

On Some Grasses, Chiefly of the Edwards Plateau of Texas

V. L. Cory¹

In 1885 the condition of my father's health obliged our family to move to a drier climate and a higher altitude. In so doing, we followed the pioneers closely enough to witness the transformation of a prairie country into a Great Plains empire devoted to the growth of a grass called wheat. Among my earliest remembrances is that of a sea of other tall grasses, principally the little blue stem.

After a long tiresome drive out from town in a lumber wagon containing also our household goods, we arrived at our home-to-be in mid-afternoon of a sunshiny day. The wagon was stopped perhaps fifty feet away from a little, unpainted frame house surrounded by weeds, and I, a small, active, barefoot boy, clambered out and headed for it. Soon I was floundering in a patch of sandburs. Matters were not improved when I sat down in them, and tearfully waited as mother hurried to rescue me. Thus I learned painfully about one grass.

Our farm was situated near the outer edge of the third bottom of the Arkansas River, which was four or five miles away to the southeast. This wide belt of flat land was in the short-grass country, while just to our west was the rolling land which still was a prairie of tall-grass. Our farm had been relinquished by the original settler. It was exceptional in that not all of the 160 acres had been plowed up; for elsewhere but little if any of the short-grass prairie had been spared. Our farm was in the southwest corner of its section, and on the southwest-northeast diagonal of the quarter section, two square blocks of ten acres each of the original prairie were located with their corresponding corners on that line; an arrangement I have never seen elsewhere. The short-grass of this level land was the favorite forage plant of the buffalo, and thus was known as buffalo grass. While the short-grass land was better for agricultural purposes and settled first, the tall-grass prairie did not long remain undisturbed.

¹Field Botanist, Southern Methodist University Herbarium.

I have memories of a prairie as a sea of tall grass; but my more vivid ones are of seas of wheat as I saw them throughout my early years. In late spring and early summer, when the wheat was tall, I liked to climb to the windmill platform twenty-five feet above the ground. The view up and down the valley as far as the eye could see, showed one vast expanse of wheat. As it became yellow on ripening, that large geographic area of which we were only a small part became known as the "golden belt." As the country changed from prairie to farming land the tall grasses disappeared, and the sea of grass soon became only a memory. My experience many years later, of spending six months in sailing and drifting across the Atlantic Ocean, and rarely seeing another vessel, stresses my memories of both the sea of bluestem and of wheat . . .

In September, 1923, I became Grazing Research Botanist of the Texas Agricultural Experiment Station, with headquarters at Substation No. 14. This was situated on the Sutton-Edwards county line, midway between Sonora and Rocksprings, in the south central part of the Edwards Plateau. The five-section range of the Experiment Station was one of limestone hills and valleys, thickly studded with live oak and shin oak thickets in about equal abundance. All the drainage was to the Devils River. The larger portion of the range, the eastern and northern parts, drained through tributaries running northwest into Angela Draw, thence southwest for 12 miles into the Devils River, while the smaller portion, the southwestern part of the range, drained off to the southwest through tributaries of Dry Devils Draw, which joined the Devils River 65 miles downstream, or 40 miles south by west thereof. The divide land was two hundred feet higher than the lowest part of the valley land. Here I first became acquainted with curly mesquite grass.

Both the ranching business and the range vegetation were quite new to me; since this sort of work was just beginning, we lacked both library and herbarium facilities. So my first work was to become familiar with the species of plants growing on the range; and in doing this I had, perforce, to accept the ideas and opinions of the residents as to the character of the range and the proper methods of harvesting the crop it produced. Once a month, for three complete years,

I closely followed a selected mother animal of each of the three types of livestock kept on our range: cattle, sheep and goats. I recorded the time of all their activities, from their rising in the morning until their bedding down that night (long working hours for a man!) I noted the time devoted to feeding upon the various species of plants. I also, during this period of three years, made a comprehensive and extensive vegetation survey, counting the plants, computing the ground space occupied by various species, and mapping the thickets and characteristic features of the vegetation.

From the start, the general impression conveyed to me by my associates and the ranchmen was that curly mesquite was superior to all other grasses as a forage for livestock, especially so for sheep and goats. Because the curly mesquite grew almost everywhere, it was their belief that this section of Texas was favored above all other sections as a ranching country. There was little or no interest concerning any possible improvement of the range, nor its maintenance in as good condition as it was then. Seemingly, those who had some knowledge of the range in its earlier days, were now satisfied that its present condition was better for livestock than it had been then. I eventually learned, however, that the range as I first knew it, already had seriously deteriorated, and that its condition was steadily worsening.

My first enlightenment came within a few years when, near Sonora, I chanced to meet an elderly cowboy. After mentioning my great interest in range vegetation, I asked him if he could give me any information about it, and particularly of what it was like in the earlier days. He was friendly and at once qualified himself as a pioneer. It pleased him to have a younger man ask for information which it was in his power to give.

We were in the valley of a tributary of Angela Draw (here about a mile wide), a mile or so above its junction with that draw. He told me that fifty years before he had traveled this same draw, and down the Devils River valley nearly to Juno, as he drove a flock of sheep from his headquarters near Junction. There were no fences, nor was the country timbered then, as is now the case. This valley and all the other valleys then were free from woody plants; and the entire country was a prairie of tall bunch-grass, reaching

at least to one's stirrups. The tall grass (which he called "sage grass," and which we designate as silver beard grass) was certainly *Andropogon saccharoides*. At that time the only short-grass was around water holes and in depressions in the valleys. Thus in the early days this tall grass was dominant in a vast prairie. This was much the same as the prairie with a similar dominant tall grass, the little blue stem (*Andropogon scoparius polycladus*), which I had known as a child in Kansas.

Since the country in the vicinity of his early activities had now become something of a vast cedar brake, substantially worthless for grazing purposes, I asked the elderly cowboy about the occurrence of the junipers at that time. These, he said, were few in number and confined to the headers (the gully or ravine-like beginnings of the branches of the draws, or drainage courses, on the escarpment bordering the valleys). He further elaborated on the vast changes in vegetation that had taken place by stating that where he had first worked, just as it was here and everywhere in the general region, the tall grass had gone, trees had spread everywhere, and the valleys, once having grass only, now were occupied chiefly by weeds, thorny shrubs, and prickly pear. The vegetation we were viewing evidently appeared to him as it did to me. I had witnessed in my very early years the destruction of a prairie through plowing, but until this time I had hardly realized that a prairie could be destroyed by long continuous overgrazing. Destruction by overgrazing takes longer, but it can be accomplished well within the allotted years of a cowboy's life.

In December, 1923, while upon an exploratory stroll, I came upon a dead ewe, her muzzle discolored by a greenish, frothy exudation. She was lying just outside of a stony, grassless flat at the head of a draw. This flat was thickly studded with prickly pear plants, unusually large for the region, growing in a dense stand of poison bitterweed, *Actinea odorata*. I had never even heard that this plant was poisonous to sheep, but the evidence here was obvious that such was the case. This was almost the first of a long series of extensive losses of sheep from feeding on this particular plant. I reported the discovery to the Veterinarian and the Shepherd of our staff. The former reported one or two simi-

lar cases from localities over a hundred miles northwest of the Experiment Station. Both agreed with my interpretation of the evidence. The ranchmen who had lost sheep suspected the plant as the cause; it was four years later, however, before its toxicity was established through experimental feeding. At this time the plant was largely confined to flats at heads of draws, and to lake-beds; there was little or no occurrence of it in most grasslands. Such spots soon became known as "bitterweed hazard areas." In but a few years, poison bitterweed spread so extensively throughout the grassland, that in its flowering season the country appeared as a sea of gold, the vista always limited by numerous thickets of oaks. The quick spread of this poisonous forb brought sharp attention to the rapid deterioration of the range, and served to convince many ranchmen that their ideas concerning the character and the capacity of their ranges were decidedly faulty.²

At Substation No. 14, in addition to the open range where grazing was continuous throughout the year, there were three fields, two of which were grazed after the crops were removed, and one, devoted to growing spineless cactus, not grazed at all. There was also a rectangular enclosure, 2 x 8 rods (set up in 1918 but with fencing sometimes defective during the first ten years), which gave chances for the study of range vegetation. Some other enclosures were established later in areas where poison bitterweed was the dominant plant.

In 1924-26, detailed vegetation surveys of 115 acres in six of the Experiment Station pastures showed that about 85 per cent. of the grass cover was curly mesquite (*v. Cory*, "Curly Mesquite Grass in Texas and Northern Mexico," *Wrightia*, vol. 1, pp. 214-17, June, 1948.) No buffalo grass areas were included in these surveys, but this grass would rank next in importance to curly mesquite only because it occupied so much less acreage. Besides these two turf grasses, the annual grasses were grazed extensively, but only in their short periods of growth.

At those times when the turf grasses had no green growth, and in those years when winter rainfall was favorable, the annual grasses became valuable forage plants. In the short-

²The interested reader is referred to my discussion of this situation in "A Study of Carrying Capacity of a Range," Texas Academy of Sciences, *Proceedings and Transactions*, 1946 (1948).

grass country (as at Substation No. 14) the useful annual grasses were those that matured quickly, and fruited heavily at or near to the ground (which tends to insure the perpetuation of the species.) Such grasses, sought out by sheep and goats, are almost never grazed by cattle; in order of abundance on the Experiment Station range, these grasses of small growth were little fescue (*Festuca octoflora*), *Trisetum interruptum* of the oat tribe, *Limnodea arkansana* of the *Agrostis* tribe, and rescue grass (*Bromus catharticus*). In the tobosa grass country of the Edwards Plateau the most abundant annual grass frequently is little barley (*Hordeum pusillum*), which ranchmen commonly refer to as wild rye, although the two species are quite dissimilar. The little barley usually grows taller than the other annual grasses mentioned, and usually occupies disturbed or denuded areas. It matures early and becomes weedy and objectionable on the range. Rescue grass requires more favorable moisture conditions for its growth, but then becomes the most valuable of these annual grasses.

Because of their short duration, the annual grasses do not characterize range vegetation as do the perennial grasses. Thus from the east to the west on the Edwards Plateau there are zonal areas of buffalo grass, curly mesquite grass, and tobosa grass. The buffalo grass country is more nearly a pure stand of buffalo grass than is the case with the other two grasses in their areas. Substation No. 14 is in the curly mesquite grass territory, and has no tobosa grass. However, it does have a substantial amount of buffalo grass.

Curly mesquite grass (*Hilaria Belangeri*) is the dominant grass in the central portion of the Edwards Plateau, growing essentially in pure stands and occupying all the ground to which it is peculiarly adapted. This grass grows in tufts; and through its wiry stolons (which root at the nodes to form new tufts or plants) it carpets the ground. It is therefore a turf grass, or, (as contrasted with the taller bunch-grasses), one of the short-grasses. The tufts usually are from 4-10 inches tall and each stem bears a short flowering spike; the heads form usually in both spring and fall, and frequently without producing viable seed. The stems are erect and are bearded at the nodes; and the leaves are flat, usually short, crowded at the base, forming a curly tuft.

Where moisture or other conditions become unfavorable for the growth of buffalo grass, curly mesquite grass may supplant it. Since curly mesquite is less palatable to livestock than is buffalo grass, an increase of curly mesquite is evidence of retrogression of the range.

Buffalo grass (*Buchloe dactyloides*) forms a denser turf than curly mesquite, and the nodes of the culms and stolons are not bearded. Buffalo grass also differs from curly mesquite in that pistillate flowers only are produced on one plant, and only staminate flowers on another. The staminate flowers are in short spikes about half an inch long; and are conspicuous, being borne on slender culms which are 2 to 6 inches tall. The pistillate flowers are borne in heads, which are usually concealed in the mass of foliage.

Buffalo grass usually occurs in pure stands. In areas of curly mesquite grass it is usually restricted to small areas, which vary from small islands surrounded by curly mesquite grass (as in flat lands), similar islands not surrounded by grass (as in lake-beds subject to occasional submergence), to larger areas in shallower or better drained lake-beds, flats at heads of draws, and flatter portions of some of the draws. In these cases buffalo grass grows in the area that catches and holds rainfall that drains off higher ground. In flats, the depression of surface may be so little that without the change in grasses, it would escape observation. The islands surrounded by curly mesquite show up either by being grayish-green in color or by being grazed to the ground while the surrounding curly mesquite is slightly grazed, if at all. The islands not surrounded by grass are in lake-beds, and are those spots (usually only a few to several feet in diameter) sufficiently elevated to more quickly emerge from the water, while the lower areas remain submerged so long that buffalo grass cannot survive. In areas of tobosa grass both flats and lake-beds are much larger in area, and water in the latter soon drains off through sinks. The destruction of buffalo grass through excessive grazing results in spots or areas which become denuded of perennial grass and are then occupied largely by worthless or harmful forbs.

At Substation No. 14 the lake-beds, more or less circular in outline and saucer-like, are one to five acres in area. The belt lying between the irregular line of prolonged submer-

gence and the regular line of the highest submergence is one of a pure stand of buffalo grass. Above this belt is a pure stand of curly mesquite and below it, except for higher spots, there are no perennial grasses. In recent years some of the lake-beds have been fenced to exclude livestock, and thus became exclosures. In such cases, invasion of other grasses (such as rescue grass, weedy annual grasses, and moisture-loving perennial grasses) occurs, and these thrive.

In one case, a lake-bed was divided into three unequal parts, the middle one of which was established in 1928, and used thereafter as a dump ground. Five years later, the northern (and major) portion was made into an exclosure, while the southern portion remained part of the open range. In the beginning this lake-bed had a pure stand of poison bitterweed, and in its open area it still has this stand; while in exclosures this plant disappears in the first few years. In the dump ground exclosure the available surface first became a turf of buffalo grass, and then in a lower area at the north fence-line vine mesquite grass (*Panicum obtusum*) got a start and expanded into a dense mat to occupy the moister ground, even in the adjoining exclosure. This grass does not survive overgrazing on the range. Also chance introduction of Johnson grass (*Sorghum halepense*), Bermuda grass (*Cynodon Dactylon*), and rescue grass took place in the early history of the exclosure, and all have increased and were thriving four years ago. This is especially true of the Bermuda grass, which has jumped the fence to become established in small islands in the larger adjoining exclosure, which already had some islands of buffalo grass. None of the islands is in contact with another, but, as they expand, this should take place. In this event, with favorable moisture conditions, I believe that the buffalo grass will whip the Bermuda grass. The refuse in the dump ground has a bad effect on the buffalo grass, and Johnson grass probably will emerge winner in the struggle for survival. In both exclosures three or four species of annual grasses hitherto not known from this part of Texas have appeared; they give promise of retaining a foothold, at least for a period of years. Some grasses seeded in the larger exclosure have reproduced themselves, but show little ability to withstand tough competition. Other native grasses have obtained a

start, and some of these will hold their own and should increase for some years longer at least, provided the enclosure is continued as such. Two such native grasses of most promise are Texas needle grass, *Stipa leucotricha*, and white triodia (*Triodia albescens*).

Bermuda grass does not maintain itself on the open range at Substation No. 14. Once a plant became established outside of a corner of a small enclosure, in a weedy and ungrassed spot. The Bermuda grass survived about three years, and had increased to some two square feet when dry weather killed it. When seeded in some suitable spots (such as water lots where curly mesquite has been killed out and at outlets for drainage of cesspools) Bermuda grass maintains itself where closely grazed and excessively trampled (which curly mesquite does not do), and really thrives when not subjected to grazing. The evidence suggested that buffalo grass would crowd out Bermuda grass in a lawn, when amply watered.

Another instance of growth of Bermuda grass on open range in an area too dry for it to occur ordinarily, I found in the northwestern part of the Edwards Plateau. It was on a ranch where they let the windmills run constantly, so that the overflow from the tank spread out over and irrigated a small valley for a quarter-mile. This valley was occupied by a luxuriant growth of Bermuda grass. The Veterinarian and I were investigating a forage poisoning of cattle at this ranch. Outside of this subirrigated place the open range was dry, and the cows were feeding exclusively upon the rank growth of this grass; with results similar to those obtained when cattle feed exclusively upon rank growth of bur clover (*Medicago*), or on milk vetch, commonly called peavine (*Astragalus*). This condition may be called "protein poisoning," and is a forage poisoning not caused by feeding upon a toxic plant: it never takes place with either curly mesquite or buffalo grass.

A fourth perennial grass, Texas needle grass (*Stipa leucotricha*, more commonly known as speargrass or wintergrass), is unimportant at Substation No. 14. Sheep and goats did not eat it, and cattle ate it only during the winter. Elsewhere it is the dominant grass in open woods, and seems to be held in high esteem. This grass remains green in the winter while the other perennial grasses do not. The foliage

is, however, harsh to the touch, so that it is eaten by livestock only when hungry. The peculiar thing about this grass on the central portion of the Edwards Plateau is that it always grows in oak thickets on the range, where frequently it is the only grass, and never in the open. In exclosures adjacent to oak thickets, Texas needle grass invades open areas and increases slowly in abundance, for the first few years, at any rate. This grass has given, however, no evidence in the exclosures that it will ever become a dominant grass in the open. Since it will grow in the open of ungrazed areas it seems probable that, as a seedling or young plant, this grass is palatable, at least to cattle, and thus is not permitted to survive. The grass that grows in the shade is not as nutritious as that in the sunlight, hence the plants of the thickets are favored in survival.

Tobosa grass (*Hilaria mutica*) becomes important in the western and northwestern portions of the Edwards Plateau. It is a bunch-grass with rhizomes but without stolons. The wiry, solid culms are erect and usually at least one foot tall. Livestock feed upon the young growth of this grass, but avoid the mature grass whenever possible. Since the bunches of this grass are sizable, are not crowded closely together, and grow in areas where there is no run off or rainfall, space is afforded for the growth of annual grasses and palatable forbs under more favorable conditions than is afforded in areas of the turf grasses. Thus tobosa grass has a value to ranchmen beyond that afforded by the plant itself. In recent times the tobosa grass country shows areas, sometimes large and sometimes small, which are occupied either wholly or in part by turf grasses, or completely denuded of all grass. These denuded areas represent destruction of buffalo grass through excessive grazing, and are now occupied chiefly by annual forbs, frequently toxic. At the best, some of the spots devoid of perennial grasses may have a good growth of short-lived annual grasses. Larger areas are higher, better drained, have no denuded areas, and grow curly mesquite; the smaller areas are lower, not surface-drained, more or less denuded, with a mixture of curly mesquite and buffalo grass, or of buffalo grass alone.

In the Trans-Pecos area, tobosa grass grows in lake-like flats, where at times rainfall accumulates. These tobosa flats

show pure stands of this grass, and are surrounded by higher ground occupied by desert shrubs and with little or no grass. Tobosa grass also grows in valleys, narrow or wide, between hills or mountains, and usually in pure stands. Some of these areas are quite extensive, but all owe their origin to rainfall's collection and retention in the flat lands of the valleys. Tobosa grass withstands flooding and heavy trampling. It grows in loose, deep soils highly subject to erosion. Sometimes tobosa flats or valleys have been destroyed by the creation of drainage courses resulting from erosion of cattle trails, wagon roads and, in one instance, to the plowing of a long straight furrow leading down from a spring and crossing a broad flat. In the last case mentioned the furrow became a ditch six feet deep and fifteen feet wide (which will become wider as the years go by), the flat lost its grass, the vegetation became mostly desert shrubs, and there was little feed produced for the cattle.

At Substation No. 14, one winter, in three separate pastures showing progressive stages of invasion of poison bitterweed, similar exclosures were established in areas corresponding to stages of destruction of the once pure stand of curly mesquite grass. As I recall it, the approximate number of plants of the toxic forb at this time were $3\frac{1}{2}$, $5\frac{1}{2}$, and $7\frac{1}{2}$ million plants to the acre, when counted as seedling plants at 1-3 inches tall. In the heaviest infestation there were no grass plants. In all three cases the results in the exclosures were similar: the gaining of a good grass cover of curly mesquite, the elimination of the poison bitterweed, and the invasion of some of the bunch grasses. The progressive improvement continues for perhaps as long as ten years before the process of retrogression begins, and this defeats the establishment of the climax bunch-grass. On the open range, under conditions of moderate grazing, the climax grass for that area, in the course of time, should become established.

The exclosure, which was established in 1918, was located in the eastern edge of a stony flat grassed with curly mesquite and bordered by live oak thickets. At its south end it contained a long-established oak thicket (dense enough to exclude most herbaceous vegetation) thirty feet in diameter, while just outside its north end was a young thicket in which the grass cover still largely persisted. Later, by means

of root suckers from this thicket, live oaks invaded the grassland of the enclosure. In such thickets, particularly the older ones, the bunch-grasses had not been completely exterminated, as was the case on the open range; hence there was a probability that some of these tall grasses would become reestablished in this enclosure. Such turned out to be the case. Ten years or so later curly mesquite was supplanted by a dominant growth of side-oats grama (*Bouteloua curtipendula*). This species, therefore, appears to be the subclimax grass of the area. At this point the natural plant succession was halted, and it became apparent that freedom from grazing was not Nature's way of restoring the climax prairie of the Indian. When we realize the fact more generally that man in the past, and even in the present, has been prone to work against Nature, rather than with her (to our great detriment), a change for the better is potentially in the making.

Note

MONARDA PUNCTATA L. var. *maritima* Cory, var. nov.—Caule folisque hirsutis, pilis pansis 2 mm. longis et ultra; bracteis exterioribus sub glomerulis apicem versus elatis dentatisque, dente apicali quoque glanduloso-denticulato. TYPE: Aransas Co., Texas, 4½ miles north-east of Rockport, *Cory 45383*, July 25, 1944 (in Herb. Southern Methodist University). Additional collections seen: Aransas Co.: Aransas Refuge, frequent in sandy soil, *Cory 51182*, Nov. 25, 1945; Aransas Refuge, St. Charles Peninsula, *H. L. Blakey 42*, Aug., 1944. Differs from other varieties of *Monarda punctata* in that the purplish outer bracts subtending the glomerules are expanded toward the apex, rounded and toothed, the apical tooth abruptly deltoid-acuminate, as much as 2 mm. long, with five or more frequently minute glandular-pointed teeth on either side; the inner bracts are narrow, not purplish, narrowly long-acuminate, minutely and sparsely toothed or entire, long-ciliate especially below the middle; the stem and leaves are hirsute with spreading, bristle-like hairs up to 2 mm. or more long. McClintock and Epling (Univ. California Publ. Bot. 20: 180, 1942) cite other collections of this variety from Aransas and Refugio Counties, under *M. punctata*, with the remark (p. 181) that "perhaps they should be designated as a subspecies." These authors also cite a collection from Nacogdoches Co. as *Parks 33932*. This is my no. 33932, and refers to plants collected at Fern Lake, Nacogdoches Co., by Dr. Hal Parks (H. B. Parks, Jr.). I am convinced that the data for this collection are incorrect, due probably to a sheet from the coastal area becoming mixed with material from Nacogdoches Co.—V. L. CORY, Field Botanist, Southern Methodist University Herbarium, Dallas.