Showing a Region Covered with Creosote Bush, *Acacia*, etc.  
Carrying Capacity Very Low Organ Mountains.

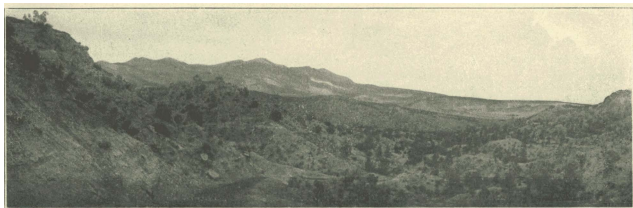


Figure 10. Rough Country on the West Side of the Mogollon Mountains.

from his holdings. The provident stockman will at once recognize the limitations of his range and instead of being forced to put on all the stock it will temporarily carry, he will put on less than it can carry, even for an extended period. He will immediately fence his range so he may know just how many head he has on a given area and will thus get accurate data as to carrying capacity where now he has only a hazy estimate or absolute ignorance. It will be to his interest to develop water at frequent intervals so that stock need not travel far for feed, thus distributing his stock more evenly over the grazing area. The ability to fence makes it possible not only to shut out the stock of a careless or overreaching neighbor, but also allows him to keep his own stock off a pasture which needs rest. It is then possible for him to use one pasture for the summer and save certain others for winter feed. It is possible for him to guard against the evil effects of poisonous plants, which are usually not abundant and occur only in restricted localities. Having control means that, if he is provident, he will kill out poisonous plants and bad weeds; he will stop arroyos and let them fill up and become set with grass. A very little work of this kind judiciously done will add many acres of grass land which are now nothing but rocky and gravelly weed beds. Definite efforts at re-seeding badly worn parts of the range are known to be a profitable investment of time, money, and effort. In a word, legalized control changes a "range" into a set of "pastures," and the presence of the fence eliminates a very large proportion of the uncertainty of the business. As an illustration of the truth of these statements, at least in part, I quote at length from a report and a letter relative to some considerable holdings in the southeastern part of the Territory.

The property is that of Mr. J. J. Hagerman and lies not far from Roswell. Shortly after it was fenced Mr. Hagerman had it carefully examined by Dr. David Griffiths, of the United States Department of Agriculture. Dr. Griffiths is an experienced investigator and is acquainted with the

ranges of much of the western United States, hence his judgment is of value. The following is quoted from his report of the examination made in 1903. After discussing the general character of the soil and the grasses, he says:

"There is so little data regarding the carrying capacity of native pastures that it is a very difficult matter to make an accurate estimate, especially when one is obliged to judge upon pastures which have been much abused in recent years, coupled with the variability of the seasons in this locality. Mr. Hinkle and myself, after riding over the ranch in May, agreed that one head to 22½ acres, or 10,000 on the entire ranch, would be a conservative estimate of its carrying capacity; and subsequently I discovered while in conversation with Mr. Hagerman that he had previously decided on about the same thing. He had estimated that he could hold 8,000 cows. These two estimates are practically the same, when one makes provision in the latter for the calves and bulls for a period of about six months of each year. I believe that this estimate is conservative, and that with a proper distribution of water the pastures can be kept in good condition indefinitely. The past season has been an unusually dry one, and the crucial test will come during the present winter."

The following letter, written in 1906, in answer to my inquiries as to the results of their treatment of the range, explains itself:

"Dear Sir—\* \* \* \* We fenced most of the Arroyo ranch, 240,000 acres, late in the fall of 1902, some of it not until early in 1903. When fenced it was divided into eight pastures, enabling us to give various parts of it a long rest, which we have done, and the result is extremely satisfactory. We began with about 5,000 cows and enough bulls to make one for about every eighteen cows. It was, as you will see, very much understocked.\* During 1904 and 1905 the rainfall was abundant, and it has been fairly good during this year.

"On large areas, which in the fall of 1902 and during 1903 seemed very discouraging, the grass now is splendid. This is particularly the case in one field of 60,000 acres which had been much over-grazed with sheep, and which we gave a complete rest during all of last year. There is a good deal of grama grass on this and it is now knee high and close together. The other grasses seem to have improved equally well. We now have 10,000 head of grown cattle and about 4,500 calves. We have about 50,000 acres which we have not used this year but will use during the winter.

"Our experience makes us believe that, taking one season with another for a long period of time, we can carry one grown animal (ones and over) on every eighteen acres without overstocking it. I mean exclusive of the calves. It will take more time to fully con-

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\*45 acres per head.

firm this opinion, but we believe it to be true. This year we have about 4,500 calves, being about 78 per cent of the cows bred or supposed to have been. When we put down more wells and otherwise improve our water supply we think this record can be beaten. We hope to get the tract so well supplied that an animal will not have to travel more than three miles to get water.

"We have attempted nothing in the way of range improvements, excepting to keep the cattle off over-pastured grass and give nature a chance to do its work. Of course, the public range outside our fence has been used and abused just as it always has been before we fenced our land. The contrast between the two is startling, and would be a good object lesson to those who object to the government taking care of a public domain, if their minds are not closed by selfishness. In my opinion, if the public domain is not taken care of, the time is not far distant when it will be ruined for grazing pur-

(Signed) J. J. HAGERMAN."

This is a single case, but the business has been carried on on such a large scale that it is fairly typical. The region referred to is of good natural carrying capacity for the Territory, but the three years' experience has shown that an increase of about 20 per cent has already been obtained, and that, too, merely as the result of giving the range rest. Much better results are no doubt possible when more active measures for the improvement of the ranges have been applied.

### The Remedy Proposed

We have seen that the present method of handling our ranges is wasteful and careless, and tends to the ultimate destruction of the stockraising industry. We have seen that every other industry of the Territory is directly or indirectly interested in the welfare of the stockraising industry and hence is harmed by such a method of handling the ranges. We have seen that the essential feature of this method of management which makes it bad instead of good is the lack of some definite form of control of the ranges placed in the hands of responsible citizens. The reason for this is that the land laws were made to fit a humid agricultural region; and hence do not work well when applied to a dry grazing region, which will not support a dense population. It is not



deemed wise (and experience has confirmed the opinion) to materially change the homestead laws; because we do not know what new method of farming may be developed, which will render it possible for a man to make a home on 160 acres of such land as is still open to entry.

Various attempts have been made to frame a lease law which would supply the need, but such laws have always been unsatisfactory because they did not adequately cover the very diverse conditions obtaining in different parts of the public domain. Any sort of lease law was believed to be not sufficiently flexible to fit all cases and at the same time prevent possible improper use of the privileges granted. Thus it will be seen that the power to delegate individual control to larger or smaller bodies of land must be placed in the hands of some authority wise enough to understand the conditions of a particular locality and just enough to all to allow of no favoritism; an authority so far removed from personal interest in the particular case as to be able to adjudicate it for the best interests of all parties in any way concerned. In the opinion of many, such an authority is easily found in the proper official of the central government at Washington.

"The only practical remedy is to give control of the range to the federal government. Such control would not only stop conflict, but would conserve the forage without stopping its use, as our experience with the national forests has fully proved. It would likewise secure to the west the great benefits of legitimate fencing without interfering in the slightest with the settlement of the country—on the contrary, while promoting the settlement of the country," says President Roosevelt. The President's recommendation as to a method of control is as definite and clear as his appreciation of the need of control. He proposes that the work of managing this area of something like 400,000,000 acres be placed in the hands of the Secretary of Agriculture, who shall be required to administer it in the way to subserve the best interests of the people who are most vitally concerned, i. e. those now oc-

cupying and using the public range in the vicinity of their own homes.

Such a plan avoids the difficulties in the way of a lease law, since it thus becomes possible to adopt that plan of management which will apply to a given region and still prevent the same plan being applied to conditions which it does not fit. It also gives discretionary powers to the Secretary, by which the actual resident of a region may be given preference over the non-resident stockman. This is as it should be, for the man who is settled in a region which he has selected for his home is the man who should be permitted to run his stock on the surrounding public range. Such a man is more directly concerned with the control of that range than anyone else; and he would be more apt to give it proper care, because his own interests are closely associated with its permanent improvement. It also agrees with the governmental policy of favoring the homemaker wherever he may be found. But men so favored should pay the necessary managerial expenses caused by such a policy; and most stockmen are ready to pay the nominal grazing fees which are sufficient to cover these expenses. That the proposition is too big for the managerial ability of a member of the cabinet seems to the author a trifle absurd. It seems strange, however, that men can handle fully as large propositions as matters of private business.

Objections were offered to the proposed plan of control by a number of speakers at the Denver Public Lands Convention, the most consistent of which were: (1) That such a form of control made the central government a landlord dispensing lands to the people, thus making all the dangers of favoritism possible; while at the same time entering into the business of managing the public property for the profit of the general government; and (2) The extreme difficulty of the task on account of the large amount of land to be managed.

What is the attitude of the general government toward the citizens? Isn't the worst that can be said of it "benevolent

paternalism?" Did the United States government ever ex-ploit the citizens of any region for the benefit of the central government? Isn't the ordinary case just the exact reverse? Does the governmental management of the postal service re-sult in great revenue to the government or does it result in very cheap and efficient service to the people? Isn't the gov-ernment committed to the policy of homemaking? And will not the establishment of a policy permitting the fencing of the public grazing lands under proper control increase the value of the lands of the resident land owner? And will not the assurance that one may have control of adjacent public range be an inducement to enter land, which is of itself insufficient to support a family? There is no intention whatever of with-drawing the public grazing lands from entry. The whole purpose of the plan proposed is merely the preservation of a goodly part of the "material basis" of our civilization else-where referred to.

What are some of the main features of such a system? What must the regulations provide for?

1. A responsible official in charge. He should be an officer of the general government, because the lands belong to the whole people, and because such an officer would be farthest removed from state politics. Preferably he should be a member of the cabinet.

2. The careful classification of the lands, with definite information as to carrying capacity of the ranges, the char-acter of the forage, and climatic and other conditions likely to affect their value. Particular care should be taken to safe-guard the mineral rights. Reclassifications should occur at stated intervals, and, for special reasons, at the option of the head official of the service.

3. The method of selecting lessees should be such as to favor the small owner who is a bona fide resident in the im-mediate vicinity of the leasehold. The method of selection, among individuals of equal rights in the respect of resi-dence, should, where possible, be by lot.

4. The period for which the lease or permit shall run should be as long as possible, and the tenure be as secure as it can be made under the system. The holder of an expired lease or permit should have preference in re-leasing.

5. The quantity of land leased to one individual should be in direct relation to the number and kind of stock which he will put upon the range and the carrying capacity of the range. This latter factor must be very carefully attended to, because the whole plan is based upon the one idea of making the public grazing lands more productive.

6. The tenant should own certain kinds of improvements made by himself and have right to all water developed by himself upon the land. These improvements might be purchased by the general government on surrender of the lease, or transferred by the owner to any succeeding lessee.

7. Roads should be established, and right to travel over large tracts should be given under certain restrictions as to the rate of travel and area of land passed over.

8. The right to cancel leases or permits, for failure to fulfill requirements or for any good and sufficient reason should be vested in the chief officer or his delegate of a specified rank.

9. The grazing lands should not be withdrawn from entry; but the lessee should be guarded from the entrance upon his leasehold of any but bona fide homesteaders. The homesteading of land in a leasehold should carry with it a right to lease a certain maximum number of acres, provided this did not reduce the large leasehold below a certain minimum, which minimum should in no case be less than the maximum allowed the second lessee. In determining these areas the factor of carrying capacity must of necessity be taken into consideration.

10. The total rentals charged should be no more than sufficient to maintain the service and should be apportioned

directly according to the relative values of benefits received. The payments should be made for one year in advance.

11. A definite ratio between different kinds of stock should be established, taking cognizance of the effect of each kind upon the range.

12. The lessee should be required to fence the lease-hold within a specified time limit. In case the permit were to a community, a bounding fence should be required, at least, and the division of the lands within this fence be delegated to the community.

13. The development of watering places within certain distances of each other (the maximum limit to be given where practicable) should be required of the lessee. Judgment is required in settling such questions, but the improvement of the range should ever be kept in mind by the official.

14. The protection of the range from erosion and from fire should be required of the lessee, and the rulings should be as rigidly enforced as possible.

15. In so far as possible the residence of the lessee upon his leasehold or nearly adjacent land should be required.

16. Locating, surveying, estimating capacity, inspection, and all such duties should be performed by officers appointed to the service by the Civil Service Commission.

17. A proper court of appeals for settling all disputes should be established.

18. All transactions in connection with the land—offer of permit, rental and other requirements, number and kind of stock allowed on the leasehold, time allowed in which to get it fully stocked, and *all* data of importance to would-be lessees—should be published at stated intervals in a prescribed and proper manner. *This feature of the publicity of all trans-actions of the burcau in charge is of vital importance.*



Figure 15. Forest and Woodland Conditions. Note Open "Park," with Blue Grama Society.



Figure 16. Blue Grama Society in Open Pine Forest. Near Reserve.



**Figure 1. Relief Map of New Mexico, Giving a General View of the More Prominent Topographical Features.**

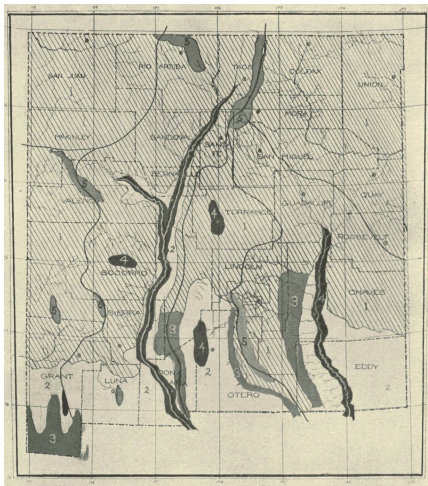


Figure 2. An Outline Map of New Mexico Showing the Distribution of the Principal Grass Societies.

1. The Blue Grama Society. The society in which Blue Grama is the dominant species. It covers the higher plains, the forest, and woodland areas.
2. The Black Grama Society. This is the society which occupies the lower plains of the Territory. The principal grasses are Black Grama, Tobosa, and the Needle Grasses.
3. This society is intermediate between 1 and 2. The characteristic grass is Hairy Grama, which replaces much of the Blue Grama and all of the Black Grama.
4. The Salt Grass Society. Mainly composed of Bunch Grass and Salt Grass, with sedges and rushes in wet situations.
5. The Arizona Fescue Society. The dominant grass is Arizona Fescue. The society usually occurs high in the mountains on open slopes and "burns."



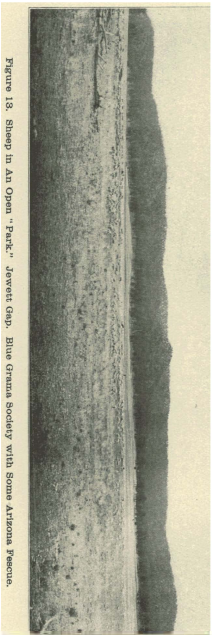


Figure 13. Sheep in An Open "Park." Jewett Gap. Blue Grasses Society with Some Arizona Fescue.

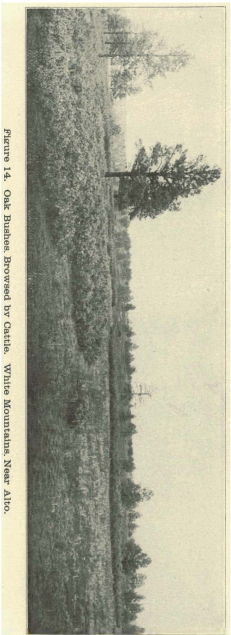


Figure 14. Oak Bushes Browsed by Cattle. White Mountains, Near Alto.

### What Have Others Done?

Texas owns her own public lands and has had a leasing system in force since 1883. A most satisfactory resumé of the history of the system of leasing now in use in that state may be found in Forest Service Bulletin No. 62 (p. 32, et seq.). The author of this article, Dr. F. V. Coville, Botanist of the U. S. Dept. of Agric., discusses in detail the growth of the leasing idea in Texas, the terms of the law which they have found most effective, and summarizes fourteen benefits derived, thirteen of which have been received by the stockmen of the state, while the fourteenth (an increased rental) comes to the state as a whole and reduces taxes for everybody in it. Dr. Coville also reports on the methods of leasing public lands belonging to the state of Wyoming, as well as the leasing system in use by the Northern Pacific Railroad for controlling their grazing lands. He then summarizes his studies in a proposed "System for the Regulation of Grazing on the Public Lands of the United States."

New Mexico already has a Territorial land commission which has charge of about 5,000,000 acres of land belonging to the Territory. The total number of acres leased does not appear in the Commissioner's latest report, but he shows \$9,247.24 received for rentals, which accounts for probably not less than 350,000 acres now rented. The system has been in operation but a short time, and no doubt all of the land will ultimately be rented. A system of regulations has been devised by the Commissioner, a printed copy of which may be had for the asking.

Each of the Australian colonies—Western Australia, South Australia, Queensland, New South Wales, and Victoria—as well as New Zealand, has extensive leasing systems in successful operation. Their systems are not alike in the details, but the central idea of each is the same; i.e. a general government official with large discretionary powers, in charge of the public lands and responsible to the highest

executive and the legislative body of the colony. Each of these colonies has large areas of crown lands which may be obtained by homestead, by purchase, or by leasing in a number of different ways. In most of them any kind of crown land may be leased for its proper purpose, as determined by the commissioner in charge, and for a rental commensurate with the value of the land. New Zealand has gone so far as to buy back lands of non-resident private owners who were using agricultural lands for grazing purposes, in order to lease them in small bodies to homemakers. The leasing policy has worked well in practically all variations, mainly because the laws have allowed the commissioner to fit the regulations to the particular conditions under which they have been applied.

Our land laws are not so adjustable; our lands are all assumed to be equally good in the sight of the law. But the application of this assumption and these laws has proven detrimental to our grazing land area. It behooves us therefore to advance to the acceptance of a saner conception of the whole question and adopt a better system of control. There is little doubt in the author's mind that the plan proposed by President Roosevelt is the best yet offered. Attention is called to the one danger of such a system by Dr. Coville in the article already referred to when he says:

"The inauguration of the system would require new legislation. Its success or failure would depend largely on the character of its administration. Discretionary powers are necessary if the law is to be successful in adjusting the equities of range occupants, and these same discretionary powers, if placed in the hands of incompetent or unscrupulous administrators, would bring disaster to the public interests and dishonor to the public service."

The question then resolves itself, as all executive and administrative questions always do, into *THE MAN*. No worthy citizen of our country doubts for a moment that we have

plenty of men who can perform such duties with credit to themselves and benefit to us.

### Summary

**INTRODUCTION.** The thesis is proposed that it is a wise policy to conserve as far as possible the "material basis" of our national prosperity. The forage crop of our public lands is believed to be a part of this material basis and capable of being conserved.

**AREA AND APPORTIONMENT.** The total area of about 78½ millions of acres is apportioned in Mexican land grants, railroad land grants, Territorial land grants, forest, Indian, and military reserves, patented lands, and public lands. More than 90 per cent of these lands are now valuable for stockraising only and probably will always remain so.

**TOPOGRAPHY.** The salient topographical features of the Territory are set forth with their associated climatic conditions.

**FORAGE PLANTS.** The main grass societies are discussed and the distribution of each is shown on a map. These societies may for convenience be called (1) the Blue Grama society; (2) the Black Grama society; (3) the Colorado Blue Stem society; (4) the Arizona Fescue society; (5) the Water Grass society; (6) the Salt Grass society. A number of other forage plants which are not grass-like are mentioned and the importance of each is noted.

**WEEDS AND POISONOUS PLANTS.** A number of weeds are characteristic of particular kinds of overstocked ranges; and a number of poisonous plants have been pointed out, while a few others remain to be studied.

**CONDITION OF THE RANGE.** Examination of the range shows it to be run down and not nearly as productive as it might be and as it once was.

**THE CUMULATIVE EFFECTS OF OVERSTOCKING.** Stock eat

the valuable forage plants and leave the poor ones, thus giving the latter undue advantages in the struggle for existence. "Skinned" ranges do not hold water; the run-off is greater and more rapid, tending to increase dryness, the cutting away of soil, and the drying up of springs and water courses. A particular example of the effects of overstocking upon the drainage and erosion is given.

**THE CARRYING CAPACITY.** The average carrying capacity for the whole Territory obtained from the acre-age and the average amount of stock, as well as it can be estimated, is approximately 35 acres per head per year (of cattle or equivalent). Detailed estimates for different parts of the Territory are given.

**THE FINANCIAL VALUE OF THE RANGE.** An estimate of the value of the range as obtained in several different ways shows that the prices ordinarily paid, viz: 2½c to 5c per acre per year, are about what the business will bear.

**THE METHOD OF MANAGEMENT** now in operation is detrimental to the business itself, to the ranges, and for both these reasons to all other industries of the Territory. The lack of legal control and responsibility are the principle characteristics of the present method or rather lack of management.

**THE DESIRABILITY OF A BETTER SYSTEM OF CONTROL.** An *ideal* system would place the land in the hands of as many individuals living upon it as it will support, and this ideal is the thing to be striven for. The important features to be included in any plan of management are to delegate legal control and impose responsibility upon the recipients. Both of these factors tend to the improvement of the range and therefore of the industry.

**THE RESULTS OF CONTROL.** A special case is cited in which control of a large area resulted in a 20 per cent improvement of the range in the course of about three years.

THE REMEDY PROPOSED. It is proposed that the public grazing lands be placed under the control of a member of the cabinet and a system of permits or leases be established under rules adapted to each separate region and governed by the conditions obtaining in the region. The fees should be large enough to support the staff necessary to carry the plan into effect. Some of the objections to this plan are considered. Points which must be covered by the regulations are submitted. These are largely based upon the experience of others.

WHAT HAVE OTHERS DONE? Attention is called to a resumé of the land laws of Texas by Dr. F. V. Coville, as well as the lease laws of Wyoming and the Northern Pacific Railroad Company. Our own Territorial policy is cited. The extended experience of the Australian colonies has proven that the plan is not only feasible but by far the best land policy yet proposed. The whole question resolves itself into the administration of a policy for the good of the many instead of for the few.



Figure 8. Mangas Valley, Near Mangas Springs. Cut Out in One Night as Result of An Ordinary Rain of About Two Hours' Duration.

to estimate the range horses of the Territory at about 50,000 head. It has been impossible to get data as to the number of goats running upon our ranges, but there are no doubt several thousand head.

Taking (1) the average number of head of cattle, 1,027,205; (2) the cattle equivalent of the average number of head of sheep, 899,146; (3) assuming the number of range horses to be 50,000, and (4) the number of goats at about 100,000, the cattle equivalent of which would be 25,000 head, we have the equivalent of a little more than 2,000,000 head of cattle as the average number supported by the ranges of New Mexico all the time. Taking 90 per cent of the territorial area as representing the total grazing area now in use we have 67,650,000 acres on which are supported 2,000,000 head of cattle, or an average carrying capacity of 33.8 acres per head per year. Just how the figures relating to sheep and cattle are obtained is uncertain, but they are probably taken from the tax assessment returns, at least in part. If this is the case, there is little doubt that the numbers are too small. Assessors and collectors have said more than once to the author that the tax returns generally show less than the actual number of stock and frequently very much less. In one case that the author remembers, it was a local joke that one season a large company shipped more stock than it paid taxes on, and it wasn't selling out either. A pronounced increase of the figure representing the total number of stock would raise the carrying capacity materially.

As a matter of fact the carrying capacity of our ranges is very different for different localities, and changes in the same locality with the seasons. Speaking very generally, the ranges of the south central and southwestern part of the Territory have the lowest carrying capacity, though the northwest corner is also low. A fair estimate for the south-western part (and one made independently by two experienced managers of large cattle interests of the region), tak-