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REPORT

OF AN

INVESTIGATION OF THE GRASSES

OF THE

ARID DISTRICTS OF TEXAS, NEW MEXICO,
ARIZONA, NEVADA, AND UTAH,

IN

1887.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1888.

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LETTER OF TRANSMITTAL.

WASHINGTON, *January 20, 1888.*

DEAR SIR: In accordance with your directions to make an investigation of the grasses of the arid districts of the West, Mr. G. C. Nealley, of Houston, Tex., was appointed to investigate the grasses and forage plants of the arid portions of Texas, and Prof. S. M. Tracy, of Columbia, Mo., to make similar investigations in Arizona, New Mexico, Nevada, and Utah. The latter investigations were very thorough, considering the time occupied, but were necessarily mainly restricted to the vicinity of the railroad stations.

A detailed report from each of those observers is herewith presented. Of the 200 species collected in this region we may be assured that there are many which would prove useful for cultivation, and it is to be hoped that the experiment stations of the States embraced in the arid districts will give to such a thorough trial.

Respectfully,

GEO. VASEY,
Botanist.

Hon. N. J. COLMAN.

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REPORT OF AN INVESTIGATION OF THE GRASSES OF THE ARID DISTRICTS OF NEW MEXICO, ARIZONA, NEVADA, AND UTAH.

Raton, New Mexico, June 6.

Raton is at the southern base of the Raton Mountains. The adjoining plains afford excellent pasturage, being well covered with *Buchloe dactyloides* (Buffalo grass) and *Hilaria Jamesii*, while in many places *Agropyrum glaucum* is becoming very abundant, and is said to be increasing annually and valued very highly. The latter is occasionally cut for hay, and is everywhere known as "Blue-grass." The higher mesa lands also give good pasturage and are often cut for hay. *Agropyrum repens* (Quack grass), a species of *Poa* (*P. Tracyi*), a variety of *Festuca ovina*, and a species of *Carex*, apparently *muricata*, are very abundant, and there is a considerable mixture of *Bouteloua oligostachya* (Gramma-grass).

Rain-fall is said to be on the increase. Alfalfa and oats form the leading cultivated hay crops.

The following notes were taken on the grasses found here:

Koeleria cristata.

Occasionally seen on the sides of the mountains, and on the mesas.

Found at almost every station on the whole trip, but never very abundant. It is known as June grass.

Festuca ovina, var.

Very abundant at the top of the mesa, but not yet in flower. It forms a large part of the mesa hay.

Bouteloua oligostachya (Gramma-grass).

One of the most common species on the mesas.

Agropyrum glaucum (Blue-joint, Blue-grass).

Common on lowlands and the sides of the mesa.

Hilaria Jamesii (Black bunch-grass).

Very abundant on the vegas (meadows) with *Buchloe*, and said to be increasing. It makes excellent pasture at all times when not covered with snow.

Poa pratensis (June-grass, Kentucky blue-grass).

Seen at one place on the side of the mountains only.

Poa Tracyi.

A species of *Poa*, which was found abundant near some springs toward the top of the mesa.

Schedonnardus Texanus (Crab-grass).

Common on the vegas and valued for early pasture, but worthless for hay or late range. Found through New Mexico and Arizona.

Carex muricata? (Water-grass).

Very abundant on the side of the mesa and in low places on the top. It is cut with the grasses for hay and is eaten fairly well.

Santa Fé, New Mexico, June 13.

The grasses of the mesa in this vicinity are very sparse, chiefly consisting of Grama (*Bouteloua oligostachya*) and Buffalo grass (*Buchloe dactyloides*). In the mountain valleys and hill-sides there is a larger variety. On irrigated land some of the eastern species occur.

The grasses noted here were:

Elymus sitanion.

Very abundant on hills, and occasional on lowlands.

Poa Bigelovii.

In one locality in a ravine.

Poa annua.

Abundant on lowlands and eaten closely.

Poa pratensis (June-grass, Kentucky blue-grass).

Comes in wherever the land is irrigated. Very common in door-yards.

Aristida purpurea.

The most common species on the hills.

Agrostis verticillata.

Common on low ground and eaten closely.

Agrostis vulgaris (Redtop).

Occasionally seen on low ground.

Hordeum jubatum.

Common.

Sporobolus cryptandrus.

Occasionally found. Not yet generally in flower.

Sporobolus depauperatus.

Rare.

Glyceria nervata.

Not rare along a stream.

Stipa viridula, var. *robusta*.

Rather common at the foot of the hills and apparently not eaten very much by stock. It was not seen elsewhere on the trip, except at Colorado Springs.

Alopecurus aristulatus.

Common on wet ground.

Lolium perenne.

Quite common on low dry lands and eaten closely.

Phleum pratense (Timothy).

One field seen, which was sown on irrigated land in January, 1886, gave a heavy crop the following season, and now (June, 1887) looks well.

Dactylis glomerata (Orchard-grass).

Grows occasionally in irrigated fields.

Buchloe dactyloides (Buffalo-grass).

Much less common here than at Raton.

Bouteloua oligostachya (Grama-grass).

Very abundant on the hills, and the most highly valued of any of the native species.

Melilotus parviflora (Sweet clover).

Very common here and seen occasionally in damp places from here to Los Angeles.

Trifolium involucreatum.

Common on the banks of ditches, and eaten closely by stock.

Trifolium repens (White clover).

Common in yards and along the streets.

Trifolium pratense (Red clover).

One field on irrigated land, the first ever tried here, gives a heavy crop this year.

Medicago sativa (Alfalfa).

This is the leading hay crop. It costs about \$10 per acre to sow and irrigate it the first year, after which it gives a profit of \$20 per acre annually. The hay sells at from \$18 to \$20 per ton.

Albuquerque, New Mexico, June 15.

The city is located in a broad valley on the Rio Grande. The soil of the valley is very sandy, and when but a few feet above the level of the river is almost barren, except where irrigated. On both sides of the valley are high mesas, and 8 miles to the west there are extensive lava beds. On the mesas *Bouteloua oligostachya*, *Hilaria Jamesii*, and *Aristida purpurea* are the prevailing species. On the lowlands, *Agrostis verticillata* and *Eatonia obtusata*, with a few sedges, form the bulk of the pasture and hay. *Oryzopsis cuspidata* is quite common and grows very large on low, sandy lands and along the slopes of the mesas. This is often called "wild millet," or Bunch-grass, and many consider it superior to *Bouteloua* on account of its larger and abundant seed. Wild rye, a species of *Agropyrum*, is valued highly for pasture when young, but is considered worthless when old. I am told that 60 miles south of here

Andropogon saccharoides forms the bulk of the hay crop. *Poa pratensis* (Kentucky Blue-grass), and *Cynodon dactylon* (Bermuda grass) have both been introduced, but do not spread.

The following forage plants were noted in this vicinity:

Agrostis verticillata.

Found in wet meadows throughout the region visited.

Agrostis vulgaris (Red-top).

Occasionally seen in wet meadows.

Agropyrum unilaterale.

Common along the banks of ditches.

Agropyrum tenerum.

Common in one locality, at the edge of a wet meadow.

Eatonia obtusata.

In the same situation as the above.

Sporobolus asperifolius.

Common on ditch banks and similar situations throughout the region visited. It is very generally affected with a species of fungus (*Tilletia asperifolia*, E. & E.)

Sporobolus airoides.

Common on the mesa. Found on dry, sandy soils throughout nearly the whole region visited.

Sporobolus cryptandrus, var. *stricta*.

Seen at the foot of the mesa, where it was eaten closely.

Sporobolus cryptandrus.

Occasionally seen in the streets.

Panicum obtusum, called *grape-vine mesquit*.

Common here and at Algodones, where the runners were often 10 feet long. It is eaten well by stock.

Elymus Macounii.

Common on low, wet land.

Aristida purpurea.

Common on the mesa.

Triodia pulchella.

Occasionally seen on the mesa.

Hilaria Jamesii.

Very abundant on the high mesa.

Bouteloua polystachya.

Seen in one locality on the mesa.

Bouteloua eriopoda.

Found in the same locality as the above, and what seemed to be the same as this was the most common species on the lava bed.

Bouteloua racemosa.

Found sparingly on the side of the lava.

Munroa squarrosa.

Found in small quantities in one locality.

Chloris verticillata.

Common on low, sandy land.

Andropogon saccharoides, var.

Common on low, sandy land, where it is valued highly for hay and used when young for pasture.

Polypogon Monspeliensis.

Common at the edge of streams and in swampy places through New Mexico and Arizona. It varies from 1 inch to 2 feet in height, and is not eaten when other food is to be had.

Polypogon littoralis.

Common with the above in wet ground.

Eragrostis Purshii.

Rare.

Stipa pennata, var. *Neo Mexicana.*

Occasionally seen on the mesa.

Scleropogon Karwinskianus.

Quite common on the high mesa above the lava beds.

Muhlenbergia Texana.

Abundant among rocks on the side of the lava bed.

Setaria caudata.

Rather common near the base of the lava bed.

Bromus racemosus. (Introduced.)

A single plant seen.

Dalea scoparia.

Very abundant on the mesa near the lava beds. It furnishes almost the entire forage in the dry season.

Juncus Balticus, var., and a species of *Eleocharis* form fully two-thirds of the growth of the low meadows which are cut for hay. Pastures containing the same species are eaten closely and evenly.

Coolidge, New Mexico, June 19.

Coolidge is located 6 miles west of the Continental Divide, in a valley some 5 miles wide, with buttes perhaps 1,500 feet high upon the north, and sloping hills fully as high upon the south. There is no water for many miles in any direction except that obtained from wells. The valley or pass over the divide reaches from near Bluewater to Winslow, Ariz., and through its whole length is dry except in the rainy season. In the cañons are occasional springs which afford scanty water for the few sheep and goats kept by the Indians, but water in sufficient quantity for cattle or horses is rarely found except where wells have been dug. Very little stock is kept here, and there is no farming of any

kind. *Bouteloua oligostachya*, called here black grama, is the most abundant species of grass. In the valley *Buchloe dactyloides* (Buffalo-grass) is also common, and *Agropyrum glaucum* is seen occasionally, while on the hill-tops a species of *Muhlenbergia* is quite common, together with a small proportion of *Hilaria Jamesii*. Very few species were found in a condition for herbarium specimens, as the grasses here make no growth until the August rains fall, when they are said to make a rapid and abundant growth until snow comes, and then remain dry until the next year. Ice an eighth of an inch thick formed here last night, June 19.

The grasses noted here were the following:

Schedonnardus Texanus.

Only occasionally seen here, but at Chaves, 30 miles east of here, it is one of the most common species along the railroad.

Sporobolus depauperatus?

Quite common in the valley, and closely grazed. All the plants observed were affected with a fungus.

Poa Bigelovii.

Occasionally seen in the valley.

Agropyrum glaucum. (Blue stem.)

Somewhat common, but not eaten when grama (*Bouteloua oligostachya*) is to be had.

Elymus Sitanion.

Common, but not plentiful.

Oryzopsis micrantha.

Not rare on the top of the mesa.

Andropogon scoparius.

Rare.

Bromus ciliatus, var.

Occasionally found on the side of the mesa.

Poa Bigelovii.

Rather common on the top of the mesa.

Sporobolus cryptandrus.

Common on the mesa.

Koeleria cristata.

Occasionally found on the mesa.

Sporobolus tricholepis.

Common on the mesa.

Winslow, Arizona, June 23.

From Coolidge to this point the railroad follows the valley, which in the wet season is the course of the Little Colorado River, but which is now almost dry, water being seen at but two points. The country is

very similar to that about Coolidge, but more sandy and barren. The nearest ranch where good water can be had is 25 miles to the south-east, and there are no others besides that within 50 miles. On the sandy plains about here is a scant growth of *Bouteloua oligostachya* (Grama-grass), with a smaller amount of *Buchloe dactyloides* (Buffalo-grass), the whole insufficient to afford range now (June 23), even if water could be had. Along the river, which is strongly alkaline, *Distichlis maritima* (Salt-grass), is almost the only species, and is eaten somewhat. After frost, stock live mostly upon White sage (*Atriplex*), and "saleratus weed" (*Salicornia herbacea*), which grows quite abundantly on soils too alkaline for other plants. This plant is quite abundant about Salt Lake City, the only other locality where it was observed on the trip, and is valued highly there for winter feed.

In the San Francisco Mountains, 50 to 70 miles southwest of here, Black bunch-grass (*Hilaria Jamesii*) is very abundant, and regarded as the most valuable species. *Bouteloua oligostachya* (Grama-grass) is also common there, and in the pine woods "Pine bunch-grass" (*Festuca*, an undetermined species) is the main reliance for winter range. Wild peas (*Vicia?*) grow abundantly, and are very highly prized for sheep.

Flagstaff, Arizona, June 24.

Flagstaff is in the dense pine forests of the San Francisco Mountains, at an elevation of 6,886 feet. Excellent grasses are abundant, but owing to the total absence of living streams very little stock is kept. The more common grasses are "Pine bunch-grass" (*Festuca* ——), *Bouteloua oligostachya*, *Andropogon scoparius*, and *Agropyrum glaucum*. The latter is often cut for hay, but is not valued as highly for that purpose as is the *Bouteloua oligostachya*.

The following notes were taken on the grasses found here :-

Poa Californica.

Somewhat common on the hill-sides.

Stipa arenacea, var.

Occasionally seen on the hill-sides.

Stipa Pringlei.

Common at the edge of the lava bed.

Agropyrum glaucum (Blue joint, blue-grass):

Very common, and sometimes cut for hay, but not valued highly.

Stock do not eat it when other grasses can be had, but it becomes an important item of feed when other grasses are covered with snow.

Koeleria cristata.

Common.

Festuca (No. 118). (Pine bunch-grass.)

Very abundant, and the most highly valued species. Grows in large clumps, so that it is difficult to mow, but makes excellent winter range. It is eaten by stock of all kinds about as readily as grama (*Bouteloua oligostachya*). It is said to grow only in pine forests, and was not observed elsewhere. It is not yet in flower (June 24).

Andropogon scoparius.

Common on low hills.

Oryzopsis micrantha.

Common on the rocky sides of a cañon.

Aristida purpurea.

Occasionally found in dry rocky places on the hills.

Epicompes rigens (Deer grass).

Occasionally found on the lava bed. Excellent for feed.

Muhlenbergia Wrightii.

Found on the lava bed.

Bouteloua racemosa.

Occasionally seen in the clefts of the rocks.

Sporobolus tricholepis.

Rare on lava bed.

Sporobolus Arizonicus.

Rare in the same situations.

Carex muricata.

Common at the foot of hills and in cañons.

Peach Springs, Arizona, June 27.

Peach Springs is in a dry valley, surrounded by high hills which have a scanty growth of cedar, with an abundance of cactus, agave, and yucca. Most of the feed for the few animals kept here is brought from California, though the Indians occasionally bring in small lots of hay which they have cut with knives. One light shower is all the rain-fall this year to date, and no more is expected until August or September.

Collections of grasses were made as follows:

Stipa speciosa.

Common on the top of the hills.

Stipa viridula.

Common on the hill-sides.

Panicum obtusum (Grapevine-grass).

Somewhat common on low land.

Eremochloe Kingii.*Aristida purpurea*.

Common on dry rocky hills.

Bouteloua racemosa, *Elymus Sitanion*, and *Bouteloua oligostachya* (grama) were seen occasionally. Cows were noticed feeding on the leaves of *Yucca baccata*, the leaves being dropped after mastication; perhaps eaten more for their watery juice than for nourishment.

Grand Canon, Arizona, June 29.

This place is 23 miles north of Peach Springs. The trail from the springs here is down a cañon, which has one or two springs near its head, but is dry the rest of the way, except the last mile. The cañon is very narrow and barren, and the sides very precipitous and rocky. The tops of the hills are commonly bare, except of cactus and sagebrush.

Collections were made as follows, all at or very near Grand Cañon:

Panicum capillare.

Common along the creek.

Sporobolus asperifolius.

Very common along the stream.

Polypogon monspeliensis.

Very common along the stream.

In a "visitors' register" kept at the camp here I find a note by Dr. Asa Gray, as follows:

CONSPICUOUS PLANTS OF THE GRAND CAÑON.

Fouquieria splendens, Ocotilla.

Acacia Lemmoni (Cat's claw).

Allionia.

On ground; flowers all day and all the year; shuts at night.

Fallugia paradoxa.

Bush, with white rose-like flowers on slender stalks.

Cowania Mexicana.

Like the last. Many greenish-white blossoms.

Larrea Mexicana (creosote).

Porophyllum.

With yellow, sweet-scented flowers in balls on slender twigs.

Eriogonum inflatum (Indian pipe-stem).

Abronia.

In sand by the river; small white flowers in a cluster.

Oenothera albicaulis.

Large flowers, separate.

Erythraea calycosa.

Herb with red star-shaped flowers.

The Needles, California, July 1.

The lands here along the Colorado River are sandy barrens, with very little vegetation, except creosote-bush (*Larrea Mexicana*) and grease-wood

(*Sarcobatus vermiculatus*). No grasses of any kind were seen excepting *Distichlis maritima*, which grows along the river, and what seems to be *Bouteloua polystachya*, which is somewhat common on dry soils.

From here to Bagdad, about 60 miles, not a single plant of any species of grass could be found, and there are no other plants upon which cattle can live. On July 1 the thermometer, in a well sprinkled and shaded porch, indicated 117° and on July 2, 123°.

Barstow, California, July 2.

On the Mohave River (now nearly dry), with high barren hills on each side. A few cattle are kept along the river, but none on the hills.

The following grasses were noted :

Distichlis maritima.

Very abundant along the river.

Sporobolus airoides.

Common.

Oryzopsis cuspidata.

Seen occasionally ; becoming more abundant farther west.

Panicum Urvilleanum.

On a sandy bank ; one plant only.

Polypogon Monspeliensis.

Common.

Stipa speciosa.

Common on hill-sides.

Phragmites communis.

One clump seen on the river bottom. It was also seen at Los Angeles, and at Wadsworth, Nev. Two species, apparently of *Trisetum* and *Diplachne*, were seen in the crevices of the rocks.

Mojave, California, July 3.

This place is situated on the border of the Mojave Desert, where for miles no plants of any kind can be seen. As there are no streams or springs about here, no stock is kept. The coast winds bring sufficient moisture, so that outside the desert many plants grow well with very little rain, but good grasses are rare. *Oryzopsis cuspidata* is somewhat common, also *Hordeum jubatum*, and on the hills to the south *Elymus condensatus* is quite plentiful. *Erodium* is seen occasionally. *Stipa speciosa* is common on the hills, and a species of *Poa* is occasionally seen.

Los Angeles, California, July 8.

Los Angeles is situated about 20 miles from the coast, in a well-watered valley, surrounded by high hills.

I found here a much greater variety of grasses than at any other point since leaving Albuquerque. On the hills *Elymus condensatus* is

abundant, and eaten well when young. *Stipa setigera* is also found, and considered good feed, and *Avena fatua* is sufficiently abundant to be valued highly. *Erodium* or "filaree," is very abundant, and forms a large per cent. of the wild forage. The hill-sides produce an abundance of *Bromus ciliatus*, which is one of the leading sorts for horse feed.

The notes taken here were as follows:

Elymus condensatus.

Fairly abundant on hill-sides, sometimes 8 or 10 feet tall, but usually not more than 3 feet. It is eaten only when young, except the seed spikes, which horses eat well during the winter.

Bromus ciliatus, var.

Very common on hill-sides, and eaten well, especially by horses.

Stipa setigera.

Common on the hills.

Koeleria cristata.

Occasionally seen on the hills.

Avena fatua.

Occasionally on hills and dry land. More abundant farther north, and often cut for hay in the Napa Valley.

Trifolium microcephalum.

Very common on low land and well eaten.

Melica imperfecta.

Common on hill-sides.

Juncus bufonius.

Festuca Myurus.

Common.

Panicum sanguinale.

Common on the river bank, but not yet in flower.

Distichlis maritima.

Common on low lands.

Paspalum distichum.

In one locality.

Poa annua.

Occasionally found on the river bank.

Medicago denticulata? (Bur-clover).

Very abundant on low lands in all southern California. Grows rapidly, and stock will leave any other forage to get it.

Hosackia juncea?

Common along river bottoms and eaten somewhat by cattle.

Elymus Orcuttianus.

Common on river bottoms, but not well eaten.

Lamarekia aurea.

Common along road sides.

Scirpus maritimus.

Common in wet places.

Trifolium involueratum, var. *heterodon*.

Occasionally found in wet soil, but not eaten very freely.

Sporobolus airoides.

Common on dry soils, but not valued. Commonly called "Guayatta."

Cyrodon dactylon (Bermuda grass).

Common in door-yards here and still more common at Pasedena, 10 miles east of here. It does well, but needs constant irrigation.

Poa pratensis (Kentucky blue-grass).

Does not succeed as well as Bermuda, the soil being too sandy.

Erodium.

The early settlers claim that this has always been abundant here, and throughout the whole region from here to Colorado it is spoken of as "coming in from California."

Reno, Nevada, July 16.

Reno is on the Truckee River, at the foot of the Sierra Nevada Mountains, in a basin some 10 miles across. The soil is fertile, and produces good crops of alfalfa and redtop where irrigated, but there are occasional spots, sometimes of several acres in extent, which are too stony for cultivation, and which are almost barren, except a scattering growth of *Artemesia*, *Atriplex*, and *Sarcobatus*.

Alfalfa and redtop are the only plants grown for hay. Timothy is abundant along ditch-banks and other places where it can have constant moisture, but as it gives but one crop yearly, while alfalfa gives three, it is not grown much for hay. It is generally claimed that a ton of alfalfa is equal to a ton of any other hay for fattening purposes, but for work-horses it is not worth more than half as much as timothy.

The most abundant native forage plants are *Agrostis vulgaris* and *seabra*, *Avena fatua*, *Elymus triticoides* (?), *Poa tenuifolia*, *Oryzopsis cuspidata*, *Vicia Americana*, *Elymus condensatus*, *Trifolium involueratum*, *Sporobolus asperifolius* and *Erodium cicutarium*. The last named is known through the entire Southwest as "Filaree," and has become very common here within the last five years. It was noticed also at Trinidad, Albuquerque, and Santa Fé, N. Mex.; Wadsworth, Nev.; and at Ogden and Salt Lake City, Utah. It is valued very highly on account of its early spring growth, and it continues to grow throughout the season, providing it has moisture. It is eagerly eaten by all kinds of stock, even after it is completely dried and the plants are blown about by the

wind. It flourishes on stony and sandy lands where the grasses do but little, and I regard it as the best forage plant that I have found for introduction in the mountain regions.

Collections were made as follows: Those marked with a ? were generally too far advanced to have the species identified with absolute certainty:

Agrostis scabra.

Occasionally seen near the river.

Agrostis vulgaris (Redtop).

Very common along streams and in meadows throughout the State; "comes in" in irrigated lands and forms a large part of the hay crop.

Panicum capillare.

Found sparingly at every stop between here and Denver.

Oryzopsis cuspidata (Bunch-grass, sand-grass).

Somewhat common on dry soil. Grows well on the hills, and is valued highly for winter range, but is not eaten much during the summer.

Poa tenuifolia.

Common on low lands.

Poa larvis?

Common on alkaline meadows, and valued both for hay and pasture.

Poa pratensis.

Occasionally found on low ground, but is nowhere abundant.

Elymus triticoïdes? (Wild rye, wild wheat).

Common on low ground, often cut for hay and of great importance for winter pasture. Also common at Wadsworth, Nev.

Elymus Sitanion.

Common along road-sides.

Elymus condensatus, var.

Common, and valued for winter pasture, but not eaten when other grasses can be had. It is sometimes cut for hay.

Elymus tenuis.

Along the river-bank.

Avena fatua (Wild oats).

Very abundant from California eastward to Central Nevada, and occasionally found in the Salt Lake Valley. It is often cut for hay and makes excellent pasture. It was not seen in Arizona or New Mexico, nor in the arid regions of Nevada and Utah, but is said to be found occasionally there.

Stipa comata.

Common on the dry barrens.

Stipa occidentalis.

Common in wet soil everywhere.

Sporobolus asperifolius.

Common on low land.

Sporobolus cuspidatus.

Common on the river-bank.

Bromus secalinus (chess.)

Common on irrigated lands.

Bromus mollis.

Occasionally found in dry soils. Very common in the Napa Valley, Cal.

Bromus maximus.

Common along roadsides.

Bromus racemosus.

Occasionally found on wet ground.

Bromus breviaristatus.

Grows sparingly along the river bank.

Eatonia obtusata, var.

Along ditch banks.

Beckmannia (Wild timothy).

Common on wet ground and in shallow water from here east to Elko, Nev. It is valued very highly both for hay and pasture. Many regard it as the most valuable of all the native species, but it will grow only on soil which is constantly wet.

Holcus lanatus.

Occasionally found on ditch banks.

Hordeum murinum.

Very common.

Eragrostis major.

Introduced and yearly becoming more common in the valley.

Festuca microstachys.

Occasionally found on the barrens.

Agropyrum glaucum (Blue-joint, Blue-grass).

Common and valued.

Oryzopsis Webberi.

On ditch banks and barrens.

Eragrostis poaeoides (small form).

On ditch banks.

Polypogon.

In strongly alkaline soil.

Erodium cicutarium (Filaree).

Very highly prized. People here inform me that they have frequent requests for seed to be sent to localities where it has not been introduced. It is becoming more abundant here every year.

Medicago sativa (Alfalfa).

The plant here is affected with a species of fungus (*Phacidium medicaginis*, Lasch.), the specimen sent being no worse than a fair sample of most fields, not only here but wherever I have seen alfalfa. The farmers make no complaint of it; in fact no one seemed to have noticed it. Mr. Davis, the editor of the Live Stock Record, informs me that it is even more common about Denver than here.

Melilotus alba.

Common throughout Utah and Nevada on low ground, and used considerably for pasture. It is almost the only plant in some fields about Salt Lake City.

Trifolium involucratum.

Very abundant on wet ground. Found everywhere along streams, but more common here than elsewhere.

Trifolium tridentatum.

Common on ditch banks, and eaten closely.

Carex siccata?

Very common on lowlands, where it is cut for hay. It is eaten fairly well.

Several species of *Cyperus*, *Scirpus*, and *Carex* grow on low grounds and are called "water-grass;" although they are not valued as highly as the grasses, these sedges form an important part of the pastures, and are eaten closely in the absence of other feed. Some meadows which are cut for hay are at least three-fourths covered with these.

Wadsworth, Nevada, July 21.

Wadsworth is on the Truckee River. The valley here is narrow and surrounded by high, barren, treeless hills, which have a scattering growth of sage-brush and grease-wood, with but little grass. Alfalfa is the main crop, though redtop is very common in the few cultivated fields. The native meadows along the river contain species of *Agrostis*, *Koeleria*, *Bromus*, and a large proportion of sedges or "water-grasses," as they are termed here. Collections were made here as follows:

Agrostis exarata, var.

Common.

Poa larvis.

Occasionally found on low ground.

Koeleria cristata.

Common on ditch banks.

Panicum capillare.

Common on low ground.

Sporobolus airoides.

Found at Winnemucca and Palisade, Nev., and very sparingly on low ground here.

Agropyrum glaucum (Blue-joint, Blue-grass).

Common here and highly valued.

Winnemucca, Nevada, July 23.

The Humboldt River runs through this valley, but so far below the general level of the land that there are no cultivated fields. The Humboldt and Carson sink, where the river finally disappears, is during the rainy season a lake, but now a perfectly barren plain, while for miles on either side the soil is so dry and alkaline that nothing is produced except occasionally a stunted grease-wood. The rain-fall here in 1886 was 4 inches and this year to date has been .15 of an inch.

Elymus Orcuttianus.

Common in the valley and grows to some extent on the hills. It is the most valuable species here, being the main reliance through the year.

Panicum capillare.

Somewhat common along the river.

Hordeum jubatum.

Occasionally seen in well-watered yards.

Setaria viridis.

With the above.

Agrostis vulgaris (Redtop).

Does well here.

Poa pratensis (Kentucky blue-grass).

Doing well here in irrigated grounds.

Poa (too old for identification). Mountain bunch-grass, small bunch-grass.

Common on the hills and mountains from here to Ogden. It is said to start very early and to make excellent spring forage, but it dies as soon as dry weather comes. When abundant and the seeds are ripe stock fatten rapidly upon it. At this date it has nearly all disappeared.

Battle Mountain, Nevada, July 25.

In an extensive dry and barren valley, with no cultivated fields for many miles in any direction, and no cattle nor sheep. In the town are

twenty-three flowing wells, each about 250 feet deep, but the flow is very small and usually not more than enough for family use. The largest garden in the town is about 60 yards square and receives all of the water from two of these wells, and still the garden does not have enough. In this garden *Agrostis vulgaris*, *Poa pratensis*, *Hordeum jubatum*, and *Panicum capillare* were noted.

Palisade, Nevada, July 26.

The Humboldt Valley here is very narrow and without cultivated fields. The hills on each side are from 1,000 to 1,500 feet high, quite steep and rocky, with no trees, and but a scanty growth of grass.

Poa tenuifolia.

The most abundant species on the hills and valued highly for spring forage. It is claimed that this and similar species were formerly much more abundant all through this region, and their disappearance is attributed to the fact that the roots are short and take but a slight hold upon the soil, so that when the herbage is bitten off by stock the plant is either pulled up or the roots so loosened that it soon dies. It is certainly true through most of this State and a large part of Utah that when a range has been pastured for a year it is usually three years at least before it will afford equally good pasture again.

Agropyrum tenerum (Rye-grass).

Very common on the lower part of the hills and in the valley.

Agropyrum divergens.

Common on the top of the hills.

Elymus triticoides.

Rather common along the river.

Festuca microstachya.

Common on dry hills, but disliked after ripening and not valued.

Hordeum pratense (Fox-tail).

Common on low land.

Festuca ovina, var (Pinon-grass).

Common in crevices in rocks.

Eatonia obtusata.

Common near the river.

Sporobolus cuspidatus.

Common on low sandy barrens.

Phalaris arundinacea.

Common on low wet land.

Stipa comata.

Rare on hill-sides.

Stipa occidentalis.

Common on high hills.

Trifolium cyathiferum.

On the side of a hill, near a spring.

Elko, Nevada, July 28.

Elko is near the headwaters of the Humboldt River, in a valley from 1 to 3 miles wide. But little of the land is irrigated, but where fenced it is seen to produce a fair crop of grass in its natural state. In one meadow, 6 miles east of the town, I found *Poa laevis*, *Agrostis exarata*, *Sporobolus filifolius*, and a species of *Elymus*, the most abundant grasses. This land was not irrigated, but is only 5 or 6 feet above the level of the river, and the yield, I should judge, would be from one-half to three-fourths of a ton per acre. In the same meadow are occasional patches of *Beckmannia*, or "wild timothy," which is regarded as the most valuable grass here, both for forage and for hay, but it will grow only where it can have abundant and constant moisture. On the drier meadows and foot-hills *Elymus condensatus* is the most abundant species and the main dependence for winter range. Greasewood and White Sage are somewhat abundant on the hills, and *Distichlis* (Salt-grass) covers many acres along the river.

Collections were made as follows:

Elymus condensatus.

Quite common, but not eaten in summer if other feed is to be had. It is sometimes cut-for hay, but is of poor quality.

Beckmannia erucaeformis.

Common on the river bank and in swampy ground from Elko to Reno, and is everywhere one of the most highly valued species. It is more abundant here than at any other point on the route.

Agrostis exarata (Redtop).

Somewhat common.

Melica strieta.

In one locality in clefts of the rocks on the mountains.

Sporobolus asperifolius.

Common at the edge of a hot sulphur spring.

Agropyrum divergens.

Common on the hills.

Festuca microstachys.

Common on the hills.

Ogden, Utah, July 31.

Ogden is in Salt Lake Valley, 10 miles from the lake, with high mountains on the opposite sides. The valley is watered by the Ogden River, and is mostly under cultivation, alfalfa being almost the only

forage crop. Redtop and timothy are both abundant along ditch banks and on wet ground, and a few wild meadows are almost wholly redtop. One field of red clover was seen, but the crop was poor, and alfalfa will be sown in its place. On the mountains good pasture is found all summer, while the bench lands too high for irrigation become so dry as to be almost barren, except for occasional plants of *Stipa comata* and *Agropyrum glaucum*. *Erodium cicutarium* is found occasionally, and is said to be becoming more abundant. *Agrostis vulgaris* var. (Redtop) is abundant on moist soils, and *Hordeum jubatum* (?) is a troublesome weed in exhausted land.

The upper part of the mountain has an abundant supply of grass, and stock find good pasture here all summer. The same is said to be true of all the mountains in this vicinity.

Collections were made as follows:

Agrostis vulgaris.

Common on lowlands and in cañons.

Agrostis scabra.

Rare in low ground.

Agrostis microphylla.

Along ditch-banks in the cañon.

Agrostis exarata, var.

Common in the cañon.

Agropyrum glaucum.

Common on dry ground.

Agropyrum tenerum.

With *A. glaucum*.

Agropyrum divergens.

Common in the cañon and on the upper half of the mountain.

Agropyrum caninum.

In the cañon.

Elymus canadensis.

Common on lowlands.

Elymus tenuis.

On low, dry sands and the foot-hills.

Elymus condensatus, var. ?

Occasional in wet meadows.

Elymus sitanion.

On rocks, near snow, at the summit.

Sporobolus asperifolius.

Common.

Sporobolus cryptandrus.

Common on dry, sandy soils.

Sporobolus gracillimus.

Occasionally found in the cañon.

Koeleria cristata, var.

Common on low dry ground.

Poa laevis?

Occasionally found on low ground.

Poa tenuifolia.

Common at the summit.

Poa purpurascens.

Common in the same locality.

Poa flexuosa, var. *occidentalis*.

Abundant in a cañon near the summit.

Ammophila longifolia.

Rare on wet ground.

Muhlenbergia glomerata, var.

Occasional on wet ground and in the cañons.

Muhlenbergia comata, var.

On the river-bank.

Glyceria arundinacea.

Occasionally found on ditch-banks.

Glyceria nervata.

In a cañon near summit.

Distichlis maritima.

Everywhere on alkaline soils. Nowhere have I found it considered of any value except at Winslow, Ariz., where it is almost the only green thing found.

Cenchrus tribuloides.

Common here, but seen elsewhere only at Cañon City, Cal.

Stipa comata.

Common on the bench lands.

Stipa viridula, var.

Abundant on the upper half of the mountain.

Bromus secalinus.

The most common species on low, dry, sandy land.

Bromus breviaristatus.

Common in the cañon.

Bromus racemosus.

Occasional in the cañon.

Panicum capillare.

Occasionally found on the river-bank.

Phalaris arundinacea.

On the river-bank; also found at Palisade, Nev.

Deyeuxia neglecta.

On the river-bank.

Deyeuxia neglecta, var. *robusta*.

Common on the river bank.

Cinna pendula.

In the cañon near the base of the mountain; rare.

Festuca confinis.

Common on rocks near the summit.

Festuca Jonesii.

In the cañon.

Lake Park, Utah, August 8.

The following were collected here:

Distichlis maritima.

The most abundant species here, in the low, marshy, alkaline soil on the shore of Great Salt Lake.

Agropyrum repens.

Common.

Deschampsia calycina.

Common.

Spartina gracilis.

Common.

Poa tenuifolia, var.

Occasionally seen.

Sporobolus cryptandrus, var. *stricta*?

Occasionally found in dry, sandy places.

Erodium cicutarium (Filaree).

Rather common, even where the soil is quite alkaline.

Salt Lake City, August 9.

The city is 5 miles from the lake, and about the same distance from the mountains. Between the city and the lake the land is low and mostly in cultivation. From the city to the base of the mountains the land rises and forms a broad bench, which produces a fair growth of *Agropyrum repens* and *A. glaucum*, but almost no other grasses except where irrigated.

Collections were made as follows:

Agropyrum divergens ("Wire bunch-grass").

The most common species on the mountains.

Agropyrum caninum.

In clumps on low ground; rare.

Agropyrum glaucum, var.

Abundant on moist soil on bench land.

Agropyrum tenerum, var. *robustum*.

Along a ditch on the bench.

Lolium perenne (Rye-grass).

Introduced. Found occasionally in pastures and meadows.

Elymus sitanion.

Common on dry barren soil.

Bromus racemosus.

Common.

Poa annua.

Common along ditches on the bench lands.

Phleum pratense.

Several meadows here which are cut for hay contain about equal proportions of Timothy and Redtop, with usually a large mixture of *Hordeum*.

Carex Jamesii.

Very abundant in moist meadows, and in occasional spots almost the only species. It is cut for hay, but is said to be not very good.

Medicago lupulina.

Common in pastures and along roadsides on low grounds, where it is eaten closely.

Juab, Utah, August 13.

This is situated in a dry valley 100 miles south from Salt Lake. The valley is about 6 miles wide with a wet-weather stream. During the dry season all the water comes from wells. Considerable Redtop is found on the lower lands and *Agropyrum divergens* and *Erodium cicutarium* are found to some extent.

On the mountains, 8 miles east, *Agropyrum divergens* is one of the prevailing species. The range about here is said to be much more barren than it was five years ago, prior to the introduction of sheep. West of the town there are barren, treeless hills, with a scanty growth of the above-mentioned grass, together with *Oryzopsis cuspidata*. White sage (*Atriplex*) is the main reliance for winter range.

Frisco, Utah, August 14.

Frisco is in a dry, hilly region, wholly destitute of water, excepting an occasional alkaline well. All water for drinking or washing here has to be brought from Black Rock, 45 miles distant. The water from the wells is used for stock, and seems to be harmless after the animals become accustomed to it, though they are often made sick on first using it. The hills have a scanty growth of cedar and during the spring a fair growth of grass, but are now almost bare. There are not more than one-fourth the number of cattle in this part of the country now that

there were three years ago, and the range has been eaten so closely as not to afford even reasonably good feed for the few animals left.

Grama (*Bouteloua oligostachya*), Bunch-grass (*Poa tenuifolia*, var.), and Indian millet (*Oryzopsis cuspidata*) are the leading grasses. White sage, or shad scale, as it is also called (*Atriplex confertifolia*), is relied upon largely for winter feed.

Collections were made as follows :

Poa Californica.

Very common and eaten well.

Poa tenuifolia (Bunch-grass).

Common and valued highly.

Stipa viridula.

Occasionally found.

Hilaria Jamesii.

Abundant on the upper part of the hills, but apparently not eaten as well as *Poa Californica*, or next.

Bouteloua oligostachya.

Rather common, but only one plant seen with green stems or leaves. It was not seen elsewhere between here and California.

Atriplex confertifolia (White sage, or Shad scale).

Common on dry hills, and eaten well after frost.

Provo, Utah, July 15.

The location and surroundings of Provo are similar to those of Ogden, the town being in a well-watered valley at the foot of high mountains. No crops can be grown without irrigation, and the unwatered bench lands are exceedingly barren, as also are the foot-hills. High up in the mountains are numerous springs and good pasture, but the streams usually disappear below 7,000 or 8,000 feet, and below that there is but little feed. The lowland meadows are mostly timothy and redtop, mixed with *Hordeum* and various sedges.

Collections were as follows :

Agrostis grandis.

Common in cañons ; nearly all the specimens found were affected with an *erysiphe*.

Agrostis, sp.

Common.

Bromus Kalmii, var. *occidentalis*.

Occasionally seen in the cañons.

Agropyrum caninum.

With the above.

Agropyrum tenerum.

Common in a rocky cañon.

Glyceria nervata (form).

Common along streams.

Glyceria nervata (large form).

Common in a wet, rocky cañon.

Cinna pendula.

Common at an altitude of about 10,000 feet, near the summit of the mountain.

Melica bulbosa.

Occasionally found near the summit.

Poa flexuosa, var?

At the summit.

Poa reflexa.

Common at the summit.

Bromus ciliatus, var.

Common at the summit.

Trisetum subspicatum.

In a cañon at an altitude of about 9,000 feet.

Stipa viridula.

At 8,000 to 10,000 feet.

Elymus Americanus.

Common at about 7,500 feet, along a stream.

Pleasant Valley, Utah, August 18.

Pleasant Valley is on the eastern slope of the mountains, bordering the Salt Lake Valley. This is a very dry region, similar to that about Green River. *Agropyrum glaucum*, *A. repens*, and *Elymus condensatus* are the more common species. *Oryzopsis cuspidata* is common on the hills, and *Poa tenuifolia*, var., is also frequent.

As in other parts of Utah and Nevada, the amount of wild grass now found on the range is very much less than it was before the introduction of sheep, which seem to have killed the roots of most perennial species, so that what was good pasture land five years ago is now almost barren.

Green River, Utah, August 20.

The bluffs here are high and barren. I found no cultivated land except three small places on the river bank, and there are said to be no other ranches nearer than the Lasal Mountains, 20 miles to the south-east. The range here is so barren that no stock is kept. A rain about July 1 wet the ground to a depth of about 3 inches; previous to that there had been no rain or snow since April 20, 1886. On the sandy lands along the river a number of coarse grasses were found, but on the mesas and hills I could find nothing except occasionally *Agropyrum repens* and *Poa tenuifolia*, var.

Collections were made as follows:

Sporobolus cryptandrus, var. *strictus*.

Common, but only eaten when young. I have noted it at every stop from Ogden to this point, and have rarely found a plant which had been touched by stock, even where other grasses were eaten closely.

Sporobolus airoides.

Common in valleys throughout Utah, but eaten only when young, and not valued for hay.

Sporobolus asperifolius.

Very common.

Agropyrum glaucum (Blue-grass, blue-stem).

Quite common and regarded as the best native species. Grows sometimes 4 feet high. It is abundant from here to Denver.

Bouteloua polystachya, var.

A few plants seen in cultivated ground.

Munroa squarrosa.

Common, but not eaten by stock. Also seen at Denver.

Panicum capillare, var.

Common.

Panicum crus-galli, var.

Several of the more common forms are abundant on the river-bank.

Agrostis vulgaris.

Rather common in irrigated land.

Schedonnardus Texanus.

Common and eaten well in spring; but worthless after becoming dry.

Atriplex canescens (Shad-scale).

Perhaps the most important forage plant here after frost.

Juncus nodosus, var. *megacephalus*.

Said to be eaten well, especially by horses.

S. M. TRACY.

JANUARY, 1888.

REPORT OF AN INVESTIGATION OF THE FORAGE PLANTS OF WESTERN TEXAS.

HOUSTON, TEX., *January 17, 1888.*

DEAR SIR: In accordance with the appointment received from the Commissioner of Agriculture to make an investigation of the grasses and forage plants of the arid districts of western Texas, under your direction, I started westward from San Antonio on the 2d of May, having secured a good teamster to accompany me. At that time the country about San Antonio and westward showed the effects of the severe drought that had prevailed for over a year. At San Pedro Springs and in places along the San Antonio River, I noticed scattered growths of *Panicum sanguinale*, *Eleusine indica*, *Eatonia obtusata*, *Paspalum distichum*, and *Bromus unioloides*, with patches here and there of the Buffalo or early Mesquite grass (*Buchloe dactyloides*). The system of water-works in the city has induced fine lawns of the Bermuda-grass (*Cynodon dactylon*) with luxuriant gardens. But all over the surrounding country I saw no grass; only at very rare intervals a dry-looking plant or two of *Buchloe*. Between San Antonio and Castroville, 27 miles, the Mesquite is by far the most predominant shrub, with occasionally a *Zizyphus*, sometimes called Texas buckthorn, and still less frequently an *Acacia*. The shrubbery and trees became much more varied as we advanced west. The prickly pear (*Opuntia*) was conspicuous all along our route, growing more plentiful as we journeyed on. Here and there were signs that the Buffalo-grass had a range in this region. Before reaching Castroville I saw at the dry beds of some of the creeks a few plants of *Bromus unioloides* in bloom. Next to the Buffalo-grass it seems to withstand the drought better than any other grass.

From San Antonio to Uvalde, 93 miles, we passed only one permanent running stream, the Sabinal. As we approached the Hondo, while riding over the hills or slight elevations, I noticed the *Acacia* shrubs, *Zizyphus*, *Parkinsonia Texana*, and a few other shrubs freely mixed with the Mesquite and a few large trees of live oak and hackberry. The prickly pear growths were also more abundant, and I gathered a few specimens of the following grasses: *Aristida purpurea*, *Bouteloua Burkei*, *Triodia acuminata*, and *Triodia Texana*. On arriving at the Hondo we fortunately found one of the water-holes that occur in places along the dry bed of this and also of other water-courses. I collected three grasses at this place: *Panicum sanguinale*, *Chloris verticillata*, and *Chloris cucullata*.

Along our route from the Hondo to the Sabinal no grass was seen. Of the quantities of prickly pear I remarked how fresh and vigorous they looked amid the dearth of other herbage. The abundance and quality of the different species are indeed a benefit to the stockmen in these regions. I was informed that an immense amount of the "leaves," as the flat joints of the *Opuntia* are called, were eaten for forage.

Not far from the Hondo we passed a ranch where a large quantity of the prickly pear had been hauled, and the joints were passing through the preliminary scorching. A large herd of cattle was feeding on the scorched food as if with a relish. I heard one man say, "The prickly pear is all that saves this country;" and another, "The cattle just love it, they can't get anything else." But cattle can not well thrive entirely on such diet. I heard from others that it was better for the health of the cattle to have such food mixed with hay or grain occasionally. I saw a few cattle feeding on the joints in the field before they were cut and prepared, but they were moving their mouths as if in pain. I was told that very often cattle, and sheep particularly, take such food without its having gone through the scorching that softens the spines and destroys the bristles. It would seem that these cactus lands that have been regarded so worthless will be more valuable, not only as furnishing food for stock, but also in other ways in which some of the species can be utilized. In some of the machine-shops the prickly pear serves a good purpose as a lubricant. The Mexicans, who give the name of nopal to the different species of flat-jointed opuntias, prepare certain dishes in which the nopal "leaf" is mixed with other food. It also has the reputation of making a good poultice for sores and bruises. Of the opuntias with cylindrical joints (called by the Mexicans, Chollas), two species are common in Texas west of San Antonio. With their numerous branches they have a shrubby appearance. One, *Opuntia frutescens*, I met with frequently between San Antonio and Del Rio, and less often in places farther west. The other, *O. arborescens*, I found sparingly east of Del Rio, but west of there very abundant. I have seen both species trained into good hedges.

On our arrival at the Sabinal, we turned from our direct course westward for a short trip up the Sabinal Valley. Near the creek, but not on its border, I noticed single plants scattered here and there of *Aristida purpurea* (purple bearded-grass) that is widely diffused in western Texas. On the border of the creek I found two or three other kinds of the bearded grasses (*Aristida*) *Stipa setigera*, *Thurberia Arkansana*, *Eleusine Egyptiaca*, and other grasses that I gathered at points already mentioned. We rode along the Sabinal only as far north as Utopia, and there, by the creek, I found a few specimens of *Panicum pubescens*, the only place I saw it west of San Antonio. On some of the hills that tower along the sides of the creek one sees occasionally in riding along a few plants of the Soto! and *Nolina* that flourish in such great abundance in western Texas. Gladly would I have lingered in this interest-

ing region, the Sabinal Valley, perhaps one of the most inviting regions in Texas to the botanist.

Passing from the Sabinal to Uvalde, a similar vegetation presented itself as that towards the Hondo; the same kinds of shrubbery and cactus growths. All over these western regions vegetation at that time was probably at its worst, the dry weather having continued so long. It may be noted here that some of the settlers had asked for State aid, which had been granted. I heard that in several of the settlements west of San Antonio provisions and "drought-money" were being received. The first evening at Uvalde Mr. Hale, my teamster, brought me a fine specimen of *Leersia oryzoides* that he found in a swampy place by a creek, one of the branches of the Nueces. Probably this is the western limit of this grass. We visited Leona Mountain, near Uvalde. On its summit I found a few specimens of *Melica diffusa*, *Panicum lacnanthum* and *Setaria caudata*. At Uvalde I was informed that not only loads of prickly pear were hauled into the town, but also that quantities of sotol, for stock feed, were brought from the mountains west.

Soon after leaving Uvalde we crossed the Nueces, by whose clear water several grasses were flourishing—the same kinds that I found by the San Antonio River. From the Nueces to Eagle Pass, with our route still marked by the absence of grass and the abundance of prickly pear among the numerous shrubs, I noticed the few cattle here and there, and, as some one said, "looking like walking skeletons." I heard sundry reports of a number of cattle dying from starvation. I saw some of the cattle feeding or trying to feed on the prickly pear, and in two or three instances I noticed the cattle attacking the long leaves of the Spanish bayonet, *Yucca baccata*, that forms a prominent feature of the flora of this region and is frequent all over western Texas. At Eagle Pass the surrounding country looked indeed barren and desolate; in most places on the hills not even a shrub with green foliage. But I was informed that after continued rains the mesas of this region are covered with good grass. All over western Texas it would seem as if there must be quantities of seed in the soil. No matter how barren or rocky a place may be, a season of rain is followed by a coating of grass and other herbage.

Leaving Eagle Pass, we rode for some distance along the Rio Grande and came to a place on the bottom land favored with a very luxuriant vegetation. Here I found excellent specimens of *Setaria setosa*, *Sorghum halepense*, *Eragrostis capillaris*, and other grasses that flourish in moist situations. The grasses at this place were mixed with luxuriant growths of other herbaceous plants. Prominent here were the tall stalks of *Phragmites communis*, and still more conspicuous on the islands in the river were the taller stalks of *Arundo donax*. From the river our route led by one of the coal mines, and near one of the shafts I took notice of an inclosure formed by placing together the stems and leaves of the Spanish bayonet, *Yucca baccata*, thus making a serviceable fence. The

roots, stems, and leaves of the *Yucca* also subserved a good purpose in forming an embankment by the side of a hill, where a tramway was made to one of the shafts.

Passing over the hills and through the gorges and over the mesas that mark the configuration bordering the Rio Grande, we saw no change for the better in vegetation before reaching Las Moras Creek. There I found the grasses similar to those of the permanent running creeks eastward. The herds of sheep and goats that one sees traveling in this region must find their sustenance principally from the shoots and foliage of the mesquite and other bushes. On the hills bordering the Rio Grande the prickly pear is met with much less frequently than it is some distance away from the river.

As we approached Del Rio vegetation looked more cheering. There had been recent rains, and grass was beginning to start afresh. I found several interesting grasses at Del Rio both by the side of San Felipe Creek and along the irrigating ditches through which pass the clear waters of the creek, so important to the gardens and plantations around Del Rio. Here I collected about a dozen grasses, including *Setaria glauca* (at Del Rio may be its western limit), *Cenchrus tribuloides*, *Cenchrus echinatus*, and *Panicum colonum*, var. *zonale*. On the banks of the Rio Grande I found a few plants of *Sporobolus Wrightii* (the Maton of the Mexicans) in bloom. Later in the season this tall coarse grass forms a prominent feature of the vegetation along the river.

From Del Rio to the Devil's River I noticed no special features in the vegetation. Where we crossed the river I saw a luxuriant growth of *Panicum sanguinale* and *Panicum colonum*, and a number of specimens of *Panicum crus-galli*. These three grasses, so common at many of the streams throughout Texas, illustrate the fact that plants preferring moist situations are of wider distribution than those in more dry situations. West of Devil's River the Sotol (*Dasylirion Texanum*) became noticeable from its abundance on the side of the hills—in many places forming the principal vegetation. The sundry useful purposes it has served are doubtless well known; esteemed by Mexicans and others as food—the leaves chopped off and the "head" cooked. As furnishing the mescal, the popular beverage of the Mexicans, it has long been well known. The herders of sheep and goats value it as a forage plant. Cattle also seem to be fond of it. I saw several plants where the leaves had been cut away and the head left for the benefit of the stock. One herder in Val Verde County said that in the dry season he placed his main reliance on the Sotol for the sheep.

Proceeding westward from the Devil's River, the Lechuguillo (*Agave heteracantha*) presents itself in great confusion, like the Sotol, occupying the ground in places to the exclusion of all other plants. Valued as a soap or "amole" plant and as a fiber plant, the Lechuguilla has long been known. The Ocotillo (*Fouquieria splendens*) also becomes

prevalent. The single plants, with their long branchless stalks, growing on the rocky mesas, offer a striking feature to the landscape. I have seen good serviceable fences made with the prickly stems of these plants.

The *Nolina* (Hickory grass) I saw but sparingly near Devil's River, becoming very abundant farther west. I saw wooden and adobe buildings with the roofs thatched with the long, tough leaves of this plant. The leaves are bound with thongs of hide, and I was told that such a covering would last for years, and would not leak in rainy weather. One man in Juno, who had a roof thatched with this "grass," said he preferred it to a shingle roof.

From Devil's River to Flanders I saw no grasses in bloom away from the creeks, except a few stray specimens of *Pappophorum apertum* and on one of the divides a small patch of running mesquite-grass, *Hilaria cenchroides*. At Flanders, in a deep, rocky ravine by the side of a natural alkaline well, I found *Polypogon Monspeliensis*, a grass that is common in many places on the Gulf and Atlantic coasts. On account of the difficulty in getting water we concluded to change our route, so from Flanders we returned to Devil's River and rode along its west side, passing over the mesas and valleys. I saw the Sotol in great abundance on the hill-sides. At the foot of one of the hills I gathered a few specimens of *Hilaria mutica*. This grass I have seen in large patches west of the Pecos. While going through the picturesque Dead Man's Pass I collected some specimens of *Aristida*, *Panicum reticulatum*, and a few other species of grass. In one place near a creek I found a few plants of the rescue-grass (*Bromus unioloides*); this is the most western point at which I have seen it. Just before reaching Old Camp Hudson we rode a short distance along the river, bordered by stately trees of poplar and willow, wild china, pecan, and others. Where we camped by the river, opposite the old fort, I found the grasses *Paspalum distichum* and *Panicum colonum*. We rode some distance up the river. At one point I found some fine specimens of *Elymus canadensis*. Leaving the river we rode northwest a few miles, and arrived at Juno post-office. Here I noticed the Sotol plentiful on the hills, and by a creek running through the place I found a few grasses that are partial to moist places.

After a day at Juno we proceeded westward to Johnson's Run. Just before reaching it I noticed a small patch of *Triodia albescens*, and near by a small patch of *Hilaria mutica*. All along our way from Juno to the Pecos I frequently saw small patches of the buffalo-grass, but it looked rather parched. Along some of the leads, or draws, as they are called—branches of the arroyos—I saw an occasional *Aristida*, *Triodia acuminata*, and *Andropogon saccharoides*. We passed Howard's Wells, where a few green bunches of *Hilaria mutica* presented themselves, with a few stray specimens of *Chloris elegans*. Journeying along some distance we ascended a steep hill, on the top of which was a large area covered with Lechuguilla. Here I found a few specimens of *Schedonnardus Texanus*. We rode for some hours over a lengthy plateau, our way marked by *Nolina*

in abundance, but I saw none in bloom. I noticed here the *Hilaria mutica* at intervals among the meager growths of buffalo-grass.

We turned off a short distance from our track and camped at night by a rocky ravine where were wells of good, clear water. At this place I found a number of interesting grasses; some fine tussocks of *Eriochloa sericea*, *Panicum unisetum*, *Panicum reticulatum*, and *Panicum ciliatissimum*. I noticed many cactus plants along our route, mostly of different species from those of the *Opuntia*. It is between San Antonio and Devil's River that the prickly pear in Texas seems to be most abundant; but the shrubby-like *Opuntia arborescens* is common towards the Pecos and farther west. Leaving the plateau, we descended a hill into Live Oak Creek Valley, where I noticed the Spanish bayonet (*Yucca baccata*) in abundance. Near the creek I saw a few clumps of *Muhlenbergia Texana* and *Andropogon saccharoides*. We passed a large goat ranch. I saw several of the goats feeding on the foliage and shoots of the bushes.

From Live Oak Creek, graced with its lordly oaks among the other timber, we rode on to the Pecos, and camped by its side near the mouth of Live Oak Creek. The alkaline, muddy water of the Pecos presented a strong contrast to the clear water of the creek. At the foot of the hill I found two or three blooms of *Panicum leucophæum*, and near the river *Cenchrus tribuloides* and *Chloris cucullata*. On the bank of the river I found a few stalks, just starting into bloom, of the common grass of the Pecos, *Sporobolus airoides*. This locality was favored in one place with a covering of the buffalo-grass, the best patch of it I had seen since leaving San Antonio. Crossing the river we rode for some distance on the other side, where I found a few small patches of buffalo-grass of very meager growth, till we arrived at Pontoon, a station of one building, with a store. From here we took a direct course to Stockton. A mile west from Pontoon I saw the last vestige of the buffalo-grass on the journey, and I noticed a few straggling plants of *Pappophorum apertum*. The appearance of these and a few specimens on the divides in Val Verde County might lead one to infer that this species (*P. apertum*) is capable of resisting drought better than many other grasses.

Our route in Pecos County was through as desolate a region as any we had yet traversed. The hills in view on either side of us looked more barren than those east of the Pecos River. Already on our expedition we had taken precaution to obtain water in passing from one locality to another. In this part of the country we were obliged to be still more careful. The keg we had with us was an important requisite, but sometimes we rode long distances before finding water for the two mules that composed our team. We managed to keep a supply of corn or oats for the mules; at this season, of course, placing no reliance on grass at any point for even a "pretty fair picking." We overtook two emigrant teams en route for New Mexico, and the owner of one of them informed me that two years ago he had traveled over that same region

in Pecos County, and for nearly a week his horses had no food except what they could get from the mesquite and other bushes along the way.

After traveling some distance from the Pecos we were cheered by the sight of a creek and spring; a short distance farther on we came to another creek, and still farther on to the Escondido Creek and spring. I saw on the borders of each luxuriant growths of *Agrostis verticillata*, and less plentifully the *Panicum obtusum*. The clear water of these creeks is salty alkaline, similar to that of Comanche Creek, flowing by Stockton. On the 7th of June we arrived at Stockton, having been a little over a month in passing through these regions, in the most uninviting time of the year perhaps; certainly as regards the presence of grass. Doubtless in the autumn all these portions of country are favored with the "yearly wave of rain-fall," and generally furnish through the fall and winter months a pretty fair pasturage; though perhaps not as good as that of the mountain regions farther west, where some of the grama grasses afford such excellent pasturage and hay through the winter. It was a pleasant sight at Stockton—the large plantations, where corn, oats, and vegetables produce good crops, the result of the system of irrigation from the creek. By the irrigating-ditches a rampant growth was noticeable in places, of *Panicum obtusum*. On the borders of the creek I saw several plants of *Agrostis verticillata* and *Distichlis maritima*.

After spending a day in the neighborhood of Stockton we started for Fort Davis, taking the old telegraph road. After traveling a few hours we came to a swampy place, where I noticed a few patches of *Hilaria mutica*. Proceeding some distance farther we crossed a creek, and a few miles farther on camped at night by one of the tanks or water holes that are seen occasionally in this region. The next day we crossed a muddy stream, along whose banks the *Sporobolus airoides* was conspicuous. We rode over a long flat, covered by large tussocks of this grass. Where we camped the next night, by the side of a clear creek, I saw some luxuriant growths of *Hilaria mutica* and *Triodia albescens*. Let it be remembered that I make note of the only grassy places I met at this season. The next morning we started towards Saragossa. From that place we rode along the side of Toyah Creek to Victoria. Both of these are small settlements, with Mexican adobe houses. Along the sides of the creek the *Sporobolus airoides* was prominent. In one place near the creek I noticed *Hilaria mutica* and *Panicum leucophæum* growing luxuriantly. Leaving the low prairie region by Toyah Creek we approached the picturesque Limpia Cañon, through which flows the clear water of Limpia Creek. In a few places on the edge of the creek I saw a few specimens of *Panicum colonum* and *Panicum crus galli*, and at two or three places on the rocky slopes, among the bowlders, a few tufts of grass starting forth. We reached Fort Davis on the night of June 11.

The country around Fort Davis looked very barren in June; the high

prairie almost entirely destitute of vegetation, and on the steep slopes of the hills no grass at all among the numerous timber growths. I saw a large number of goats browsing on the numerous shrubs and trees along the cliffs and on the hill-sides. Along the irrigating ditches by the Government gardens, amid a rank growth of other herbage, I found good specimens of such grasses as *Chloris elegans*, *Sporobolus cryptandrus*, *Eragrostis mexicana*, *Panicum obtusum*, *Panicum colonum*, and a few others. From Fort Davis I took an expedition to the "Pineries," and was favored with the company of Mr. William Lloyd, an enthusiastic ornithologist and entomologist, who was making a collection of birds for a New York museum. Our route was through the western division of Limpia Cañon, our road winding along the clear flowing Limpia Creek towards its source.

All along the Limpia Creek and its branches much of the land is used for pasture; generally in the broad parts of the valleys, but also where the valleys are made abrupt by the hills sloping down to either side of the creek. I noticed by the side of some of the ravines and cliffs remnants of last year's flora, such as dry stalks of the grasses *Elionurus candidus*, *Epicampes distichophylla*, and a few others that are prominent in the fresh vegetation of the mountain sides in the fall. In all the mountain regions of Texas the rains of August and September bring new life to vegetation. Through the spring months—though many of the trees and shrubs are in bloom in May—there seems to be with the grasses and other herbage an entire suspension of growth away from the water-courses. I noticed in a few places, still covering small areas, dry plants of some of the Gramma grasses of the preceding year. It would seem that, late in the spring and early in the summer, these continue to preserve their nutritive properties, and where they have not been browsed upon or cropped, furnish forage until the fresh growth in the fall.

I saw in the Limpia region several specimens of the remarkable "loco" weed (*Astragalus mollissimus*). It appeared much more common on the broad valleys than on the hill-sides. Its direful effects on cattle and horses who taste it are well known. I heard of its having caused also the death of many sheep, but no reports of goats being seriously affected. It may be that they entirely avoid it. It is worth mentioning here that donkeys (Mexican burros) feed on the "loco" without any injury to them.

Up in the Pineries in June I saw but very few grasses along the creek. At the base of one of the foot-hills, near the border of the creek, I found a few plants of *Poa andina*. At the old Government saw-mill I gathered some specimens of *Panicum bulbosum*.

Returning to Fort Davis, we rode over to the picturesque region of Musquis, south of the fort. Here I saw by the sides of the creek, as it flows through the cañon, a few plants, here and there, of *Tripsacum dactyloides*, *Diplachne dubia*, *Setaria setosa*, and others. These were also

seen in great profusion when I visited the same region in September. Southward from Musquis we rode to Murphyville, and spent two days in the neighborhood. At that time of the year, early in July, the surrounding hills looked indeed desolate and barren. I deferred making observations in any of these western regions until a month or two later, for then the rains of August and September would give a cheerful aspect to the face of nature. While passing through on the train from Murphyville to El Paso, nature presented all along the route the same dreary aspect—no grass on the hills and mesas, or on the prairies. But in some places the numerous shrubs and yuccas gave a charm to the landscape.

While in El Paso, three weeks in July and most of August, I saw no grass on the surrounding hills. The system of irrigation, here as elsewhere, brought forth a luxuriant growth of grass and other plants along the irrigating ditches and in the gardens. Among the grasses growing in the park at El Paso were fine specimens of Timothy (*Phleum pratense*), Red-top (*Agrostis vulgaris*) and Rye grass (*Lolium perenne*); These were mixed with such grasses as are frequent on cultivated land in the Gulf States, *Cynodon dactylon*, *Sorghum halepense*, and *Panicum sanguinale*. It is worthy of note (as illustrating the value of the Grama-grasses in the summer), that several loads of hay were hauled in July into El Paso—grama hay it was called—cut in the mountain region, 10 miles north of the town. In the latter part of August the rainy weather caused a fresh start to the vegetation, and the green shoots springing up, gave quite a spring-like appearance to the landscape.

In journeying from El Paso eastward there could everywhere be seen the reviving vegetation. At Marfa a very cheerful view was presented, with the surrounding country favored with a carpet of green grass and other herbage. At Fort Davis and the neighboring regions plant-life had started forth in great profusion. At every point the green grasses appeared—on the flats, in the swampy places, on the high prairies, on the craggy mountain sides, on the narrow shelves at the sides of the steep cliffs. About the middle of September I went over to Medero Creek, 30 miles south of Marfa. Here I found several of the gramas in abundance, though not spread over the surface to the extent that they were near Marfa and other places. But I collected in this region, on the hills and mesas, and near the sides of the creek, several grasses that I saw nowhere else. I have noted them in the appended list. Though many of the grasses have an extended range, certain species seem to be partial to one or two localities. Such sections might be characterized by certain grasses whose narrow range renders them, in their favorite haunts, a prominent feature of the vegetation.

On the last day of September I started, with a young man and team, from Marfa towards the Staked Plains. Part of our route was through Limpia Cañon, north of Fort Davis, and the contrast in the aspects of

vegetation at this season from that of June was very noticeable. I gathered several interesting grasses in this region, which I have noted in the list, giving the names and localities. October, it would seem, is the best month in which to study the grasses of western Texas. I found there all the species in their prime of bloom, though it was too early to gather seeds. Leaving Limpia Cañon we next came to the broad plain watered by Toyah Creek. Although in early June this region was barren, it was now mostly covered with a good carpet of grass. After traveling for some distance on the prairie we approached the Pecos, where the vegetation did not look so cheerful. The soil in the vicinity of the river is so impregnated with alkaline salts that only a few grasses and other plants can thrive. The Salt-grass (*Sporobolus airoides*) finds such a soil congenial. Its green tussocks in October were scattered about in abundance on the flats bordering the river.

Crossing the Pecos at Pecos City (a village of three stores in running order) we took an eastward course to the Sand Hills, which have been characterized as "a dreary, chaotic belt of reddish sand tossed by the wind into hillocks, cones, and ridges of various sizes and shapes." I saw a topography similar to such a description, but at the time of my visit, in October, I found a very luxuriant vegetation; though but few shrubs beside the Mesquite, which was abundant. The numerous grasses and other herbaceous plants were in their full prime of bloom. The species of grass peculiar to this belt I have specified in the appended list.

From the Sand Hills we passed on to the southern edge of the Staked Plains, not going farther east than Odessa. At this point the surface was covered in many places with large patches of grass, but it looked parched and dry. I learned that in August and early September vegetation at this and other portions of the Staked Plains was at its best. In the country surrounding Odessa the species of grass by far the most abundant is the "White grama" (*Aristida*). It is valued for hay, and seems to be the grass most esteemed at the southern edge of the Staked Plains, keeping its nutritive qualities in the field through the fall and early in the winter.

We returned to Marfa on the same route—by way of Pecos City and along Toyah Creek and Limpia Creek. I gathered some more specimens and a few seeds. Arriving at Marfa on Friday night, October 21, we started the following Monday for the Chinate Mountains. Along our route on the high prairies, varied here and there by swells or low ridges, the surface was generally covered with good grass, mostly the Gramas. But before reaching Cibilo Creek, riding about 40 miles, we passed no permanent running stream; only at some of the arroyas, a water-hole or tank, where the water is retained a long while after rains. On reaching the mountains vegetation looked more advanced than in the Limpia region. Many of the grasses were past their prime, but I collected several good specimens as well as seeds. While passing through the

Chenates I saw at several points burros loaded with wood or hay, being driven by Mexicans down the mountain sides. Such is a common sight during winter in these mountains. The value of these mountain grasses—in many localities consisting entirely of the Gramas—with their esteemed qualities of self-curing, can be seen not only in the pasturage they afford in the winter, but in the amount of hay that is cut. Immense quantities are cut for hay in the fall, and in a climate that continues dry and clear the first half of the year, can be kept through the spring and early summer without the protection of barns or other buildings. Stockmen say that horses and cattle are fond of the blooms of the Gramas; the “heads or tops” as they call them. In the fall, when the grasses are fresh, stock often prefer the tops to the foliage.

While passing through some of the gorges and on the lower mesas (on our way to Presidio on the Rio Grande) the Grama-grasses could be seen in great abundance. But descending to the bottom-land, that stretches for some distance till it reaches the river, I saw only scanty growths of grass, only slight patches here and there, often only a stray plant or tussock. The few specimens I gathered in the neighborhood of Presidio I have noted in the list. Arriving at Marfa, on our return trip the last day of October, we started on the 2d of November for a three days' trip over to Musquis, by way of Paisano, returning by way of Fort Davis. Though late in the season, I gathered several specimens and seeds.

The following grasses were collected during my whole trip:

Panicum fasciculatum.

Different forms of this grass I found growing in the gravelly soil on the craggy slopes. I saw it nowhere in abundance, generally in scattered tussocks. It seemed to be more common in the Limpia region than elsewhere.

Panicum ciliatissimum.

This I saw in a few places in the Limpia region. Less abundant than the preceding.

Panicum autumnale, var.

This is frequently seen on the lower ridges and in gravelly soil near the creeks.

Panicum bulbosum.

This I saw in several places at Limpia Cañon, on gravelly slopes near the creek, and in like situations in Musquis Cañon.

Panicum lachnanthum.

Frequent on many of the lower ridges, more common on slight elevations in the valleys. On some of the bottom-lands, where the soil is sandy or gravelly, it is seen in great profusion.

Panicum crus-galli.

Frequently seen on the borders of the creeks. In some localities very abundant.

Panicum sanguinale.

Seen in several places on the creek bottoms.

Panicum colonum.

With the preceding. More common.

Panicum capillare.

Occasionally seen associated with the preceding.

Panicum proliferum.

This grass, so common in cultivated ground in eastern Texas, I saw only in one spot by the side of Toyah Creek.

Panicum obtusum.

This was often seen on the borders of creeks; sometimes on the gravelly slopes near the sides of creeks. I have seen it in great luxuriance on the borders of creeks whose waters are strongly alkaline.

Panicum Harvardii.

Several plants of this tall, striking grass, I saw scattered about at the Sand Hills in October. Not seen elsewhere.

Panicum Hallii.

Another grass peculiar to the Sand Hill region. Its procumbent stems, rooting at the joints, are scattered freely among the other grasses, but not forming patches.

Paspalum distichum.

Occasionally seen in muddy places on the borders of creeks. Where the soil is gravelly it does not thrive.

Eriochloa punctata.

Frequently seen on creek bottoms. Often mixed with *Panicum sanguinale*.

Setaria setosa and var. *caudata*.

Both of these are plentiful in the valleys of western Texas; generally in soils adjacent to creeks. Not rare on low ridges near the borders of creeks. The var. seems more abundant than the type.

Cenchrus tribuloides.

One of the most common grasses at the Sand Hills. Fortunately it thrives only in sandy soils.

Cenchrus myosuroides.

This was seen only in one locality; in large clumps by the side of the creek at Cibilo Cañon.

Tripsacum dactyloides.

This was seen only at Musquis (south of Fort Davis) growing in clumps in a few places along the creek.

Hilaria mutica.

This occurs in all the valleys of western Texas; often in gravelly soil near the creeks; not rare on the slopes of the lower ridges. On the low prairie at Toyah Creek I noticed it, in some places forming large patches of itself, though generally mixed with other grasses.

Hilaria cenchroides.

This was seen in two localities; on the high prairie near Marfa--several plants mixed with some of the Gramas; and on one of the lower mesas on the south side of the Chenates.

Tragus racemosus.

Near Fort Davis, on the high prairie, I saw several plants of this scattered about; also in several places along Limpia Creek north of the fort. It seems to be thoroughly naturalized.

Imperata Hookeri.

This was seen only in one locality; by the side of Medero Creek, 30 miles south of Marfa.

Elionurus candidus.

Frequent in many places on the craggy slopes. It seemed especially abundant in the Limpia region and in the neighborhood of Musquis. I found it at several points at Paisano and in the Chenate region, and on some of the hills near Medero Creek.

Heteropogon contortus.

Common on all the craggy slopes of the mountains.

Andropogon cirrhatus and *Andropogon hirtiflorus.*

Both of these are common in the Limpia region on the craggy slopes.

Andropogon saccharoides.

Often seen at the base of the lower ridges. More common on gravelly soil near the creeks.

Andropogon Hallii.

Seen only at the Sand Hills. A few large clumps here and there among the other herbage.

Chrysopogon nutans.

Seen at Musquis in one locality growing in clumps near the creek. Also seen in one other locality; a few scattered plants at an arroya near Cibilo Creek.

Sorghum halepense.

At Musquis Cañon I saw a few plants growing by the side of the creek. Cultivated at Fort Davis and at El Paso.

Aristida bromoides.

Frequently seen near the borders of creeks and at the base of a ridge.

Aristida dispersa.

In the same localities as the preceding and in like soils and situations.

Aristida Palmeri.

Several specimens of this were seen scattered about on the lower ridges and mesas in the Limpia region and in the Chenates.

Aristida purpurea.

Different forms of this were seen near many of the creeks and on the slopes of the lower ridges.

Aristida Havardii.

This was seen in a few places on the lower mesas at the southern base of the Chenate Mountains.

Aristida.

On the prairie extending south of Marfa I saw several plants of this scattered here and there. At the southern edge of the Staked Plains, about Odessa, it is the most prevalent grass, known as the "White grama."

Aristida Schiediana.

Seen at several places in the neighborhood of Musquis and in the Limpia region. Growing like other grasses on the craggy slopes in the gravelly soil between the rocks and boulders.

Stipa flexuosa, n. sp.

Seen only on some of the lower mesas near Medero Creek. Growing in clumps in abundance.

Oryzopsis fimbriata.

Seen in a few places on the craggy slopes in the Limpia region and at Paisano.

Muhlenbergia Texana.

Frequent on the mesas and high prairies. On the low prairie at Toyah Creek I saw several specimens.

Muhlenbergia arenicola.

Common on the high prairie between Fort Davis and the Chenates.

Muhlenbergia monticola.

Several clumps of this I saw scattered about on the craggy slopes in the Limpia region.

Muhlenbergia spiciformis.

Seen in the same localities of the preceding, also at Musquis Cañon. It offers a rare exception among grasses in its choice of habitation. I found it nowhere on the gravelly slopes. All the specimens I saw were growing on the steep sides of ledges, sometimes on very narrow shelvy places on the side of a steep cliff; often in fissures of the rock, with no soil apparently for its nourishment.

Muhlenbergia ———, n. sp.

Several specimens of this were seen on the craggy slopes at Limpia Cañon.

Lycurus phleoides.

Common on the lower ridges and mesas. I saw several plants of it on the slight ridges that mark the uneven surface of the prairie land around Marfa.

Epicampes distichophylla.

This is one of the most common grasses on the craggy slopes of the mountains. The form without awns I saw only in the Limpia region.

Epicampes stricta.

Seen only in two localities—in gravelly soil near Medero Creek and in one spot near the creek at Musquis Cañon.

Sporobolus airoides.

The prevailing grass along saline and alkaline streams. At nearly all the creeks in western Texas, on the low prairies and in the broad valleys subject to overflows, large level surfaces are covered with tussocks of this grass.

Sporobolus Wrightii.

Common on the bottom land of the Rio Grande. Often mixed with the preceding on the flats by some of the creeks.

Sporobolus cryptandrus.

Frequent on the high prairies. Common at the Sand Hills.

Sporobolus cryptandrus, var. *strictus*.

Scattered about in abundance at the Sand Hills. A few specimens seen near Toyah Creek.

Sporobolus cryptandrus, var. *flexuosa*.

One of the most common grasses at the Sand Hills.

Sporobolus cryptandrus, var. *robusta*.

A striking feature of the grass growths at the Sand Hills. Less common than the preceding.

Sporobolus Nealleyi, n. sp.

Seen at the Sand Hills only in one spot.

Sporobolus ramulosus.

Frequent at the Sand Hills; seen in a few places on the prairie near Marfa and in a valley near Musquis.

Sporobolus asperifolius, var.

Seen at several places along Toyah Creek. Not seen elsewhere.

Sporobolus repens.

Seen at several places on the prairie near Marfa; sometimes in patches occupying the ground for some yards. A few plants also seen in a valley near Musquis.

Agrostis verticillata.

Frequent on the borders of creeks.

Cynodon dactylon.

Several plants were seen at the Sand Hills, where it seems to be naturalized. I saw fine lawns of it at Fort Davis, Marfa, and El Paso.

Chloris cucullata.

Common in the gravelly soils of the valleys. Frequent at the Sand Hills.

Chloris elegans.

Common on the bottom lands of the creeks.

Trichloris verticillata.

Seen at several points along the Rio Grande, generally in clumps. Also seen in places along Toyah Creek. On the Pecos flats I saw a few plants mixed with *S. airoides*. It seems to thrive on alkaline soil.

Bouteloua oligostachya (Blue grama).

This well-known grass, so abundant in these western regions, is seen in its greatest perfection on the high prairies, covering extensive areas. Mixed with some of the other grammas, it occurs on the grassy slopes and in wide, gravelly spaces on the mountain-sides. Unlike many of the mountain grasses, the grammas are not at their best on the craggy slopes. In many localities the best hay is furnished by a mixture of this and other grammas.

Bouteloua hirsuta (Black grama).

This, with a more extensive range (extending eastward beyond the Brazos, in East Texas), is much less abundant than the blue grama. In some places it is largely mixed with other grammas. Several specimens were seen at the Sand Hills.

Bouteloua Harvardii.

Seen in a few places in the Limpia region, and near Musquis Cañon; also at some of the foot-hills on the north side of the Chenates, and at Paisano.

Bouteloua eriopoda (Woolly-jointed grama).

One of the most common grasses in the Chenate region. On the lower ridges and prairies just north of the mountains it is generally the prevailing grass, covering large areas. In the gorges of the Chenates, on some of the grassy spots, this and the following (*B. stricta*) constitute the principal growth. On the high prairies it is occasionally found mixed with the blue grama. It is frequent in the Limpia and other mountain regions. Several specimens were seen at the Sand Hills.

Bouteloua stricta.

Common in several portions of the Chenate region. Seen in abundance on some of the lower ridges at the southern base of the mountains.

Bouteloua racemosa.

Common in gravelly soil in the valleys. Often seen on low ridges.

Bouteloua polystachya.

Never seen in patches, like most of the other grammas. With its short, procumbent stems it prefers situations where there is no turf. It is found in a great variety of soils. I saw it in open spaces on high prairies and on low prairies and flats; sometimes on hill-sides. Several specimens were seen at the Sand Hills. It is frequent on the Rio Grande bottom at Presidio.

Bouteloua aristidoides.

Often associated with the preceding, but less abundant. Of the same manner of growth and choice of habitation.

Pappophorum Wrightii.

Frequent on many of the mesas and low ridges.

Pappophorum apertum.

Often seen with the preceding, but less abundant; but it has a range farther east than its congener. Not rare in valleys between Devil's River and the Pecos.

Cottea pappophoroides.

Seen in one spot by the side of Medero Crook; also in two localities in the Chenates; on a slope at Cibilo Cañon, and in a ravine at the southern base.

Triodia acuminata.

This, common east of the Pecos, I saw only in one locality farther west, at an arroyo near Musquis.

Triodia albescens.

Seen in a few places by Toyah Creek. Farther east it is abundant in several localities.

Triodia avenacea.

Frequent on some of the lower mesas by Medero Creek. A few specimens were seen at a ravine branching from Cibilo Cañon.

Triodia Nealleyi, n. sp.

Seen only at one locality, on a craggy slope in Cibilo Cañon.

Triodia cragrostoides.

With the preceding.

Triodia pulchella.

Seen at many of the arroyos; sometimes on the high prairies. A few plants were also seen scattered on the river bottom near Presidio.

Triodia trinerviglumis.

Abundant at Cibilo Cañon. Seen at several points near Toyah Creek.

Triodia repens, n. sp.

Seen only in one spot by the side of Limpia Creek (about 15 miles north of Fort Davis), just below a rocky slope. Here, on a level surface a few yards square, it formed a complete turf.

Triplasis purpurea.

Seen in a few places at the Sand Hills.

Diplachne dubia.

Common along the creeks. In some places on the creek bottoms it was found growing very luxuriantly.

Diplachne fascicularis.

Seen at several points along the Rio Grande, and on some of the creeks. It is somewhat partial to alkaline soil.

Scleropogon Karwinskianus.

This was seen often in small patches scattered over the prairie region near Marfa and Fort Davis, and near Toyah Creek.

Munroa squarrosa.

This peculiar grass, with its contracted stems and leaves, was seen at several places on the prairie about Marfa—common at the Sand Hills.

Arundo donax.

At various points on the Rio Grande. A few specimens seen at Presidio.

Phragmites communis.

Common along the Rio Grande.

Eragrostis Purshii.

Common on the creek bottoms. In some places the principal grass growth.

Eragrostis poaeoides.

With the preceding, but less common.

Eragrostis lugens.

Frequent in the Limpia region on the craggy slopes.

Eragrostis Neo-Mexicana.

With the preceding.

Eragrostis oxylepis.

Frequent at the sand-hills.

Eragrostis curtipedicellata.

A few plants seen at the sand-hills.

Eragrostis reptans.

Seen only at one point at Limpia cañon on a grassy slope.

Distichlis maritima.

This common grass of saline and alkaline soils I found in one place by Toyah Creek.

Bromus ciliatus, var.

Seen only at Fort Davis, near the summit of one of the cliffs.

G. C. NEALLEY.

DR. GEO. VASEY,

Botanist, Department of Agriculture.

FORAGE PLANTS OF ARIZONA AND NEW MEXICO.

In September, 1887, a circular was sent to about fifty stockmen in Arizona and New Mexico, asking for specimens of any plants used for forage, with notes on their value. Considerable valuable information was thus obtained. The returns showed that many plants which are regarded elsewhere as useless weeds are of much value there for forage. The specimens sent were numbered to correspond with the accompanying notes. These specimens were identified by the botanist, and their names, together with other information, returned to the senders. The following notes, sent by Dr. J. Pool, of Benson, Ariz., will serve as an example of the replies. Further information on these and other forage plants of this region will be found elsewhere in this bulletin.

Sporobolus Wrightii (Sacaton grass).

This grass is adapted to the valleys, and grows on any kind of soil, good or poor, where there is a little moisture. It grows at all times of the year, attaining the height of 8 or 9 feet. When there is plenty of rain in July and August it grows very fast, and in September it blooms. It grows in bunches or tussocks, and finally mats together. It grows from both the seed and root; is very hardy, and does not tramp out very easily. It is sometimes cut for hay.

Trichloris verticillata (sometimes called Fox-tail grass).

This grass is very good forage, growing on the high land of the valleys. It comes from seed after the summer rains fall. It grows to the height of 4 feet, and is not easily tramped out.

Bouteloua polystachya (Six-weeks grass).

This grass starts after every rain, on the mesas and bottom lands, and comes to maturity in six weeks. It grows very thick, comes every year, and is relished by horses, cattle, sheep, etc.

Muhlenbergia Texana (Grama grass).

This grass is adapted to the mesa lands, table lands, and hills, and grows to the height of 2 feet, and in bunches or clusters, matted together. It is very fine feed for cattle, horses, and sheep, and it also makes very good hay, of which a great many tons are cut every year. It starts up after every rain. It has very fine seed, as you will see by the specimens. It stands drougths very well, which we often have in this Territory, and when the dry weather comes it dries and remains good all winter. But it tramps out in three or four years where cattle run on the range.

Panicum crus-galli (Water-grass).

After the summer rains in all swampy places or low lands this grass commences growing, sometimes attaining the height of 6 or 7 feet. It is relished by all kinds of stock, and does not tramp out, as it always starts from the seed.

Setaria setosa.

This grass comes up in bunches after the summer rains in the hills and valleys. It is not very thick, and grows mostly around bushes and trees. It is a very good grass for horses, cattle, and sheep, and does not tramp out, and in fact is spreading. It grows to the height of 3 feet. We do not know any name for it.

Hilaria Jamesii (Guyetta).

This grass grows on the hills and mesa lands, and does not tramp out easily. It grows to the height of 18 inches, is relished by all stock, horses, sheep, and cattle, and stands the droughth well. It is cut for hay a great deal in the Territories.

Eragrostis megastachya.

This grass is common in the valleys and cañons of this Territory, and is relished by all kinds of stock. It grows to the height of 2 feet and does not tramp out readily, as it comes from seed after the summer rains.

Chloris elegans.

This grass comes up in bunches around bushes and trees after the summer rains. It grows about 2 feet in height, and is relished by all kinds of stock. It seems to be spreading.

Eriochloa punctata.

This comes from seed in the valleys after the summer rains, and is relished by all kinds of stock. It grows thickly, is not tramped out, and is sometimes cut for hay.

Allionia incarnata (Gunaninpil of the Spanish).

This is a slender prostrate plant, which comes from the seed after the summer rains. All stock relish it, and it is not tramped out readily. The natives use it as a substitute for tea.

Amarantus (Careless-weed, big-weed).

This weed, which is known everywhere, is abundant over the hills and low-lands in this Territory, coming after the summer rains. It is relished by all kinds of stock, sheep, hogs, cattle, and horses.

Portulacca oleracea (Purslane).

This herb, which probably grows all over the United States, is abundant in this part of the country, and comes after the summer rains, and is relished by all kinds of stock, sheep, hogs, horses, cattle, etc.

Prosopis juliflora (Screw-bean, mesquit tree).

The leaves are very good browsing for horses and cattle. It bears two crops of beans a year, which are next to barley for fattening purposes, for horses, sheep, cattle, and hogs. This tree is the chief timber of this Territory for fencing and fuel. The small branches bear sharp thorns; it grows chiefly in good soil in the valleys and mountains, becoming very scrubby on the mesa lands.

Tribulus maximus.

This herb grows very abundantly all over the country when there is plenty of rain. It runs along on the ground, and has a small yellow flower. The cattle eat it all by licking it up from the ground. We know of no name for it.

Atriplex canescens (Sage-brush).

This grows in the higher valleys and on the mesas or table-lands. It is of a shrubby character, and attains a height of 10 feet. The leaves and small twigs are eaten by cattle, and in some parts of the Territory there is nothing else for feed. Stock keep fat upon it, but it gives milk a bad flavor. Bees obtain honey from the blossoms.

Cyperus strigosus (Tula-grass).

This grass grows in the swampy lands of this valley, attaining the height of 4 feet. It is relished by all stock.

GRASSES AND FORAGE PLANTS FIGURED IN THIS BULLETIN.

The most common and conspicuous of the grasses mentioned in the report of Mr. Neally and of Professor Tracy are figured herewith, and the figures will aid much in an identification of the species by those living in the arid districts, and will be useful in directing experiments for their cultivation or utilization.

Panicum crus-galli (Barn-yard grass).

This is an annual grass, with thick, stout culms, usually from 2 to 4 feet high. In the Southern States it is often employed and considered a valuable grass. Professor Phares, of Mississippi, says that—

In that and some other States it is mowed annually, and is said sometimes to furnish 4 or 5 tons of hay per acre. It annually re-seeds the ground, and requires no other cultivation or other care save protection from stock and the labor of harvesting. In one county in Mississippi hundreds of acres are annually mowed on single farms. Cows and horses are very fond of it whether green or dry.

In the Northern States it is hardly ever employed. (Plate 1.)

Panicum virgatum (Fall panic-grass, switch-grass).

A tall perennial grass, 3 to 5 feet high, growing mostly in clumps in dry sandy soil, very common on the sea-coast, and also in the interior to the base of the Rocky Mountains. This is a good and prolific grass if cut when young; when ripe it becomes harsh and unpalatable. It forms a large constituent of the native grasses of the prairies, particularly in moist localities. (Plate 2.)

Aristida purpurea (Western beard-grass; purple three-awned grass).

This species prevails extensively west of the Mississippi River from British America to Mexico, and is abundant on the plains of Kansas, New Mexico, and Texas. It grows usually 1 to 1½ feet high, with slender culms, branching at the base, and with short, involute leaves. It is an exceedingly variable species, and there are several distinct varieties. The panicle is 6 to 8 inches long, rather narrow, erect or flexuous. The spikelets are much like those of the preceding species, but usually larger, and with longer awns or beards. In some varieties these awns are 2 or 3 inches long, widely diverging, and purplish colored, the whole panicle having a graceful and feathery appearance. (Plate 3.)

Stipa viridula (Bunch-grass).

A perennial grass, culms 2 to 4 feet high, leafy; the radical leaves 12 to 18 inches long, those of the stem 4 to 10 inches long, one to two lines

wide, involute, and bristle-like at the point; sheaths long, smooth, the uppermost inclosing the base of the panicle; panicle very variable in size, from 6 inches to a foot or more, narrow and loose, variable in thickness, the branches mostly in twos and threes, erect and appressed, much subdivided. Widely diffused over the Rocky Mountain region, extending to California and British America, furnishing a considerable part of the wild forage of the region. (Plate 4.)

Setaria setosa (Bristle-grass, fox-tail).

A native species growing in New Mexico, Texas, and southward into Mexico and South America. It grows about 2 feet high. The stem and leaves are smooth, except a fine hairy ring at the joints. The leaves are 6 to 10 inches long, narrow, and gradually tapering to a long point. There is a tuft of short white hairs at the top of the leaf-sheath. The panicle is 4 to 6 inches long, erect, or slightly nodding at the top, narrowly cylindrical, with very short sessile branches, usually somewhat interrupted below; sometimes the lower branches are longer, and the panicle looser. We know little as to the agricultural value of this species; as it is found in the arid districts, it is deserving the attention of farmers of that section. (Plate 5.)

Hilaria Jamesii.

The grass was formerly called *Pleuraphis Jamesii*. It is a native of the arid regions extending from Mexico to Colorado, growing in clumps from strong scaly runners or rhizomes. The base of the culm is usually covered with the dried leaves of the preceding year. The culms are from 1 to 1½ feet high, with a few short, rigid, light green or bluish-green leaves, which are more or less involute. Each culm is terminated by a simple loose spike, 1 or 2 inches long, with alternate clusters of sessile spikelets. These clusters are quite complex in structure, each one containing three spikelets, one central and two lateral. We do not know to what extent this grass prevails, but all reports speak highly as to its feeding value. (Plate 6.)

Andropogon scoparius (Wood-grass; broom-grass).

This grass usually grows from 2 to 3 feet high, the flowering spikes coming out in small clusters from many of the side joints on slender graceful peduncles. The spikes have a small bract near the base, and consist of a slender axis, with from six to ten alternate joints. This grass forms an important portion of the native grasses of the prairies of Kansas and Nebraska, extending in some of its forms to the Atlantic coast. (Plate 7.)

Andropogon provincialis (Blue-stem).

This is the tallest of our species. It grows erect to the height of 5 or 6 feet, in rocky or hilly ground, or at the West it is abundant on the native prairies, where it is frequently called blue-stem. The leaves are long, and frequently somewhat hairy on the sheaths and margins. The

spikes are in small clusters of three to six, terminating the stalk, and also several clusters from the side branches. The spikes are usually 2 to 3 inches long, rather rigid, and contain ten to twenty flowers each. At each joint there is one sessile perfect flower and one stalked one, which is male only, otherwise it is nearly like the fertile one. The outer glumes are about 4 lines long, the upper ones tipped with a short stiff awn. The flowering glume of the perfect flower is twisted and about one-half inch long.

This species, as above stated, is abundant on the prairies of the West, where it is one of the principal hay-grasses of the country, and is extensively cut and cured for winter use. (Plate 8.)

Chrysopogon nutans (Wild oat-grass).

This is a tall perennial grass, having a wide range over all the country east of the Rocky Mountains. It grows rather sparsely and forms a thin bed of grass. The stalks are 3 to 6 feet high, smooth, hollow, straight, and having at the top a narrow panicle of handsome straw-colored or brownish flowers 6 to 12 inches long, which is gracefully drooping at the top. The spikelets are at the ends of the slender branches of the loose panicle, generally of a yellowish color. This grass, when it occurs in quantity, is frequently utilized for hay-making, for which purpose it should be cut early. (Plate 9.)

Oryzopsis cuspidata (Indian millet.)

This grass has a wide distribution, not only on the Sierras of California, but northward to British America and eastward through all the interior region of Utah, Nevada, New Mexico, Texas, Colorado, and Nebraska to the Missouri River. It is a perennial, growing in dense tufts, whence its common name of bunch-grass. The culms are 1 to 2 feet, with about three narrow convolute leaves, the upper one having a long, inflated sheath which incloses the base of the panicle. In Montana it is one of the most esteemed *bunch grasses*, and thrives on soil too sandy for other more valuable species. The abundant seeds are very nutritious and fattening for cattle. (Plate 10.)

Sporobolus cryptandrus.

This species grows chiefly in sandy soil. The culms are frequently bent at the lower joints, then rising erect to the height of 2 or 3 feet. The leaves are mostly near the base, where the joints of the culms are short; here the sheaths are short and the blades of the leaves 5 to 6 inches long, the upper sheaths become longer and the blades shorter; the leaves are flat, but become involute in dry weather. The top of the sheath is fringed with fine soft hairs. The long and narrow panicle is for a long time completely inclosed in the very long sheath of the upper leaf, but finally emerges except the base and becomes more or less spreading. The full panicle is from 6 to 12 inches long, the branches mostly alternate or scattered, the lower ones about 1 inch apart and 2

inches long, the upper ones much closer and shorter, all flowering nearly to their bases with the spikelets short-stalked and appressed.

This species is very common in sandy fields in the Northern and Southern States, as well as over all the dry plains west of the Mississippi River, extending from British America to Mexico, where it furnishes a portion of the wild pasturage. It deserves observation and experiment as to its value. (Plate 11.)

Sporobolus airoides (Salt-grass, fine-top grass).

Culms arising from strong perennial, creeping root-stalks 2 to 3 feet high, thickened at the base and clothed with numerous long, rigid, generally involute, long-pointed leaves, which are smooth and bearded in the throat of the sheath, panicle becoming exerted and diffuse, 6 to 12 inches long, 3 to 4 inches wide; the branches capillary, scattered, mostly single, or in whorls below, the branches subdivided above the middle and rather sparsely flowered.

A common grass throughout the arid regions of the West, sometimes called salt-grass, and affording considerable pasturage in some places. (Plate 12.)

Agrostis exarata (Northern redtop, mountain redtop).

This is chiefly a northern species, being found in Wisconsin and westward to the Rocky Mountains, also in British America and California to Alaska. It is very variable in appearance and presents several varieties. It is generally more slender in growth than the common redtop. The panicle is usually longer, narrower, and looser. In all the forms the palea is wanting or is very minute.

There is reason to believe that this grass can be made to supply the same valuable place on the Pacific coast that the *Agrostis vulgaris* does at the East, but it requires investigation and experiment. (Plate 13.)

Deschampsia cæspitosa (Hair-grass).

This is an exceedingly variable species, having a very wide distribution in this and other countries. It is somewhat rare east of the Mississippi, but on the elevated plains and in the Rocky Mountains, also in California and Oregon, it is one of the common bunch-grasses which afford pasturage to cattle and horses. In the East it is found in the hilly regions of New England and the Alleghanies. The panicle is very handsome, presenting a purple or glossy hue and a loose, graceful appearance. We know very little as to the value of this grass; it may be found worthy of cultivation in the arid interior districts. (Plate 14.)

Chloris alba.

An annual grass growing in tufts, 1 to 2 feet high, smooth, the culms frequently branched and bent at the lower joints, decumbent, becoming erect; leaves numerous, smooth, the sheaths mostly loose, the blade broad, the upper sheath dilated, and at first inclosing the flower spikes,

which are eight to fifteen in number, 2 to 3 inches long, and umbellate or fasciculate at the top of the culm or of the lateral branches.

This is a common grass in the arid regions of New Mexico, Arizona, and further south and west. It furnishes a large quantity of foliage, but of its agricultural value we have no information. (Plate 15.)

Bouteloua oligostachya (Gramma, mesquite grass).

This is the commonest species on the Great Plains. It is frequently called Buffalo-grass, although that name strictly belongs to another grass (*Buchloë dactyloides*). On the arid plains of the West it is the principal grass, and is the main reliance for the vast herds of cattle which are raised there. It grows chiefly in small, roundish patches, closely pressed to the ground, the foliage being in a dense cushion-like mass. The leaves are short and crowded at the base of the short stems. The flowering stalks seldom rise over a foot in height and bear, near the top, one or two flower spikes, each about an inch long and from one-eighth to one-quarter of an inch wide, standing out nearly at right angles, like a small flag floating in the breeze. Where much grazing prevails, however, these flowering stalks are eaten down so much that only the mats of leaves are observable. In bottom lands and low, moist ground it grows more closely, and under favorable circumstances forms a pretty close sod, but even then it is not adapted for mowing, although it is sometimes cut, making a very light crop. Under the most favorable circumstances the product of this grass is small compared with the cultivated grasses. It is undoubtedly highly nutritious. Stock of all kind are fond of it, and eat it in preference to any grass growing with it. It dries and cures on the ground so as to retain its nutritive properties in the winter. No attempt is generally made by stockmen to feed cattle in the winter. They are expected to "rustle around," as the phrase is, and find their living, and in ordinary winters, as the fall of snow is light, they are enabled to subsist and make a pretty good appearance in the spring. But in severe winters there are losses of cattle, sometimes very heavy. (Plate 16.)

Bouteloua polystachya (Low grama-grass).

This species probably does not reach farther north than northern New Mexico. It is an annual, from 6 to 10 inches high, growing in clumps; the culms are slender, branching, and bent at the lower joints. The culm terminates in a raceme-like panicle, 3 to 6 inches long, composed of five to seven alternate, narrow, one-sided spikes, which are about 1 inch long and one-half inch to 1 inch apart. There are several varieties or forms of this species, some smaller and some larger. It abounds near the banks of streams and furnishes excellent pasturage. (Plate 17.)

Buchloë dactyloides (Buffalo-grass).

This grass is extensively spread over all the region known as the Great Plains. It is very low, the bulk of leaves seldom rising more

than 3 or 4 inches above the ground, growing in extensive tufts or patches, and spreading largely by means of stolons or offshoots similar to those of Bermuda grass, these stolons being sometimes 2 feet long, and with joints every 3 or 4 inches, frequently rooting and sending up flowering culms from the joints. The leaves of the radical tufts are 3 to 5 inches long, one or one half line wide, smooth, or edged with a few scattering hairs. The flowering culms are chiefly dioecious, but sometimes both male and female flowers are found on the same plant but in separate parts. Next to the grama-grass it is perhaps the most valuable grass in the support of the cattle of the plains. (Plate 18.)

Triodia trinerviglumis (Spear-grass).

Another perennial species, growing in Colorado, Arkansas, Texas, New Mexico, and southward. The culms are 2 to 3 feet high, and rather stout; the radical leaves are somewhat rigid, 6 to 12 inches long, narrow, acuminate-pointed, inclined to be involute, the sheaths more or less hairy. The smooth culm has three or four leaves, which are 4 to 8 inches long and slender-pointed. Little is known of its abundance or agricultural value. (Plate 19.)

Triodia acuminata (White tuft-grass).

A low species, growing in tufts from 6 to 12 inches high, the leaves short and narrow, but abundant near the ground; the culms are erect, slender, with one or two short leaves, and terminated by an oblong, spike-like panicle about an inch long, composed of a few crowded sessile or nearly sessile branches, each with one to three spikelets. The spikelets each contain eight or ten crowded flowers. This is a native of the arid regions of Texas, New Mexico, and southwestward. (Plate 20.)

Diplachne fascicularis (Spike-grass).

An annual grass of vigorous growth, 2 to 3 feet high, growing in brackish marshes or wet ground near the sea-coast, and also far inland in the Mississippi Valley, Texas, Arizona, etc., in alkaline soil. The radical leaves are narrow and half to two-thirds as long as the culms, rough on the margin; those of the culms similar, with long, smooth loose sheaths, the upper ones usually inclosing the base of the panicle. The culms are frequently branched at the lower joints. The panicle is large, 6 to 10 inches long, consisting of numerous (fifteen to thirty) spike-like branches, which are 2 to 4 inches long, mostly alternate, sometimes fasciated below, angular and rough, and flower-bearing throughout. (Plate 21.)

Diplachne dubia.

A grass of similar aspect to the preceding; the leaves somewhat longer and more rigid; the panicle rather shorter, and composed of six to twelve branches, which are stouter and more spreading. The spikelets in age become spreading, and the axis zigzag. It is of more southern range than the preceding, occurring in the Gulf States and southwestward. (Plate 22.)

Eragrostis major.

This is a foreign grass which has become extensively naturalized, not only in the older States, but in many places in the western and southern Territories. It is found in waste and cultivated grounds and on roadsides, growing in thick tufts, which spread out over the ground by means of the geniculate and decumbent culms. The culms are from 1 to 2 feet long, the lower joints bent and giving rise to long branches. The grass is said to have a disagreeable odor when fresh. It produces an abundance of foliage, and is apparently an annual, reaching maturity late in the season. We are not aware that its agricultural value has been tested. (Plate 23.)

Distichlis maritima (Salt-grass, alkaline-grass).

This is described in most botanical works as *Brizopyrum spicatum*, but recently the name given by Rafinesque has been accepted and restored to it by Mr. Bentham. It is a perennial grass, growing in marshes near the sea-coast on both sides of the continent, and also abundantly in alkaline soil throughout the arid districts of the Rocky Mountains. It has strong creeping root-stocks, covered with imbricated leaf-sheaths, sending up culms from 6 to 18 inches high, which are clothed nearly to the top with the numerous, sometimes crowded, two-ranked leaves. The leaves are generally rigid and involute, sharp-pointed, varying greatly in length on different specimens. The plants are dioecious, some being entirely male and some female. The panicle is generally short and spike-like, sometimes, especially in the males, rather loose, with longer, erect branches, and sometimes reduced to a few spikelets.

Although this can not be considered a first-class grass for agricultural purposes, it is freely cut with other marsh grasses, and on the alkaline plains of the Rocky Mountains it affords an inferior pasturage. (Plate 24.)

Poa tenuifolia (Blue-grass of the plains and mountains).

This species in several varieties is common in California, Oregon, Montana, etc., and is one of the numerous bunch-grasses referred to in the accounts of the wild pasturage of that country. The foliage of some forms is scanty, but of others the radical leaves are long and abundant. It is stated that the Indians gather the seeds of this grass for food. It is probable that it, by careful cultivation, may be made as valuable in agriculture for the region where it grows as the *Poa pratensis* is in the Eastern States. (Plate 25.)

Festuca scabrella (Bunch-grass).

A perennial grass growing in strong clumps or bunches, and hence called "bunch-grass." It is a native of the Rocky Mountain region, from Colorado westward to California and Oregon. The culms are usually 2 to 3 feet high, erect and smooth; the radical leaves are numerous, about half as long as the culm, generally rigid, involute, and sca-

brous on the margins; the blade is prone to separate when old, leaving an abundance of leafless sheaths at the base; the cauline leaves are about two, short and pointed, 2 or 4 inches long; the sheath scabrous, the ligule short or wanting; the panicle is usually 3 to 5 inches long. In Montana it is called the *Great-bunch grass*, and is one of the principal grasses of that country. It is the prevailing species on the foothills and mountain slopes at from 6,000 to 7,000 feet altitude. It is rather too hard a grass for sheep, but there is no grass more valued on the summer ranges for cattle and horses. It makes excellent hay for horses, and is cut in large quantities for this purpose. It grows in large tussocks, making it rather a difficult grass to mow with a machine. It is one of the most important grasses of eastern Oregon and Washington. (Plate 26.)

Agropyrum glaucum (Blue-stem, blue-joint).

This species prevails on the western plains from Texas to Montana, and is well known to stockmen. It differs from the *Agropyrum repens* in having a stouter, more rigid stem and leaves; the leaves, indeed, often becoming involute and stiff. It is also of a light bluish-green color. The spike is generally shorter, denser, and with larger spikelets.

Mr. Richard Gaines, of Colorado Springs, Colo., says:

We think this is the best grass grown, superior to timothy or clover. We call it Blue-stem, or Blue-joint; no richer hay can be made from anything known.

Plate 27 is a figure of *Agropyrum repens*.

Hordeum nodosum (Barley-grass).

An annual or biennial grass, growing principally in alkaline soils and on the borders of saline marshes, especially in the Western States and Territories. Although eaten by cattle when in a young state, it can not be claimed as of anything more than temporary value. The culms are usually 1 to 1½ feet high, sometimes in moist places reaching 3 feet, and varying as to smoothness or pubescence.

The leaves are usually flat, 2 to 4 inches long, and about two lines wide. The flowers are in a close cylindrical spike about 2 inches long, with three spikelets at each joint of the rachis. (Plate 28.)

Elymus condensatus (Giant rye-grass).

This is a perennial grass, ranging from San Diego throughout California and into Oregon and Washington Territory, also in the Rocky Mountain region of the interior. It is very variable, but always a strong, heavy-rooted, coarse grass, from 3 to 5 or even to 12 feet high.

Mr. Bolander states that it seems to do excellent service by fixing the soil on the banks of creeks and rivers. In the larger forms the culms are half an inch thick. The leaves are smooth, 2 feet long, and an inch wide or more, and the panicle 8 to 14 inches long and 1½ inches thick. As it usually occurs in arid grounds, it is from 3 to 6 feet high,

the leaves about a foot long, and half an inch wide, and the spike-like panicle 4 to 8 inches long. Mr. W. C. Cusick, of Oregon, says :

This is a very valuable grass, commonly known as rye-grass. In Baker County large quantities are cut for hay, for which it is said to be excellent. It is also much used as a winter-forage plant. Cattle are driven into the dry bottoms where it grows, and live upon it when the shorter grasses are covered with snow.

(Plate 29.)

Medicago sativa (Alfalfa).

This plant is called lucerne, medick, Spanish trefoil, French clover, Brazilian clover, and Chilian clover. It is not a true clover, though belonging to the same natural family as the clovers. Alfalfa, the name by which it is commonly known in this country, is the Spanish name, which came into use here from the fact that the plant was introduced into cultivation in California from South America under the name of alfalfa, or Brazilian clover. The plant had previously been introduced into the Eastern and Southern States, but attracted little attention until its remarkable success in California. In Europe it is generally known as lucerne, probably from the canton of Lucerne, in Switzerland, where it was largely cultivated at an early day. It has been known in cultivation from very ancient times, and was introduced from western Asia into Greece about 500 B. C. It is now largely grown in southern France, and to a considerable extent in other parts of Europe. It has been introduced into several of the countries of South America, and on the pampas of Buenos Ayres it has escaped from cultivation, and grows extensively in a wild state. Though known for a long time in the United States, alfalfa is not yet cultivated to the extent that it should be.

Prof. E. W. Hilgard, in the Report of the Department of Agriculture for 1878, page 490, says :

Undoubtedly the most valuable result of the search after forage crops adapted to the California climate is the introduction of the culture of alfalfa, this being the name commonly applied to the variety of lucerne that was introduced into California from Chili early in her history, differing from the European plant merely in that it has a tendency to taller growth and deeper roots. The latter habit, doubtless acquired in the dry climate of Chili, is of course especially valuable in California, as it enables the plant to stand a drought so protracted as to kill out even more persistent plants than red clover. As a substitute for the latter it is difficult to overestimate the importance of alfalfa to Californian agriculture, which will be more and more recognized as a regular system of rotation becomes a part of the general practice. At first alfalfa was used almost exclusively for pasture and green-soiling purposes, but during the last three or four years alfalfa hay has become a regular article in the general market; occasional objection to its use being the result of want of practice in curing. On the irrigated lands of Kern, Fresno, and Tulare Counties, three and even four cuts of forage, aggregating to something like 12 to 14 tons of hay per acre, have frequently been made. As the most available green forage during summer, alfalfa has become an invaluable adjunct to all dairy and stock farming wherever the soil can, during the dry season, supply any moisture within 2 or 3 feet of the surface.

(Plate 30.)

Opuntia Englemanni (Cactus).

A number of species of cactus, mainly of the genus *Opuntia*, and commonly called nopal, or prickly pear, are used as food for cattle and sheep in the dry regions of Texas and westward, where the ordinary forage plants fail. In the natural state cattle do not often touch it unless driven by hunger, except while the new growth is young and tender. Sheep eat it without preparation more readily than cattle, and for them the plants are sometimes merely cut down, so as to be within reach. More often the herder passes along and clips off a portion of each flat joint, so that the sheep can enter their noses without coming in contact with the spines. For cattle it is customary to singe off the spines over a brisk blaze.

Leonard A. Heil, San Antonio, Tex.:

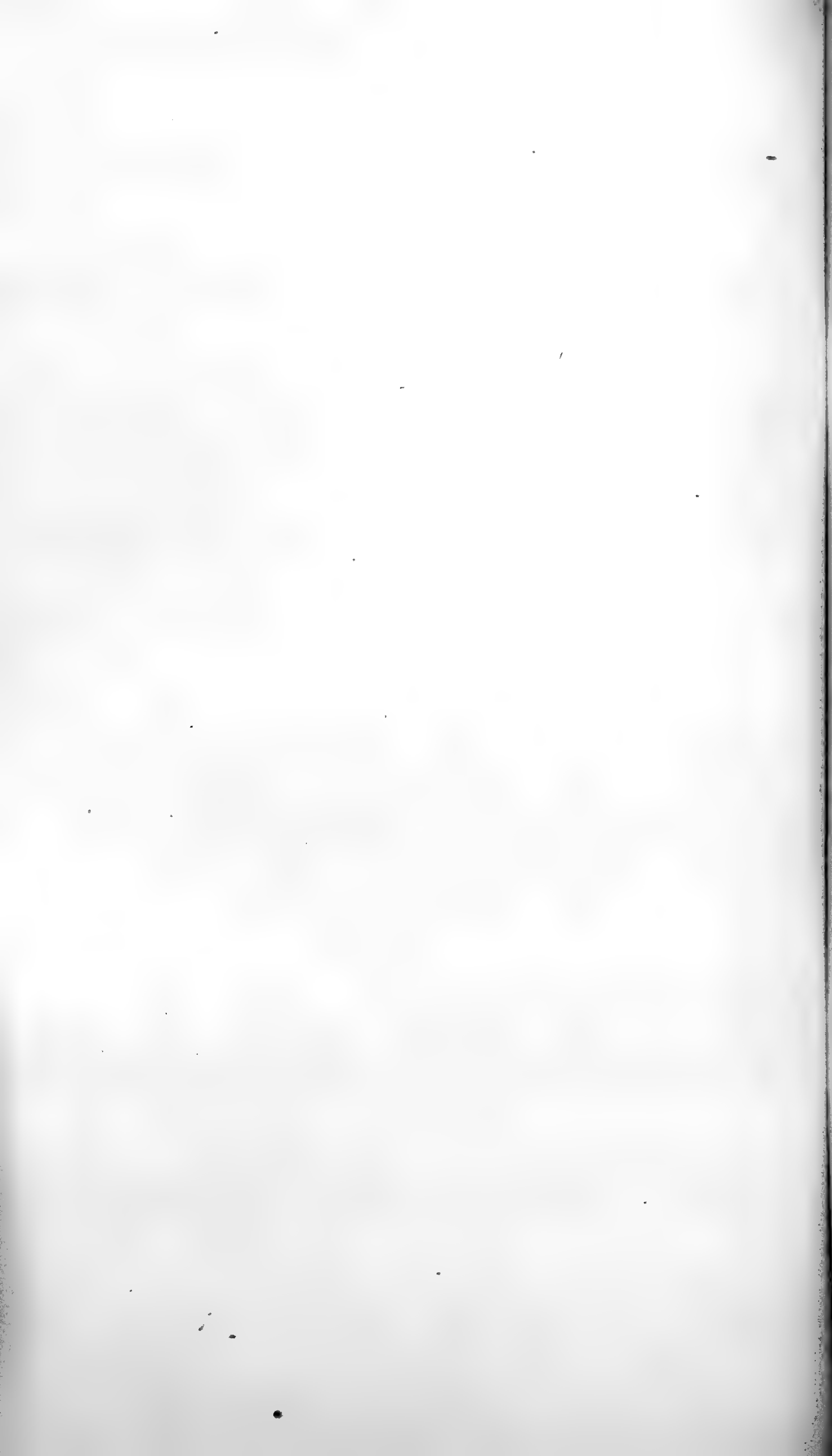
The cactus or prickly pear grows abundantly in nearly every section of southwest Texas, often reaching a height of 10 or 12 feet. Ever since the settlement of the country by the English, and probably years before, it has been used to supplement grass in times of drought, but now it is being used with other feeds at all times, and especially in the winter. Sheep do well upon it without water, there being sufficient moisture in the leaves. The herder goes along with a short sword and clips the points of the great leaves so that the sheep can insert its nose, when it readily eats them entire.

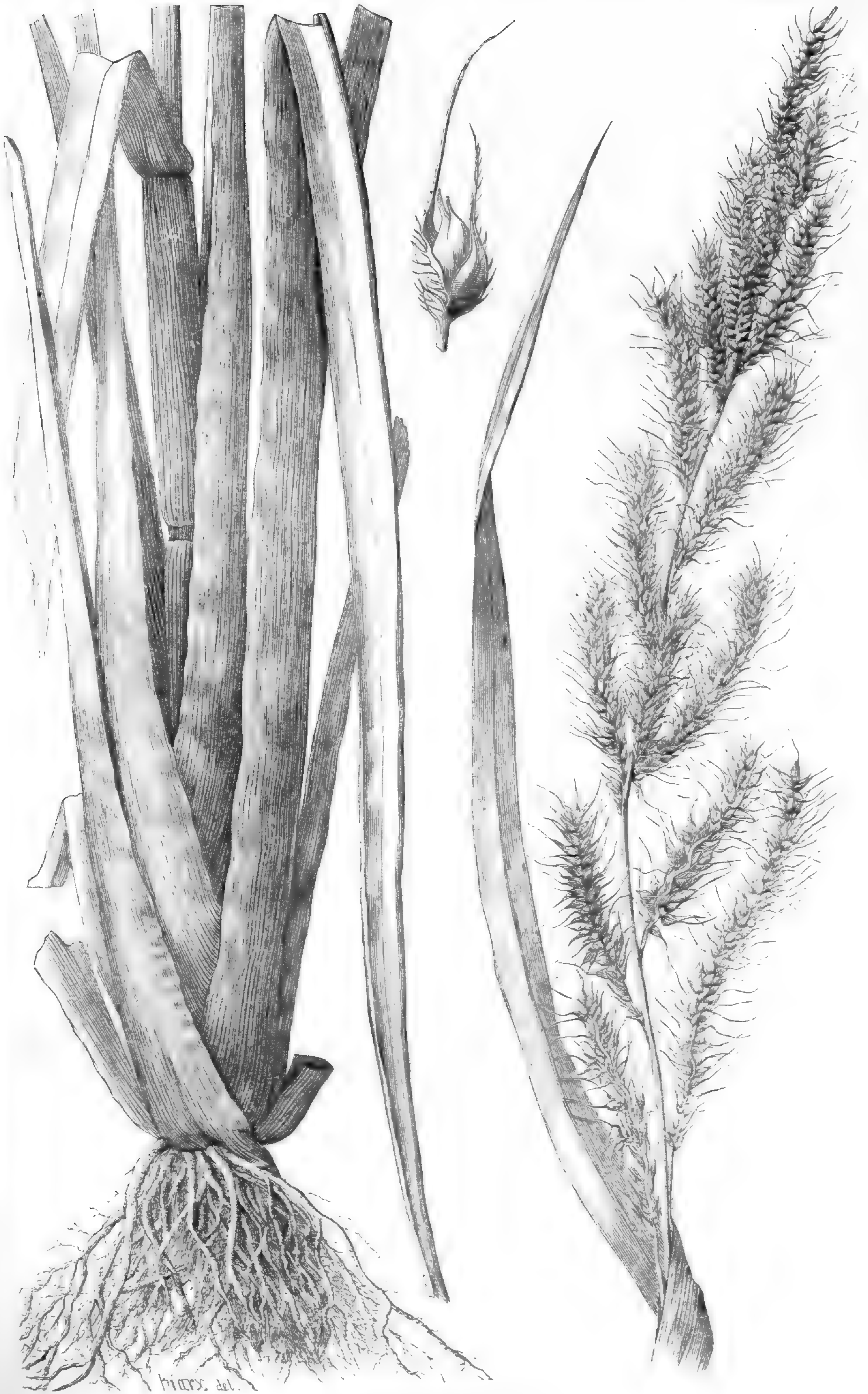
John C. Chesley, Hamilton, Hamilton County, central Texas:

The prickly pear is used here to a great extent. We have a ranch in Stephens County where we are now feeding the pear to over a hundred of our poorest cattle, and they are doing well on it. It is fed at nearly all of the ranches of Stephens County where they are feeding at all, and there are thousands of cattle being fed this winter on prickly pear that are doing well and will come to grass in good shape that otherwise would have died, or at least the larger part of them.

ILLUSTRATIONS.

1. *Panicum crus-galli.*
2. *Panicum virgatum.*
3. *Aristida purpurea.*
4. *Stipa viridula.*
5. *Setaria setosa.*
6. *Hilaria Jamesii.*
7. *Andropogon scoparius.*
8. *Andropogon provincialis.*
9. *Chrysopogon nutans.*
10. *Oryzopsis cuspidata.*
11. *Sporobolus cryptandrus.*
12. *Sporobolus airoides.*
13. *Agrostis exarata.*
14. *Deschamsia cæspitosa.*
15. *Chloris alba.*
16. *Bouteloua oligostachya.*
17. *Bouteloua polystachya.*
18. *Buchlœ dactyloides.*
19. *Triodia trinerviglumis.*
20. *Triodia acuminata.*
21. *Diplachne fascicularis.*
22. *Diplachne dubia.*
23. *Eragrostis poæoides,* var. *megas-*
tachya.
24. *Distichlis maritima.*
25. *Poa tenuifolia.*
26. *Festuca scabrella.*
27. *Agropyrum repens.*
28. *Hordeum nodosum.*
29. *Elymus condensatus.*
30. *Medicago sativa.*





Hiary. del.

PANICUM CRUSGALLI.



PANICUM VIRGATUM.



H. NICHOLS-ENG.

MARK DEL.

ARISTIDA PURPUREA.



MARY. Del.

STIPA VIRIDULA.



Mars. det.

SETARIA SETOSA.



HILARIA JAMESII.



ANDROPOGON SCOPARIUS.



ANDROPOGON PROVINCIALIS.

W.D.T. del.



W. G. & J. L.

CHRYSOPOGON (SORGHUM) NUTANS.



T. TAYLOR DEL.

ORYZOPSIS CUSPIDATA.



SPOROBOLUS CRYPTANDRUS.



SPOROBOLUS AIROIDES.



AGROSTIS EXARATA.



Moore del.

DESCHAMPSIA (AIRA) CAESPITOSA.



MARX SA.

CHLORIS ALBA.



BOUTELOUA OLIGOSTACHYA.



Munz del.

BOUTELOUA POLYSTACHYA.



NICHOLS

MARX-DEL.

BUCHLOE DACTYLOIDES.



TRIODIA TRINERVIGLUMIS.



TRIODIA ACUMINATA.



DIPLACHNE FASCICULARIS.



Marx

DIPLACHNE DUBIA.



Mary. det

ERAGROSTIS POÆOIDES.



DISTICHLIS MARITIMA.



MARX.DEL.

POA TENUIFOLIA (var.).



FESTUCA SCABRELLA.



MARX. DEL.

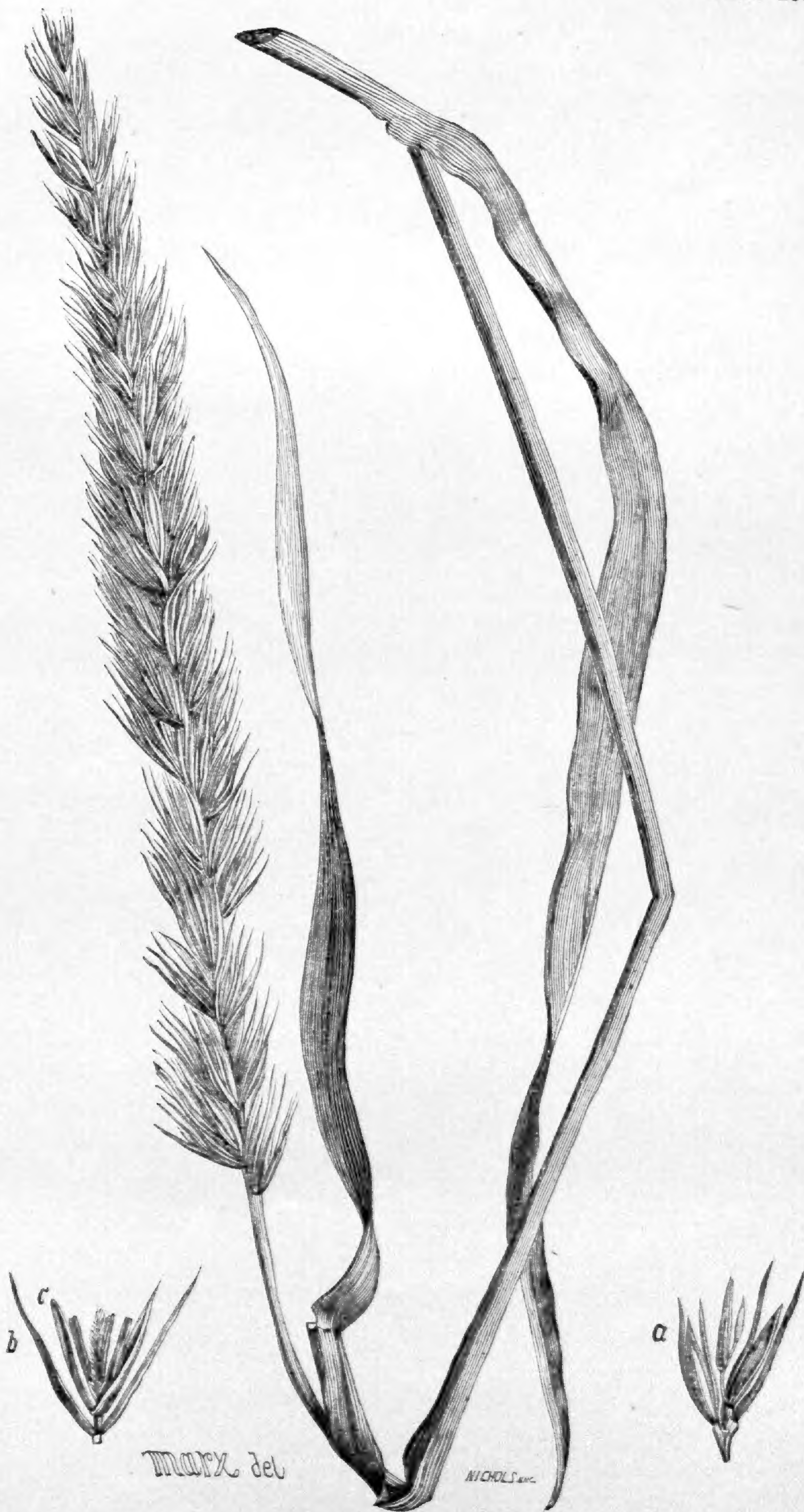
AGROPYRUM (TRITICUM) REPENS.



H.H.NICHOLS. Sc.

MARX. Del.

HORDEUM NODOSUM.



ELYMUS CONDENSATUS.