Flora of Jornada Experimental Range, New Mexico

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Introduction

A collection of specimens of 528 species of ferns and seed plants and a few lower plants was made at Jornada Experimental Range in southern New Mexico by various members of the Forest Service during the twenty-five year period from 1915 to 1939. This local herbarium serves as a basis for an analysis of the flora and vegetation of this representative semidesert area and has contributed several interesting State records and range extensions.

Jornada Experimental Range is located in northeastern Dona Ana County with headquarters 23 miles north of Las Cruces. Occupying 302 square miles (193,394 acres), it is the largest experimental range in the United States. It lies at the southern end of Jornada del Muerto, a plain having a north-south extent of more than 100 miles.

The Spanish name Jornada del Muerto means "the day's journey of the dead man," but is sometimes translated also as "journey of death." According to Wislizenus (1848), the name refers to an old tradition that the first person who attempted to cross the plain in one day perished. At this point the banks of Rio Grande become so rough and mountainous that early travelers going north to Santa Fe were forced to leave them and journey across the desolate, waterless plain a distance of 90 miles.

It may be of interest to quote portions of an early, somewhat poetic,

[1] Forest Service, United States Department of Agriculture, Washington, D. C. Jornada Experimental Range is a branch of the Southwestern Forest and Range Experiment Station, which is maintained by the Forest Service, United States Department of Agriculture, for the States of Arizona, New Mexico, and west Texas, with headquarters at Tucson, Arizona.

description of Jornada del Muerto by Mrs. Susan E. Wallace (1888, pp. 140-141, 143), wife of Gen. Lew Wallace, the territorial governor:

> Near the southern boundary of New Mexico the Spanish explorers were opposed by a barrier of all on earth most to be dreaded—a shadeless, waterless plateau, nearly one hundred miles long, from five to thirty miles wide, resembling the steppes of northern Asia.
>
> The portion I speak of appears to have served its time, worn out, been dispeopled and forgotten. The grass is low and mossy, with a perishing look—the shrubs, soapweed, and bony cactus writhing like some grisly skeleton; the very stones are like the scoria of a furnace. You vainly look for the flight of a bird, such as cheered the eyes of Thalaba in the desert; no bee nor fly hums in the empty air; and, save the lizard (the genius of desolation) and horn frog, there is no breath of living thing.
>
> . . . Standing on the edge of the measureless waste, which is trackless as water, the first explorers might ask: "What is this strange ocean of sand, with its stillness more awful than any sea?"
>
> . . . . Friendly showers fall there two months in the year, and, instead of storms of rain, in spring it is burned by those of dust and sand.
>
> The spot I am trying to describe is the battleground of the elements. In winter it is made fearful by raging storms of wind and snow. . . .
>
> In our times many a party cut off and many a traveler murdered makes good the name it bears, given by the first white men who dared its perils: *Jornada del Muerto*—"Journey of Death."

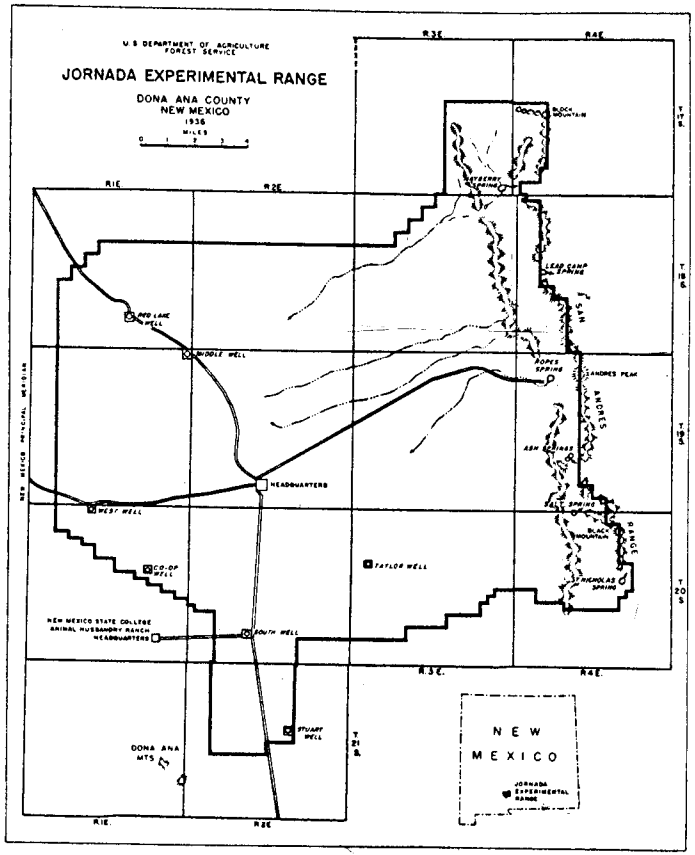
Commenting on Mrs. Wallace's description, Keyes (1905) stated that this area was considered waterless because no water appeared on the surface. He added that while abundant water lay at comparatively shallow depths, no travelers took the trouble to dig wells during nearly 350 years.

Bailey (1913) attributed the origin of the name to the death from thirst of the Spanish refugees retreating southward in 1680. He noted that in 1867 Gen. H. C. Merriam marched his infantry down this plain with only so much water as the men could carry in their canteens, covering the distance in three night marches with no great suffering or danger. Since that time the area has become occupied by cattle ranches with windmills supplying that vital resource, water. At the experimental range, water is found at depths between 300 and 350 feet.

The physiography, climate, and vegetation of Jornada Experimental Range will be reviewed briefly as a background for discussion of the flora. Three-fourths of the experimental range is within the plain of Jornada del Muerto. This portion is 10 to 20 miles east of Rio Grande, has an elevation of 4,000 to 4,600 feet, and is in the semidesert (Lower Sonoran) zone. The plain is an erosion surface formed by lateral planation and has no permanent water except wells and tanks. It is composed of unconsolidated sands, clay or adobe, and gravel of Pliocene age. The eastern quarter of the range consists of foothills and western slopes of the San Andres Mountains, which are composed chiefly of upper Paleozoic (Pennsylvanian) limestone with some sandstone and shale and which were uplifted at the close of the Tertiary. The mountains, which have a few springs, extend from the semidesert zone into the woodland (Upper

Sonoran) zone, reaching their maximum elevation of 8,000 feet on San Andreas Peak, just outside the east boundary. Their higher surfaces consist only of a western slope of bare limestone and a precipitous eastern wall. The Dona Ana Mountains, where a few of the plants were collected, are located at the southwestern edge of the Jornada Range and at one time were partly included within its boundaries. These smaller mountains consist of extrusive and intrusive igneous rocks. An account of the geology of Dona Ana County has been prepared by Dunham (1935).

The semiarid climate is characterized by the low precipitation, low humidity, hot summers, mild winters, and great daily range in temperature. Annual precipitation averages only 8.97 inches on the plain at range headquarters, elevation 4,150 feet, and 12.61 inches in the foothills at Ropes Spring, elevation 5,600 feet. About half the rainfall occurs during the summer growing



season, July, August, and September, and the remainder is fairly evenly distributed over the other months of the year. At headquarters annual average temperature is 56.3° F. and the frostless period averages 172 days. Evaporation from an open pan is very great, about 10 times the precipitation.

The vegetation of Jornada Experimental Range, which has been described by Jardine and Forsling (1922), Campbell (1929a, 1931, 1938), and others, is mainly of semidesert shrub and grassland types of the Lower Soronan zone. Vegetation maps of the area, excluding the mountain part were published by Jardine and Hurtt (1917, Fig. 2) and by Jardine and Forsling (1922, Fig. 1). Dominant species of vegetation types characterized by shrubs on the plain are honey mesquite (*Prosopis juliflora* var. *glandulosa*), broom snakeweed (*Gutierrezia sarothrae*), and soaptree yucca (*Yucca elata*) on sandy soils and sandhills; Coville creosotebush (*Larrea tridentata*) on gravelly slopes; and American tarbush or "blackbrush" (*Flourensia cernua*) on adobe. The dominant species of grassland types are black grama (*Bouteloua eriopoda*) on sands and tobosa (*Hilaria mutica*) and burrograss (*Scleropogon brevifolius*) on clay or adobe flats. Because of difference in topography and soils, the foothills have a more varied vegetation than the plain.

On the higher foothills and San Andres Mountains the shrub vegetation is of types dominated by Wright mountain-mahogany (*Cerocarpus breviflorus*), Wheeler sotol (*Dasylirion wheeleri*), and skeleton goldeneye (*Viguiera stenoloba*), and the woodland types are those characterized by pinyon (*Pinus edulis*) and one-seed juniper (*Juniperus monosperma*). A few rock plant species of the ponderosa pine (Transition) zone are represented at the summit of San Andres Peak.

Jornada Plant Collections

The work of the early botanical collectors in New Mexico has been summarized by Standley (1910a; 1910b). Blake and Atwood (1942) have listed the general and local floras of the State.

According to Standley (1910a), the first botanist to visit the interesting Jornada del Muerto was Adolf Wislizenus, who accompanied Colonel Doniphan's expedition of the Mexican War to northern Chihuahua in 1846-47. Wislizenus traveled the length of this plain during the first few days of August 1846, while en route southward from Santa Fe, and collected here the type specimens of several new species. Engelmann (Wislizenus, 1848), who made the determinations, remarked that "the famous desert, the Jornada del Muerto, furnished, as was to be expected, its quota of interesting plants." Those of the new species described from Wislizenus' specimens that have become best known include Wislizenus spectacle-pod (*Dithyrea wislizeni*), discovered near the north end of Jornada del Muerto and met with abundantly here; ocotillo (*Fouquieria splendens*); and southwest barrelcactus (*Echinocactus wislizeni*), also called "bisnaga" and Arizona water cactus, from the Dona Ana Mountains. The latter two species are characteristic and widespread in arid portions

of the Southwest. In the book describing his tour, Wislizenus (1848) recorded brief notes on the vegetation of Jornada del Muerto. He mentioned the abundance of mesquite and of "palmillas" (*Yucca elata*). The latter, the only trees he found growing on the Jornada, reached heights of 10 to 12 feet, and reminded him of African landscapes.

Several other botanists, some of them traveling with military expeditions, passed through Dona Ana, at the southern end of the plain, within the next few years.

E. O. Wooton and Paul C. Standley (1915) were located at New Mexico College of Agriculture and Mechanic Arts, only about 15 miles south of the southern boundary of what is now Jornada Experimental Range, during the years they collected in preparation for their detailed Flora of New Mexico. As a result of their extensive collections in Mesilla Valley, Organ Mountains, and southern end of Jornada del Muerto, the flora of this part of southern New Mexico is well known. In their flora the locality San Andres Mountains, including Ropes Spring, cited under more than 25 species, refers in nearly all cases to specimens collected within the present Jornada Range.

In 1912 Jornada Experimental Range was established by the Bureau of Plant Industry, United States Department of Agriculture, as Jornada Range Reserve, under the direction of Wooton. His small collections made in 1912-13 were deposited in the United States National Herbarium. From specimens collected here by Wooton in 1912, Standley (1913) described as new species *Amelanchier australis* Standl., now considered a synonym of *Amelanchier utahensis* Koehne and *Chrysothamnus elatior* Standl., later reduced to a variety, *C. pulchellus* var. *elatior* (Standl.) Kittell. In their State Flora, Wooton and Standley (1915) cited records from Jornada Range for at least two uncommon species: *Oligomeris subulata* (as *Dipetalia subulata*) and *Reverchonia arenaria*.

The present herbarium of the Jornada Experimental Range, upon which this local flora is based, was begun in 1915, when the range was transferred to the Forest Service. Specimens were collected and determined according to Forest Service instructions (1925), for the most part incidentally to regular work in grazing investigations. Collections have been forwarded to the Washington Office for determination each year, though the larger ones were made in the earlier years. After more than 20 years, specimens of additional species are still being discovered. Duplicates of more than 800 numbers representing more than 500 species of vascular plants have been deposited by the staff of the Jornada Range in the Herbarium of the Forest Service at Washington, D. C., and that at the range. These include a few specimens from the Dona Ana Mountains and the summit of San Andres Peak, both slightly outside the range boundaries.

Principal Forest Service collectors in addition to the authors are Roy H. Canfield, William R. Chapline, Robert F. Copple, Clarence L. Forsling, Ashbel F. Hough, Leon C. Hurtt, Paul B. Lister, Enoch W. Nelson, and Jacob D. Schoeller. Credit is due these men as well as other members of the Jornada Experimental Range personnel, past and present, for their work in collecting specimens.

Mrs. K. W. Parker has kindly placed at the disposal of the authors specimens of about 20 additional species not in the Jornada herbarium. Eleven of these were from College Ranch, of New Mexico College of Agriculture and Mechanic Arts, which adjoins Jornada Experimental Range on the west.

Determinations of Jornada specimens have been made by Government specialists in the Forest Service, Bureau of Plant Industry, and National Herbarium, including among others S. F. Blake, Agnes Chase, W. A. Dayton, Doris W. Hayes, A. S. Hitchcock, William R. Maxon, Paul C. Standley, and Ivar Tidestrom. In 1939 the senior author reexamined in Washington, D. C., the entire colletcion of vascular plants with the exception of the Gramineae and brought the nomenclature up to date in accordance with the International Rules of Botanical Nomenclature and conservative trends. The nomenclature used here differs but slightly from that of Cory and Parks (1937) in their Catalogue of the Flora of Texas.

Two articles on the flora of Jornada Experimental Range have been published: a report by Canfield (1934) on a study of stem structure of grasses, listing 69 grass species, and one by Little (1937b) on a collection of bryophytes consisting of 1 liverwort and 21 moss species. The latter collection included a new species, originally described by Williams (1936) as *Moenkemeyera littlei* but now known as *Fissidens littlei* (Williams) Grout.

Since this study was made, there has appeared Tidestrom and Kittell's (1941) Flora of Arizona and New Mexico, containing additional species from New Mexico not listed by Wooton and Standley (1915). Based upon his collections in 1930, Fosberg (1931, 1940) has published an account of 18 species of Cactaceae of the Pyramid Peak region and an aestival flora of the Mesilla Valley region. Both regions are in Dona Ana County about 25 miles south of the southern boundary of Jornada Range. Another recent study of a nearby locality is that by Emerson (1935) of the vegetation of 63 species on gypsum sand dunes at White Sands National Monument. This national monument is located mostly in western Otero County with its western edge only about 5 miles from the northeastern border of Jornada Experimental Range but separated by a barrier of the San Andres Mountains. However, the nearest gypsum dunes are about 15 miles distant.

State Records and Extensions of Range

Although only a short distance away from the center of botanical exploration in New Mexico, Jornada Experimental Range has contributed several State records and various extensions of known range. However, the State records have already been reported by other workers, who have examined the Jornada specimens or have made independent collections of the same species.

Species of Jornada Experimental Range not mentioned for New Mexico by Wooton and Standley (1915) nor accounted for under other names, such as synonyms and segregates, include several records of extensions of range, recently described species, and introduced species. A list of 22 species from Jornada Range that appear to be additions to Wooton and Standley (1915) follows:

Cheilanthes wootoni Maxon
Selaginella sheldoni Maxon?
Typha angustifolia L.
Avena sativa L.
Muhlenbergia rigens (Benth.) Hitchc.
Panicum huachucae Ashe
Tragus racemosus (L.) All.
Eleocharis geniculata (L.) R. & S.
Eleocharis macrostachya Britton
Scirpus torreyi Olney?
Salix gooddingii Ball
Phoradendron cockerellii Trel.
Selenia dissecta Torr.
Dalea lemmoni Parry
Polygala longa Blake
Euphorbia parryi Engelm.
Bergia texana (Hook.) Seubert
Pinaropappus parvus Blake
Sartwellia mexicana A. Gray
Viguiera dentata (Cav.) Spreng.
Xanthium saccharatum Wallr.
Zexmenia brevifolia A. Gray

A check with Tidestrom and Kittell's (1941) recent Flora of Arizona and New Mexico was made also. Only 7 species of the Jornada flora are not included in this book nor treated apparently under other names. Of these, all are recorded from New Mexico in published records with the possible exception of *Scirpus torreyi* Olney?, the determination of which is doubtful. These additions are:

Eragrostis pilosa (L.) Beauv.
Scirpus torreyi Olney?
Phoradendron cockerellii Trel.
Selenia dissecta Torr.
Oxalis amplifolia (Trel.) Knuth
Croton fruticulosus Engelm.
Pinaropappus parvus Blake

The first record in the United States for *Sartwellia mexicana* A. Gray, of Coahuila and Zacatecas, Mexico, is a specimen from the Jornada Experimental Range cited by Fosberg and Ewan (1935). The Forest Service has an earlier collection from the same locality. The Jornada collection of *Pinaropappus parvus* at the top of San Andres Peak was the second United States record of this genus and second record of this rare species, which was discovered on the Lincoln National Forest, New Mexico, and later listed by Cory and Parks (1937) from western Texas. Dayton (1939) noted the Forest Service collections of *Selenia dissecta* Torr. in New Mexico, including three Jornada specimens. The first New Mexico collections of *Bergia texana* (Hook.) Seubert, *Zexmenia brevifolia* A. Gray, and perhaps other species of the above lists were made here. Many of the Jornada species were first records for the Herbarium of the Forest Service, but these additions were to be expected because of the great differences in flora between the semidesert range and the typical national forests in higher mountain zones.

A number of species collected on Jornada Experimental Range constitute slight extensions of range within New Mexico as recorded by Wooton and Standley (1915). Probably, however, specimens of some of these have been found at several additional stations in the meantime, as the State has become much better explored botanically in recent years.

For the following 29 species of Jornada Range, Wooton and Standley (1915) cited only one New Mexico record. The 7 indicated by an asterisk (*) were known at that time only from the type locality.

Aristida pansa
Eragrostis pectinacea
Carex hystricina
Cladium jamaicense
**Eriogonum pannosum*
Amaranthus torreyi
**Abronia angustifolia*
Boerhaavia gracillima
Dryopetalon runcinatum
**Heuchera leptomeria?*
Astragalus subcinereus
Dalea glaberrima
**Schrankia occidentalis*
Croton fruticulosus
Cereus greggii
Mamillaria lasiacantha
Eremocarya micrantha
Salvia ramosissima
**Tetraclea angustifolia*
Tecoma stans var. *angustifolia*
Stenandrium barbatum
Houstonia fasciculata
Houstonia humifusa
**Actinea vaseyi*
Brickellia fendleri
Brickellia laciniata
Dicranocarpus parviflorus
Erigeron bellidiastrum
**Tetradymia filifolia*

The following 18 species were listed by Wooton and Standley (1915) from two or three New Mexico localities, but not from Dona Ana County. For some of them the Jornada record may represent a slight extension of known range within the State.

Notholaena fendleri
Chloris cucullata
Paspalum stramineum
Cyperus speciosus
Eleocharis rostellata
Nolina greenei
Phoradendron bolleanum
Petrophytum caespitosum
Astragalus crassicarpus
Astragalus famelicus
Astragalus pattersonii
Oxalis amplifolia
Rhamnus fasciculata
Oenothera hartwegi
Forestiera pubescens
Onosmodium molle var. *occidentale*
Physalis mollis var. *cinerascens*
Senecio riddellii

Distribution of Species

A study of the distribution of species of Jornada Experimental Range was made from data given in floras by Wooton and Standley (1915), Rydberg (1922), Standley (1920-26), Tidestrom (1925), and Hitchcock (1935). According to geographic distribution the species tend to fall into six more or less natural groups. Descriptions of these groups follow, together with abbreviations used in the list of species, examples and number of species in each, and percentages of the total 528 species. In this classification varieties were not considered, but the range of a species including its varieties was used.

1. New Mexico (NM). Species of local range known only from New Mexico. Only these 4 examples: *Schrankia occidentalis, Salvia vinacea, Actinea vaseyi,* and *Tetradymia filifolia.* 4 species, or 0.8 percent.

2. Southwestern (SW). Species occurring from western Texas to southern Arizona and northern Mexico, or extending slightly beyond these limits into southern California or in some cases to southern Utah and Nevada. These are characteristic of the semiarid Southwest (Lower Sonoran zone). Examples: *Bouteloua eriopoda, Hilaria mutica, Yucca elata, Larrea tridentata,* and *Flourensia cernua.* 228 species, or 43.2 percent.

3. Western (W). Species ranging widely through the western half of the United States, including those of Rocky Mountains and plains. Examples: *Sporobolus airoides, Atriplex canescens, Artemisia filifolia, Franseria acanthicarpa,* and *Gutierrezia sarothrae.* 216 species, or 40.9 percent.

4. North American (NA). Species distributed widely in temperate North America across the continent. A few species of this group are cosmopolitan. Examples: *Bouteloua curtipendula, Sporobolus cryptandrus,* and *Amaranthus graecizans.* 33 species, or 6.2 percent.

5. Tropical (Tr). Species of Mexico, Central America, and northern South America found northward into the southwestern States. Examples: *Andropogon saccharoides, Allionia incarnata,* and *Mollugo cerviana.* 26 species, or 4.7 percent.

6. Introduced (I). Species introduced by man or adventive from other regions. Examples: *Echinochloa crusgalli, Salsola pestifer,* and *Tribulus terrestris.* 21 species, or 4.0 percent.

The flora of Jornada Experimental Range is western and more distinctly southwestern, as more than two-fifths of the species are restricted to the southwestern semidesert area. More than two-fifths additional are western. Two species out of every five have the distribution, "western Texas to southern Arizona and northern Mexico." Texas is only about 35 miles south; Chihuahua, Mexico, about 45 miles south; and Arizona, about 125 miles west. The semidesert plain of the Lower Sonoran zone constitutes large portions of these States and has similar flora and vegetation of semidesert shrub and grassland types throughout.

A comparison of the species of the Jornada flora with Cory and Parks' (1937) catalogue of Texas plants shows that only about 59 species of the 528 are not listed from Texas or included under other names. Thus, 469 species, or 88.8 percent, of the Jornada flora extend south and southeastward across the Texas boundary, less than 50 miles distant.

Only 4 species of the Jornada list are confined within New Mexico. A few additional species listed by Wooton and Standley (1915) from New Mexico only have been recorded later by Cory and Parks (1937) from the Trans-Pecos area of western Texas. The group of southwestern species includes a few species of restricted range in southern New Mexico and western Texas also. A small list of endemic species was to be expected, because of the uniform character of topography over vast areas. *Chrysothamnus pulchellus* var. *elatior* (Standl.) Kittell, originally described as a species, apparently is known only from the type collection at Jornada Experimental Range.

The small number of introduced species, 21, is not surprising, as the semidesert plain is sparsely inhabited, has not been under cultivation, and has no permanent water other than very limited artificial areas. Of the introduced species *Tamarix gallica* is the only shrub, and the rest are herbaceous. Thirteen are grasses, and 15 are annuals. Most of the introduced species, not being adapted to dry habitats, are confined to moist soils around wells, tanks, and mountain springs and are not commonly represented even there. Only *Salsola pestifer* and *Tribulus terrestris* are typical xerophytic species, at home away from water, and show any promise of becoming widely distributed and abundant on Jornada Range. The latter tends to spread on locally overgrazed areas, such as in the vicinity of water tanks.

Two aquatic species have an unusual disjunct occurrence at springs in San Andres Mountains. *Cladium jamaicense,* a large sedge known as Jamaica sawgrass, one of the principal species of the Florida everglades, is represented here at perhaps the third known station for New Mexico. *Typha angustifolia,* a world-wide species, was found at a salty mountain spring as probably its second record for the State.

A few of the Jornada species occur also at a great distance southward in South America. For example, *Allionia incarnata,* a common native weed here, was described by Linnaeus in 1759 from Venezuela. *Scleropogon brevifolius,* one of the commonest grasses on clay soils, escaped the notice of early collectors in the Southwest and was originally described in 1870 from Argentina.

Two widely separated semidesert areas, one in southwestern United States and northern Mexico in North America and the other in Argentina, Chile, Bolivia, and Peru in South America, have similar climates, vegetation, and floras. Standley (1916a) made a comparison of the flora of the Mesilla Valley in Dona Ana County, New Mexico, with that represented in a collection of about 300 numbers from Rio Negro in southern Argentina. He listed twenty species common to the two localities and 45 pairs of closely related species in the distant areas. Thirty-one species of weeds from the Old World adventive in the Argentinan valley are found in New Mexico also. Johnston (1940), discussing the floristic significance of the shrubs common to the North and South American deserts, has suggested that there was in the past a widely distributed American desert flora which has persisted in the southern continent but which has become greatly reduced in the northern area.

Raunkiaer's Life Forms, Classes of Leaf Size, and Cryptogam Quotients

The general habit or appearance of the flora of Jornada Experimental Range is clearly shown by a classification of the 514 species of seed plants according to Raunkiaer's (1934) life forms, which are based upon the position of the perennating buds. Life forms of the different species were determined

from field experience and herbarium specimens, supplemented by published descriptions. Each class is listed below with abbreviation, description, examples, number of species, and percentage of the total 514 species.

1. Stem succulents (S). Fleshy-stemmed plants of Jornada Range are limited to members of Cactaceae. Examples: *Echinocereus fendleri* and *Opuntia engelmannii*. 16 species, or 3.1 percent.

2. Epiphytes (E). The only vascular epiphytes here are parasitic mistletoes, family Loranthaceae. Examples: *Arceuthobium campylopodum* f. *divaricatum* and *Phoradendron cockerellii*. 4 species, or 0.8 percent.

3. Megaphanerophytes and mesophanerophytes (MM). Trees reaching heights of more than 30 meters and of 8 to 30 meters, respectively. No megaphanerophytes are present, and even along canyons and arroyos of the San Andres Mountains the only mesophanerophytes are *Populus wislizeni* and *Fraxinus velutina*. 2 species, or 0.4 percent.

4. Microphanerophytes (M). Small trees and large shrubs 2 to 8 meters tall. Found chiefly along drainage courses in mountains and foothills. Many square miles of the plain have no plants reaching the size of trees. On the plain the only common microphanerophytes are *Yucca elata, Prosopis juliflora* var. *glandulosa,* and *Rhus microphylla*. In the mountains typical microphanerophytes are *Juniperus monosperma, Pinus edulis, Quercus grisea, Garrya wrightii,* and *Chilopsis linearis*. 24 species, or 4.7 percent.

5. Nanophanerophytes (N). Shrubs less than 2 meters high, which characterize the semidesert shrub vegetation here, have a greater number of species than any other group of woody perennials. Examples: *Dasylirion wheeleri, Atriplex canescens, Cerocarpus breviflorus, Larrea tridentata, Artemisia filifolia, Flourensia cernua,* and *Viguiera stenoloba*. 64 species, or 12.4 percent.

6. Chamaephytes (Ch). Woody perennials or undershrubs with perennating buds close to the ground. These include a few composites and other plants that are woody at the base. Most common species, *Gutierrezia sarothrae*. Others: *Oenothera hartwegi, Coldenia canescens,* and *Senecio longilobus*. 21 species, or 4.1 percent.

7. Hemicryptophytes (H). Herbaceous perennials (or biennials) with perennating buds in the surface layer of soil are by far the largest group here. Examples: the grasses, *Boutelous eriopoda, Scleropogon brevifolius,* and *Sporobolus cryptandrus;* and the weeds or forbs, *Astragalus allochrous, Sphaeralcea subhastata,* and *Baileya multiradiata*. 220 species, or 42.8 percent.

8. Geophytes (G). Herbaceous perennials with buds deeply buried in the ground in rhizomes, tubers, bulbs, and roots. Examples: *Allium deserticola, Rumex hymenosepalus, Hoffmanseggia densiflora,* and *Asclepias galioides*. 19 species, or 3.7 percent.

9. Helophytes and hydrophytes (HH). Water plants and marsh plants with buds covered by water are restricted here to springs and artificially developed water areas. Ten species of monocotyledons in the following families: Typhaceae, Najadaceae, Cyperaceae, and Juncaceae. Examples: *Typha latifolia, Eleocharis rostellata,* and *Juncus torreyi*. 10 species, or 1.9 percent.

10. Therophytes (Th). Annual herbs, of which a few appear in early spring, but most are dependent upon summer rains for growth. Common examples: *Bouteloua barbata, Eriogonum rotundifolium, Chenopodium incanum, Descurainia menziesii* var. *ochroleuca, Cryptantha crassisepala,* and *Franseria acanthicarpa*. 134 species, or 26.1 percent.

Plants of related species typically have similar life forms. However, in the genus *Houstonia* four life forms, ranging from therophytes to nanophanerophytes, are represented at Jornada Range. Three life forms are found here in the genus *Dalea* also.

A biological spectrum of the Jornada Experimental Range, consisting of percentages of various life forms among the species, is compared in Table 1 with Raunkiaer's revised normal spectrum for the earth based upon 1,000 species. When contrasted with the normal spectrum, the biological spectrum of an area is a characterization of the climate.

TABLE 1.—Comparison of biological spectrum of Jornada Experimental Range with Raunkiaer's revised normal spectrum.

Life Form	Raunkiaer's normal spectrum	Spectrum of Jornada Experimental Range
	Percent	*Percent*
Phanerophytes		
Stem succulents (S)	2	3.1
Epiphytes (E)	3	0.8
Megaphanerophytes and mesophanerophytes (MM)	8	0.4
Microphanerophytes (M)	18	4.9
Nanophanerophytes (N)	15	12.4
	46	21.6
Chamaephytes (Ch)	9	3.9
Hemicryptophytes (H)	26	42.8
Cryptophytes		
Geophytes (G)	4	3.7
Helophytes and hydrophytes (HH)	2	1.9
	6	5.6
Therophytes (Th)	13	26.1

The Jornada spectrum may not be an exact summary, as two climatic or vegetation zones are represented. However, most of the species are semidesert (Lower Sonoran). Because it has no permanent streams, also, Jornada Range

lacks many species typical of moist soils along the Rio Grande about 10 miles distant in the same zone.

Striking departures of the biological spectrum of Jornada Experimental Range from the normal spectrum are the low percentages of woody species or phanerophytes and the high percentages of herbaceous species, particularly hemicryptophytes and therophytes. All groups of phanerophytes except stem succulents are below normal, although for the nanophanerophytes, mostly semishrubs, the difference is slight. The low percentages of large phanerophytes are outstanding on this almost treeless plain. Combined percentages of megaphanerophytes, mesophanerophytes, and microphanerophytes total only one-fifth the corresponding figures of the normal spectrum.

Hemicryptophytes, which are most numerous in biological spectra of temperate regions, have the greatest excess over the percentage of the normal spectrum, and the therophytes have the next greatest. The semiarid, warm character of the climate is indicated by the high percentage of therophytes, twice the normal, and by the relatively high percentage of stem succulents. Nanophanerophytes compose the third largest group.

Approximately half the species are perennial herbs, one-fourth annual herbs, and one-fourth woody plants, mostly semidesert shrubs. Only 13 of the species of phanerophytes, or 2.5 percent of the total, have the size and habit of trees. These tree species are:

Juniperus monosperma
Pinus edulis
Yucca elata
Populus wislizeni
Salix amygdaloides var. *wrightii*
Salix exigua
Salix gooddingii
Quercus gambelii
Quercus grisea
Celtis reticulata
Morus microphylla
Prunus virens
Fraxinus velutina

Lianas are rare on the Jornada Range, and only about 15 species are listed. Herbaceous vines or twining plants are limited to 1 species of Leguminosae, *Rhynchosia texana,* and 9 additional species in the following 3 families, Asclepiadaceae, Convolvulaceae, and Cucurbitaceae. The 5 species of woody vines represented here are:

Clematis drummondii
Clematis neomexicana
Janusia gracilis
Vitis arizonica
Lonicera albiflora var. *dumosa*

The Forest Service for convenience in economic classification also divides range plants into grasses, grasslike plants (chiefly sedges and rushes), range weeds (nongrasslike herbs, or forbs), and browse plants (shrubs and trees). On this basis the flora of Jornada Experimental Range, including pteridophytes, is grouped as follows: grasses, 80 species, or 15.1 percent; grasslike plants, 11 species, or 2.1 percent; range weeds, 305 species, or 57.8 percent; and browse plants, 132 species, or 25.0 percent.

Raunkiaer (1934) has also employed classes of leaf size as a means of preparing a biological expression for the climate and environment and as a means of comparing the vegetation of areas differing in climate. His six classes of leaf size, with the maximum area for each, are: leptophylls, 25 sq. mm.; nanophylls, 225 sq. mm.; microphylls, 2,025 sq. mm.; mesophylls, 18,225 sq. mm.; macrophylls, 164,025 sq. mm.; and megaphylls. In this classification each leaflet of a compound leaf is considered as an individual leaf.

No attempt was made to classify the species of Jornada Experimental Range as to leaf size. However, on this semidesert area where most of the plant species are xerophytes diminution in leaf surface is everywhere evident. Of the various xeromorphic adaptations exhibited, certainly the microphyllous character is the most conspicuous. Most of the species here probably would fall within the class of nanophylls, but some would be grouped as microphylls. A few, including some with scale leaves, are leptophylls, and a few are leafless most of the time.

Plants of only about 15 species at Jornada Range have large enough leaves to be classed as mesophylls. This leaf size is associated usually with compensating xeromorphic adaptations or reduction in number of leaves and in a few cases with moist habitat. The 6 species with evergreen or perennial leaves within the class of mesophylls are: *Dasylirion wheeleri, Nolina greenei, N. microcarpa, Yucca baccata, Y. elata,* and *Agave parryi.* Their leaves are either thick, elongated, and leathery or succulent. Plants of the following 9 species have deciduous or annual leaves in the class of mesophylls: *Typha angustifolia, T. latifolia, Populus wislizeni, Argemone platyceras, Vitis arizonica, Datura meteloides, Apodanthera undulata, Cucurbita foetidissima,* and *Xanthium saccharatum.* The broadleaved plants with leaves of largest size here probably are *Cucurbita foetidissima* and *Datura meteloides.*

Relative numbers of species of cryptogams likewise have been used by Raunkiaer (1934) in characterizing climates. The pteridophyte quotient of Jornada Experimental Range is 0.68; that is, the actual number of species of pteridophytes, 14, is 0.68 the number that would be normal for this area in proportion to its number of species of phanerogams or seed plants, on the basis of species of the world. Similarly, the moss quotient based upon Little's (1937b) list of 21 species and one additional species listed here, is 0.47. As only one species of liverwort was found by Little (1937b), the liverwort quotient is very low, 0.07. Thus, the semiarid climate of Jornada Experimental Range is decidedly unfavorable for mosses and liverworts and to a lesser extent unfavorable for pteridophytes. Nearly all the bryophytes and pteridophytes here are xerophytes confined to rock crevices and ledges in mountains and foothills.

Distinctive Species

A number of the species are unusual or distinctive, especially in their adaptations to the semiarid climate, and a few of these will be mentioned. Among the plants most conspicuous to the visitor is the large soaptree yucca

or "soapweed" (*Yucca elata*), which is common and widely distributed on sandy areas of black grama (*Bouteloua eriopoda*) grassland and which reaches its maximum size in this portion of southern New Mexico. An emergency feed for cattle in periods of drought and a possible source of commercial fiber, this species has been the subject of investigations by Forsling (1919) and by Campbell and Keller (1929b, 1932, 1933).

Soaptree yucca, with its usually unbranched trunk bearing terminal clusters of long, narrow, evergreen leaves, is well adapted to these dry sandy soils. Its height growth is very slow, averaging only about 1 inch a year according to measurements by Campbell and Keller. Sooner or later the trunks become so tall or branched that they lose balance and fall to the ground, but they may continue to live awhile. Then sprouts at the bases of fallen plants take their places. The usual height is 3 to 6 feet; a few individuals reach 10 or 15 feet before they die, and individuals have unbranched trunks 20 to 30 feet in height, towering above the others as landmarks visible for a distance of a mile or more. While not so spectacular as its larger relative the Joshua-tree (*Yucca brevifolia*), the soaptree yucca is equally noteworthy.

One of the largest soaptree yuccas, approximately 26½ feet in height, is shown in Fig. 1. Its unbranched woody trunk is 9 inches in diameter at the base and is mostly covered with remains of dead leaves. According to the results of the growth studies referred to above, this tree is more than 300 years old.

Yucca is the State flower of New Mexico. In late June and early July it bears clusters of large white flowers on stalks above the leaf clusters. The flowers and flower stalks are eaten by cattle. Although it produces large quantities of highly viable seed in some years, soaptree yucca reproduces almost entirely by sprouts at the bases of old plants. No seedlings in advanced stages have been discovered here.

On adobe soils perhaps the most striking plant is spiny allthorn or "crown of thorns" (*Koeberlinia spinosa*), a very spiny, much-branched shrub (Fig. 2). This is often scattered on adobe flats as the only shrub, rising above a short carpet of burrograss (*Scleropogon brevifolius*). It represents an extreme of adaptation without leaves. The branches remain green and perform the activities of photosynthesis. The bluish-black berries are eaten in great numbers by birds. This species of southwestern United States and Mexico has been found also in a limited area of Bolivia.

One species of century plant or "mescal," Parry agave or *Agave parryi* (*A. neomexicana*), is found scattered over the dry rocky slopes of San Andres Mountains (Fig. 3). *Agave neomexicana* was described originally from Organ Mountains, the adjacent range on the south, and San Andres Mountain and has a distribution southward into Texas. Probably it is not distinct from *Agave parryi*. Although the plants are below average size for *A. parryi*, they are within its size variation but grow under less precipitation than the average for that species. *Agave parryi* has a basal rosette of thick, succulent, evergreen

leaves well protected by many stout spines. At maturity there are more than 100 leaves nearly 1 foot long, forming a cluster 2 to 2½ feet in diameter. More unusual is the plant's monocarpic habit. After several years of growth a tall flower stalk is rapidly produced. The young flower stalk begins to elongate in April, and by the latter part of June, now 10 to 15 feet or more in height, it bears clusters of large yellow flowers. When the seeds have matured, the plant dies.

Among the various cacti, or stem succulents, the most distinctive is the southwest barrelcactus (*Echinocactus wislizeni*), which is not uncommon at the type locality in the Dona Ana Mountains (Fig. 4). There it grows to heights of 2 to 3½ feet and a diameter of 1½ feet. Wislizenus (1848), who

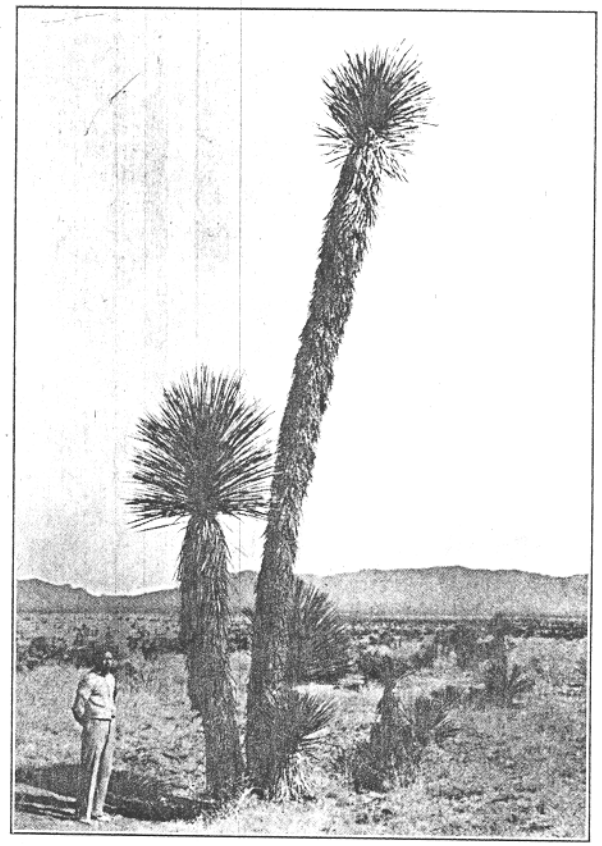


Fig. 1.—Soaptree yucca *(Yucca elata)* about 26½ feet high on Jornada Experimental Range. It is growing on a sandy area of typical black grama *(Bouteloua eriopoda)* grassland. Many smaller, average-sized soaptree yuccas appear in the background. In the distance, but within Jornada Range, is San Andres Mountain, elevation 8,000 ft.

discovered this species, reported rare specimens 3 feet and one even 4 feet in height. However, it becomes larger in Arizona, where specimens more than 6 feet high and one 11 feet high have been found.

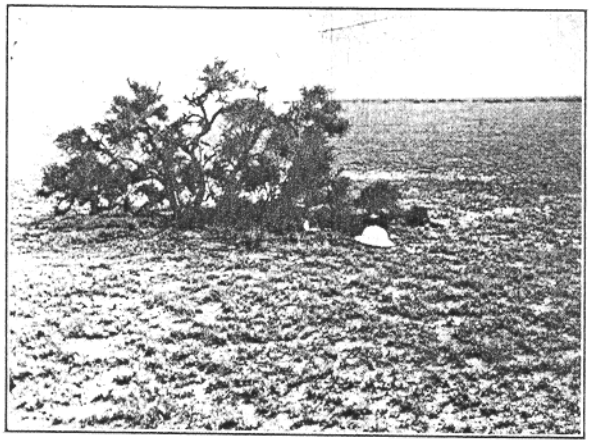


Fig. 2.—Typical spiny allthorn bush *(Koeberlinia spinosa)* growing on an adobe flat covered by a mat of burrograss *(Scleropogon brevifolius)*. Jornada Experimental Range.

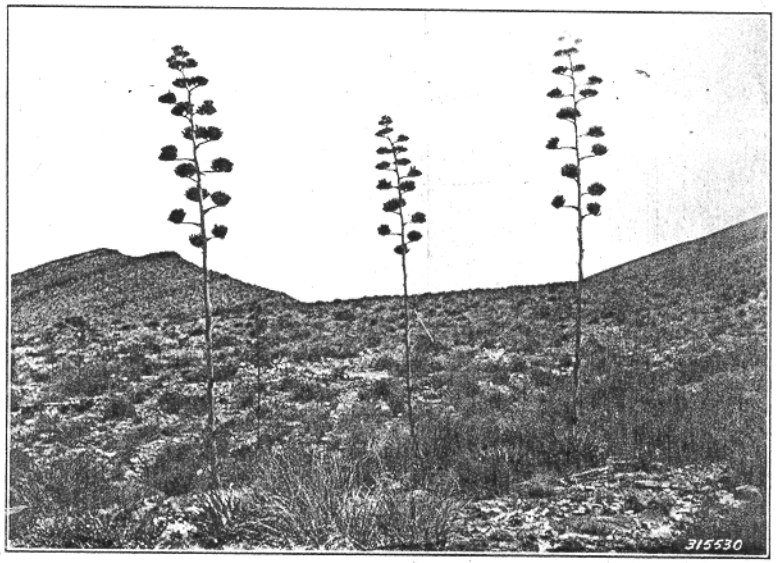


Fig. 3.—Parry agave *(Agave parryi)* in flower on rocky slope near base of the San Andres Mountains, June 19, 1935. The flower stalks are up to 16½ feet high. Other vegetation consists of semidesert shrubs of the foothills.

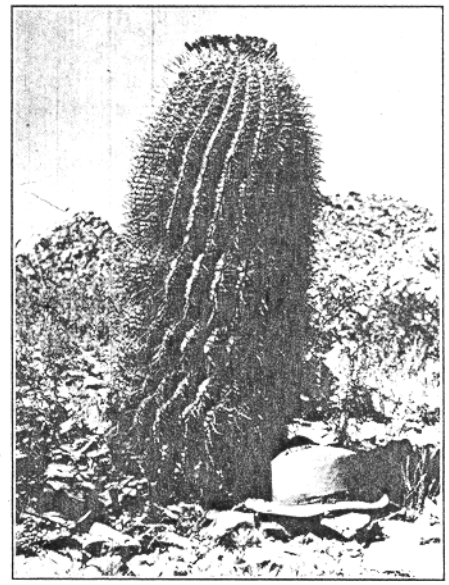


Fig. 4.—A large southwest barrelcactus *(Echinocactus wislizeni)* more than 3½ feet high, at the type locality, Dona Ana Mountains, formerly partly included in Jornada Range.

Statistical Analysis of Vegetation

The 528 species and 10 additional named varieties of pteridophytes and spermatophytes of Jornada Experimental Range are distributed among 301 genera and 82 families. The families having greatest representation, with the numbers of species in each, are: Compositae, 87; Gramineae, 80; Leguminosae, 33; Cactaceae, 16; Cruciferae, 15; and Euphorbiaceae, 15. Twenty-three families are represented by a single species each. The genera with the greatest numbers of species here are: *Muhlenbergia,* 11; *Aristida, Astragalus, Dalea,* and *Euphorbia,* 8 species each; and *Bouteloua* and *Eriogonum,* 7 each.

The greater part of the vegetation of Jornada Experimental Range is made up by relatively few dominant and common species. To determine the proportionate representation of species in the vegetation, a statistical analysis was made of data previously compiled in intensive range surveys of the area. These surveys, conducted by standard methods of the Forest Service (1932) for range reconnaissance on national forests, were made to determine the forage resources as a basis for range management. Technically trained range examiners crossed the area on foot at half-mile intervals and made detailed maps of the vegetation by subtypes, areas essentially uniform as to vegetation. For each subtype, the density of plant cover was estimated in tenths of maximum, the species making up 1 percent or more of the total composition were listed, and for each species an ocular estimate was made of the percentage of the total composition.

The plain portion of Jornada Experimental Range, containing 143,764 acres, was surveyed in 1928-29 and divided into 282 subtypes. The eastern quarter of the range, on the San Andres Mountains and foothills, known as the mountain pasture or pasture No. 11 and totaling 49,432 acres, was surveyed in 1933-34. On the latter areas, considerably more diverse in altitude, topography, and vegetation, 493 subtypes were mapped. Records from the two surveys were analyzed separately.

Data on areas occupied by plants of each species in one subtype could be obtained by multiplying the percentage of total composition of each species by both the density estimate and the acreage of the subtype. By repeating these steps for all species in all subtypes, reasonably accurate data on area occupied by plants of every species could be assembled. However, this procedure would require a great amount of calculation. A shorter, less accurate method was used in making the statistical analysis presented here. Variations in density and in area of subtypes were disregarded; all subtypes were considered as equal in extent and in density of vegetation. To a certain extent variations among subtypes as to area and density may compensate one for another, as large uniform areas of mesquite sandhills have low densities and as small types of tobosa grass have high densities.

Two values were obtained for each species: (1) the number of subtypes in which this species constitutes 0.1 percent or more of the total vegetation, and (2) the total composition of this species, determined by adding the actual percentage figures of the species for all the subtypes in which it was listed. The first value is a measure of the distribution or spread of a species on Jornada Range; the second is a measure of relative area covered by plants of this species, or a measure of the vegetation.

In a few cases different species of the same genus having the same forage value were not distinguished in the field, but were grouped together in the original field estimates. In these instances genera are included in the compilation along with species of other genera.

In the range survey of the plain portion (all Lower Sonoran) of Jornada Experimental Range the 382 subtypes were grouped into 8 general types of vegetation, having dominant species and acreages as follows:

	Acres
1. Honey mesquite *(Prosopis juliflora* var. *glandulosa)*	42,986
2. American tarbush *(Flourensia cernua)* and Coville Creosotebush *(Larrea tridentata)*	38,733
3. Black grama *(Bouteloua eriopoda)*	23,493
4. Tobosa *(Hilaria mutica)*	13,776
5. Broom snakeweed *(Gutierrezia sarothrae)*	13,509
6. Mixed grass	9,662
7. Weeds	1,335
8. Sand sagebrush *(Artemisia filifolia)*	218
Waste	52
Total	143,764

Analysis of the field records taken in the 1928-29 range survey of the plain area is summarized in Tables 2 and 3. Every species or species group making up as much as 0.1 percent, that is, one one-thousandth, of the total vegetation is listed by forage class in Table 2. The species are compared first as to the number of subtypes in which each was listed. For example, *Scleropogon brevifolius* (including *Muhlenbergia arenacea,* which is similar in appearance and is associated with the former) composed 0.1 percent or more of the stand in 208 subtypes, or 54.5 percent of the total 382 subtypes, and ranked first among the grasses in this respect.

More significant are the data on total composition. For example, *Scleropogon brevifolius* (including *Muhlenbergia arenacea*) had a total composition of 7,891, ranking first among grasses in this respect, also. This value signifies 20.9 percent of the total area covered by plants or 20.9 percent of the total volume of vegetation of all species. The figures on total composition are relative and not exact, because, as was stated above, differences in area and density of subtypes have not been taken into account.. If corrections for area and density were made, it is probable that the actual bulk of the vegetation of *Scleropogon brevifolius* and *Muhlenbergia arenacea* would be somewhat less and that of *Bouteloua eriopoda,* in second place, would be greater. In the compilation, *Scleropogon brevifolius,* which occurs in many small subtypes was overemphasized. Table 2 shows that the total composition of the vegetation of the plain area was divided among forage classes approximately as follows: grasses, 59.3 percent; browse (shrubs and trees), 33.6 percent; and weeds (forbs), 7.1 percent.

A close relation appeared between the rank of a species as to number of subtypes and its rank as to total composition. Thus, in general, the species most widely distributed over the plain area constituted the greatest percentages of its total vegetation. However, Table 2 shows several exceptions. For example, *Yucca elata* was widely distributed in almost half the subtypes but made up only 2.0 percent of the vegetation, less than certain browse species that were distributed in fewer subtypes. Conversely, weeds of a few species ranked relatively high in total composition because of their abundance in only a few subtypes.

The number of species listed is only a small fraction of the total in the flora. Although grass and browse species occupy much greater areas than do weeds, the latter include most of the species.

Table 3 lists those of the species and species groups shown in Table 2 that had a total representation of 1.0 percent or more, that is, that made up one one-hundredth or more of the total vegetation. These 13 species and groups, altogether 28 grass and browse species, composed roughly about 86.3 percent of the vegetation.

TABLE 2.—Summary of analysis of vegetation on plain portion of Jornada Range, based on 1928-29 survey, listing by forage classes every species composing 0.1 percent or more of the total vegetation.

Species	Subtype in which present		Rank as to no. of subtypes in which present	Total [1] Composition		Rank as to total composition
	Number	Percent		Number	Percent	
Total	382	100.0		38,200	100.0	
Grasses				22,611	59.3	
Scleropogon brevifolius (and *Muhlenbergia arenacea*)	208	54.5	1	7,981	20.9	1
Bouteloua eriopoda	201	52.3	2	4,557	11.9	2
Hilaria mutica	186	48.7	3	3,485	9.1	3
Sporobolus flexuosus and *S. cryptandrus*	152	39.8	4	1,584	4.1	4
Sporobolus airoides	141	36.9	5	1,290	3.4	5
Aristida spp.	110	28.8	6	1,103	2.9	6
Triodia pulchella	97	25.4	7	890	2.3	7
Annual grasses (*Bouteloua* spp. and *Aristida adscensionis*)	42	11.0	10	419	1.1	8
Muhlenbergia arenicola	56	14.7	8½	351	.9	9
Sporobolus nealleyi	6	1.6		175	.5	10
Muhlenbergia porteri	56	14.7	8½	157	.4	11
Panicum obtusum	15	3.9		98	.3	12
Triodia mutica	7	1.8		55	.1	13
Browse (shrubs and trees)				12,837	33.6	
Gutierrezia spp. (mostly *G. sarothrae*)	215	56.3	1	3,549	9.3	1
Prosopis juliflora var. *glandulosa*	175	45.8	3	2,852	7.5	2
Flourensia cernua	157	41.1	4	2,792	7.3	3
Larrea tridentata	84	22.0	5	1,706	4.5	4
Yucca elata	187	49.0	2	774	2.0	5
Atriplex canescens	34	8.9	7	263	.7	6
Artemisia filifolia	31	8.1	8	220	.6	7
Dalea scoparia	8	2.1		128	.3	8
Ephedra torreyana	53	13.9	6	125	.3	9
Lycium spp.	30	7.9	9	100	.3	10
Parthenium incanum	18	4.7	10	63	.2	11
Ephedra trifurca	17	4.5		46	.1	12
Weeds (forbs)				2,720	7.1	
Euphorbia spp.	46	12.0	4	192	.5	1
Franseria acanthicarpa	9	2.4		188	.5	2
Croton spp.	60	15.7	2	179	.5	3
Bahia absinthifolia var. *dealbata*	29	7.6	7	154	.4	4
Sida spp.	6	1.6		132	.3	5
Sphaeralcea spp.	39	10.2	5	131	.3	6
Salsola pestifer	15	3.9		127	.3	7
Perezia nana	80	20.9	1	120	.3	8
Eriogonum spp.	22	5.8		116	.3	9
Aphanostephus ramosissimus	23	6.0		111	.3	10
Hoffmanseggia spp.	24	6.3	9½	102	.3	11
Solanum elaeagnifolium	50	13.1	3	99	.3	12
Pectis spp.	38	9.9	6	96	.3	13
Boerhaavia torreyana	19	5.0		88	.2	14
Allionia incarnata	26	6.8	8	66	.2	15
Tribulus terrestris	7	1.8		46	.1	16
Cassia spp.	24	6.3	9½	43	.1	17
Amsonia arenaria	5	1.3		42	.1	18
Tidestromia lanuginosa	23	6.0		40	.1	19

[1] Total of percentages of vegetation in individual subtypes.

TABLE 3.—Summary of analysis of vegetation on plain portion of Jornada Range, based on 1928-29 survey, listing every species composing 1.0 percent or more of the total vegetation.

Species	Forage class	Subtypes in which present		Rank as to no. of subtypes in which present	Total composition [1]		Rank as to total composition	Total composition classified according to grazing value of plant					
								High		Low		None	
		Number	Percent		Number	Percent			Percent		Percent		Percent
Total		382	100.0		38,200	100.0							
Scleropogon brevifolius (and *Muhlenbergia arenacea*)	Grass	208	54.5	2	7,981	20.9	1			20.9			
Bouteloua eriopoda	Grass	201	52.3	3	4,557	11.9	2	11.9					
Gutierrezia spp. (mostly *G. sarothrae*)	Browse	215	56.3	1	3,549	9.3	3						9.3
Hilaria mutica	Grass	186	48.7	5	3,485	9.1	4	9.1					
Prosopis juliflora var. *glandulosa*	Browse	175	45.8	6	2,852	7.5	5			7.5			
Flourensia cernua	Browse	157	41.1	7	2,792	7.3	6						7.3
Larrea tridentata	Browse	84	22.0	12	1,706	4.5	7						4.5
Sporobolus flexuosus and *S. cryptandrus*	Grass	152	39.8	8	1,584	4.1	8	4.1					
Sporobolus airoides	Grass	141	36.9	9	1,290	3.4	9			3.4			
Aristida spp.	Grass	110	28.8	10	1,103	2.9	10	2.9					
Triodia pulchella	Grass	97	25.4	11	890	2.3	11						2.3
Yucca elata	Browse	187	49.0	4	774	2.0	12						2.0
Annual grasses (*Bouteloua* spp. and *Aristida adscensionis*)	Grass	42	11.0	20	419	1.1	13						1.1
Total of species listed					32,982	86.3		28.0		31.8			26.5

[1] Total of percentages of vegetation in individual subtypes.

Gutierrezia spp., *Scleropogon brevifolius,* and *Bouteloua eriopoda* ranked highest in number of subtypes, all being found in more than half the total number. Other species recorded in more than one-third of the subtypes were *Yucca elata, Hilaria mutica, Prosopis juliflora* var. *glandulosa, Flourensia cernua, Sporobolus flexuosus* and *S. cryptandrus,* and *S. airoides.*

In total composition *Scleropogon brevifolius* (including *Muhlenbergia arenacea*) ranked first, with 20.9 percent of all the vegetation, and *Bouteloua eriopoda* second, with 11.9 percent. Those with from 5 to 10 percent were *Gutierrezia* spp., *Hilaria mutica, Prosopis juliflora* var. *glandulosa,* and *Flourensia cernua.* All these are dominant in types occupying large areas, with the exception of *Scleropogon brevifolius,* which occurs as a dominant on clay soils in other types with *Hilaria mutica* and *Flourensia cernua.*

These species composing the bulk of the vegetation are classed in Table 3 as to forage value, the classification indicating roughly the relative proper-use factors and the rank in which the plants are preferred by grazing animals. The only common species high in forage value are *Bouteloua eriopoda, Hilaria mutica, Sporobolus flexuosus* and *S. cryptandrus,* and *Aristida* spp. The remaining common shrub and grass species are of low forage value or are not grazed. Only one of the browse species listed, *Prosopis juliflora* var. *glandulosa,* has even low forage value; the rest, with the exception of *Yucca elata,* are unpalatable or almost so. Table 3 indicates that roughly one-third of the vegetation on the plain portion of Jornada Experimental Range has high forage value, about one-third or slightly more has low forage value, and almost one-third has very slight forage value or none.

According to the range survey of 1933-34 the mountain pasture (Lower and Upper Sonoran) of 49,432 acres in the eastern part of Jornada Experimental Range was occupied by four main cover types in the following proportions: browse or shrubs, 92 percent; woodland (*Pinus edulis*), 5 percent; sand sagebrush (*Artemisia filifolia*), 1.3 percent; and grassland, 1 percent. This survey indicated that perennial grasses composed 72.3 percent of the total forage, browse 27 percent, and weeds 0.7 percent.

An analysis of the forage of the mountain pasture, made in the same manner as that for the plain area, is summarized in Tables 4 and 5. The total composition was distributed among forage classes approximately as follows: browse (shrubs and trees), 65.5 percent; grasses, 30.1 percent; weeds (forbs), 4.4 percent.

The mountain pasture had about three times as many woody species forming 0.1 percent or more of the vegetation as the plain area (Table 4). This difference is related to the greater extent of shrubby vegetation and greater diversity of topography in the mountain pasture. Here 25 species and groups, altogether 46 or fewer species, composed roughly 82.1 percent of the total vegetation.

As on the plain area, *Gutierrezia* spp. were first in number of subtypes,

with 82.2 percent, and *Bouteloua eriopoda* was second, with 75.3 percent. *Bouteloua curtipendula* was third, with 74.2 percent. The following additional species were found in more than half the subtypes: *Viguiera stenoloba, Parthenium incanum, Larrea tridentata,* and *Aristida* spp. Eleven others were represented in more than one-third of the subtypes.

In total composition *Gutierrezia* spp. were first, with 11.4 percent. Those with from 5 to 10 percent were *Bouteloua curtipendula, Larrea tridentata, Viguiera stenoloba, Bouteloua eriopoda,* and *Parthenium incanum.* Species without forage value made up a great part of the vegetation (Table 5). Among the common browse species only *Cercocarpus breviflorus* and *Dalea formosa* have high forage value for livestock and many of the shrubby species have very slight forage value or none. Probably only about one-third of the vegetation in the mountainous portion of the range has high forage value and more than half consists of unpalatable browse plants worthless as forage for livestock. However, many of these shrubby species are grazed by the abundant deer and occasional mountain sheep in the mountain area.

The statistical analysis of data from the two range surveys, besides indicating which species compose nearly all the vegetation, shows clearly that most of the semidesert species of Jornada Experimental Range are of little or no forage value and that plants palatable to livestock make up only a small part of the total.

SPRING WEEDS

The range surveys, which were made at or near the close of the summer growing season, do not show the spring weeds. For example, the weed vegetation in Table 2 is the late summer phase. In years when there is sufficient moisture, usually 1 or 2 years out of 5, perennial and annual weeds are conspicuous on Jornada Range in spring and furnish supplemental forage. More than 60 species of weeds, or forbs, were listed in the report of the spring forage crop of 1931, which was made from June 19 to July 10 of that year and shows the late spring aspect of weeds. Table 6 summarizes the records of spring weeds from that report and includes those species making up as much as 0.1 percent of the total vegetation in the spring season. However, the report was for the plain portion only and did not include the mesquite sandhill and creosotebush types. In that year the commonest species of spring annuals were *Mentzelia albicaulis* and *Eriogonum abertianum.*

Economic Aspects

The principal value of the native vegetation on semiarid upland areas in this part of southern New Mexico is as forage for livestock. On the Jornada Experimental Range and most similar areas the only kind of livestock is cattle. However, other parts of the San Andres Mountains are grazed by small herds of goats and sheep. Besides furnishing yearlong grazing for livestock, these semiarid areas support smaller numbers of native game mammals, mainly deer and antelope. A few mountain sheep, which are rare in the Southwest, live in

TABLE 4.—Summary of analysis of vegetation on Jornada mountain pasture, based on 1933-34 survey, listing every species composing 0.1 percent or more of the total vegetation.

Species	Subtypes in which present		Rank as to no. of subtypes in which present	Total [1] composition		Rank as to total composition
	Number	Percent		Number	Percent	
Total	493	100.0		49,300	100.0	
Grasses				14,829	30.1	
Bouteloua curtipendula	366	74.2	2	4,552	9.2	1
Bouteloua eriopoda	371	75.3	1	2,778	5.6	2
Bouteloua hirsuta	222	45.0	4½	1,186	2.4	3
Aristida spp.	262	53.1	3	962	2.0	4
Muhlenbergia spp.	188	38.1	6	914	1.9	5
Triodia pulchella	222	45.0	4½	856	1.7	6
Bouteloua gracilis	111	22.5	9	536	1.1	7
Eragrostis erosa	129	26.2	7	490	1.0	8
Scleropogon brevifolius	68	13.8		461	.9	9
Muhlenbergia arenacea	22	4.5		460	.9	10
Sporobolus flexuosus and *S. cryptandrus*	128	26.0	8	354	.7	11
Stipa spp.	102	20.7	10	296	.6	12
Lycurus phleoides	101	20.5		266	.5	13
Sporobolus airoides	50	10.1		198	.4	14
Hilaria mutica	20	4.1		86	.2	15
Triodia mutica	38	7.7		77	.2	16
Paspalum distichum	15	3.0		63	.1	17
Weeds (forbs)				2,148	4.4	
Aster linearis	117	23.7	1	276	.6	1
Melampodium leucanthum	44	8.9	8	151	.3	2
Eriogonum pannosum	76	15.4	3	149	.3	3
Notholaena sinuata var. *integerrima*	78	15.8	2	136	.3	4
Paronychia jamesii	53	10.8	6	134	.3	5
Actinea scaposa var. *linearis*	57	11.6	5	110	.2	6
Croton neomexicanus	50	10.1	7	98	.2	7
Perezia nana	66	13.4	4	92	.2	8
Amsonia arenaria	9	1.8		68	.1	9
Lesquerella fendleri	39	7.9	9	58	.1	10
Browse (shubs and trees)				32,208	65.5	
Gutierrezia spp. (mostly *G. sarothrae*)	405	82.2	1	5,641	11.4	1
Larrea tridentata	298	60.4	4	3,642	7.4	2
Viguiera stenoloba	364	73.8	2	3,535	7.2	3
Parthenium incanum	354	71.8	3	2,519	5.1	4
Flourensia cernua	222	45.0	8	1,973	4.0	5
Cercocarpus breviflorus	130	26.4		1,854	3.8	6
Nolina greenei	179	36.3	9	1,280	2.6	7
Dasylirion wheeleri	176	35.7		1,131	2.3	8
Dalea formosa	225	45.6	7	1,041	2.1	9
Pinus edulis	72	14.6		774	1.6	10
Prosopis juliflora var. *glandulosa*	116	23.5		756	1.5	11
Ephedra torreyana	242	49.1	5	739	1.5	12
Yucca baccata	240	48.7	6	707	1.4	13
Fouquieria splendens	173	35.1		698	1.4	14

[1] Total of percentages of vegetation in individual subtypes.

TABLE 4.—(Continued) Summary of analysis of vegetation on Jornada mountain pasture, based on 1933-34 survey, listing every species composing 0.1 percent or more of the total vegetation.

Species	Subtypes in which present		Rank as to no. of subtypes in which present	Total composition		Rank as to total composition
	Number	Percent		Number	Percent	
Acacia constricta	84	17.0		694	1.4	15
Coldenia canescens	154	31.2		618	1.3	16
Dyssodia acerosa	132	26.8		563	1.1	17
Rhus spp.	178	36.1	10	550	1.1	18
Juniperus monosperma	68	13.8		406	.8	19
Condalia spathulata	69	14.0		248	.5	20
Artemisia filifolia	17	3.4		239	.5	21
Opuntia spp.	130	26.4		227	.5	22
Garrya wrightii	59	12.0		214	.4	23
Menodora scabra	110	22.3		210	.4	24
Garrya goldmanii	17	3.4		182	.4	25
Quercus gambelii	23	4.7		181	.4	26
Quercus undulata	45	9.1		177	.4	27
Astrophyllum dumosum	56	11.4		161	.3	28
Lippia wrightii	58	11.8		160	.3	29
Yucca elata	41	8.3		158	.3	30
Atriplex canescens	51	10.3		137	.3	31
Ceanothus greggii	28	5.7		105	.2	32
Fallugia paradoxa	45	9.1		103	.2	33
Agave parryi	36	7.3		63	.1	34
Unknown	18	3.7		59	.1	35
Condalia lycioides	22	4.5		54	.1	36

San Andres Mountains and are now given further protection by the establishment of the San Andres Wildlife Refuge, under the Fish and Wildlife Service.

Under a program of multiple land use, these semiarid areas have other values. A good ground cover of semidesert vegetation is useful in reducing erosion, including both wind erosion and its sandstorms and sand dunes and water erosion with flash floods which may endanger irrigated valleys below. The localities around springs in the mountains, with their groves of trees, have a high recreational value, and on Jornada Range a recreational area has been developed at Ropes Spring. The area abounds in wildlife, including such animals as mule deer, pronghorn antelope, coyotes, bobcats, jack rabbits, cottontail rabbits, numerous rodents, reptiles and amphibia (Little and Keller, 1937), birds, and occasional mountain sheep and mountain lion. There is also intermittent prospecting for oil and mineral ores. However, it is likely that in the future the economic possibilities of the semidesert plants will receive more attention and that other useful products will be made from them.

The economic importance of native western forage plants has been the subject of various investigations by the Forest Service (1914; Dayton, 1931 and 1937), and several special research projects in this field have been carried out at Jornada Experimental Range. Jardine and Forsling's (1922) investiga-

TABLE 5.—Summary of analysis of vegetation on Jornada mountain pasture, based on 1933-34 survey, listing every species composing 1.0 percent or more of the total vegetation.

Species	Forage class	Subtypes in which present		Rank as to no. of subtypes in which present	Total composition[1]		Rank as to total composition	Total composition classified according to grazing value of plant		
		Number	Percent		Number	Percent		High	Low	None
								Percent	Percent	Percent
Total		493	100.0		49,300	100.0				
Gutierrezia spp. (mostly *G. sarothrae*)	Browse	405	82.2	1	5,641	11.4	1			11.4
Bouteloua curtipendula	Grass	366	74.2	3	4,552	9.2	2	9.2		
Larrea tridentata	Browse	298	60.4	6	3,642	7.4	3			7.4
Viguiera stenoloba	Browse	364	73.8	4	3,535	7.2	4			7.2
Bouteloua eriopoda	Grass	371	75.3	2	2,778	5.6	5	5.6		
Parthenium incanum	Browse	354	71.8	5	2,519	5.1	6		5.1	
Flourensia cernua	Browse	222	45.0	12	1,973	4.0	7			4.0
Cercocarpus breviflorus	Browse	130	26.4	21½	1,854	3.8	8	3.8		
Nolina greenei	Browse	179	36.3	15	1,280	2.6	9			2.6
Bouteloua hirsuta	Grass	222	45.0	12	1,186	2.4	10	2.4		
Dasylirion wheeleri	Browse	176	35.7	17	1,131	2.3	11		2.3	
Dalea formosa	Browse	225	45.6	10	1,041	2.1	12	2.1		
Aristida spp.	Grass	262	53.1	7	962	2.0	13	2.0		
Muhlenbergia spp.	Grass	188	38.1	14	914	1.9	14	1.9		
Triodia pulchella	Grass	222	45.0	12	856	1.7	15			1.7
Pinus edulis	Browse	72	14.6	34	774	1.6	16			1.6
Prosopis juliflora var. *glandulosa*	Browse	116	23.5	26	756	1.5	17		1.5	
Ephedra torreyana	Browse	242	49.1	8	739	1.5	18		1.5	
Yucca baccata	Browse	240	48.7	9	707	1.4	19			1.4
Fouquieria splendens	Browse	173	35.1	18	698	1.4	20			1.4
Acacia constricta	Browse	84	17.0	31	694	1.4	21			1.4
Coldenia canescens	Browse	154	31.2	19	618	1.3	22			1.3
Dyssodia acerosa	Browse	132	26.8	20	563	1.1	23			1.1
Rhus spp.	Browse	178	36.1	16	550	1.1	24			1.1
Bouteloua gracilis	Grass	111	22.5	27	536	1.1	25	1.1		
Total of species listed					40,499	82.1		28.1	8.1	45.9

1 Total of percentages of vegetation in individual subtypes.

tion of range and cattle management on southwestern ranges during drought was made here. Nelson (1934) made a study of the main forage species, black grama (*Bouteloua eriopoda*), based upon quadrat records covering a period of years; Canfield (1939) conducted a clipping study of the same species and tobosa (*Hilaria mutica*); and Campbell and Crafts (1939) prepared a leaflet on "How to keep and increase black grama on southwestern ranges."

Regarding the principal forage species here Canfield (1934) stated: "Native perennial grasses produce the major part of all the forage on Southwestern plains. In the Jornada region the species of five genera, *Bouteloua, Sporobolus, Aristida, Hilaria,* and *Scleropogon,* furnish 85 percent or more of the forage derived from grasses." According to the unpublished range survey report by E. H. Bomberger, the species of *Bouteloua* alone contribute 53.5 percent of the total forage in the Jornada mountain pasture.

Research has dealt also with range plants of negative economic importance, including those that are poisonous to livestock. Little (1937a) made a study of poisonous drymaria (*Drymaria holosteoides*), an annual weed causing

TABLE 6.—Weed species on plain portion of Jornada Range, exclusive of mesquite sandhill and creosotebush types, composing 0.1 percent or more of the spring growth of vegetation in 1931.

Species	Total composition
	Percent
Menzelia albicaulis	2.50
Eriogonum abertianum	1.41
Croton corymbulosus	.84
Chenopodium incanum	.79
Psilostrophe tagetinae	.70
Eriogonum annuum	.65
Perezia nana	.49
Chamaesaracha coronopus	.39
Sphaeralcea spp.	.30
Lesquerella purpurea	.29
Zinnia grandiflora	.26
Hoffmanseggia spp.	.23
Allionia incarnata	.23
Cryptantha crassisepala	.22
Franseria acanthicarpa	.19
Euphorbia albomarginata	.18
Cassia bauhinioides	.16
Solanum elaeagnifolium	.16
Heliotropium convolvulaceum	.15
Eriogonum rolundifolium	.15
Baileya multiradiata	.15
Senecio longilobus	.15
Schrankia occidentalis	.14
Evolvulus pilosus	.14
Tetraclea coulteri	.12
Dithyrea wislizeni	.12
Setinocarpus chenopodioides	.11

greater livestock losses than all other species of poisonous range plants here. Perennial weeds regarded as poisonous are *Astragalus allochrous, A. bigelovii, Baileya multiradiata, Psilostrophe tagetinae, Senecio longilobus,* and *S. riddellii.* Other poisonous annuals are *Actinea odorata* and, in San Andres Mountains, *Nicotiana trigonophylla.* Some of these are grazed by cattle very slightly if at all, and so are less dangerous than they would be on a sheep range. Broom snakeweed (*Gutierrezia sarothrae*), an unpalatable half-shrub prominent on areas deteriorated by continued overgrazing, was studied here by Campbell and Bomberger (1934).

Since trees are scarce, the smaller woody plants are used for fuel. Larger stems and roots of *Prosopis juliflora* var. *glandulosa, Condalia spathulata,* and other shrubby species are consumed locally for this purpose. Where woodland areas are accessible, wood of *Juniperus monosperma* and *Pinus edulis* is preferred to that of semidesert shrubs for fuel. Also fence posts are made from the former.

Thallophyta

Specimens of about 16 species of thallophytes were collected at Jornada Experimental Range, mostly in connection with special studies. Although obviously very incomplete, the list of species apparently contains a few additions to New Mexico and is included here as a metter of record. The determinations were made chiefly by specialists in the Bureau of Plant Industry.

ALGAE

Nostoc commune Vauch. var. *flagelliforme* (Berk. & Curt.) Born. & Flah.

FUNGI

The small and very incomplete list of fungi collected on Jornada Experimental Range was compared with Standley's (1916b) list of the fungi of New Mexico. Standley mentioned these three parasitic species of fungi collected at Jornada Range by Wooton in 1913, including one later collected here by the Forest Service:

Albugo candida (Pers.) Roussel, on *Erysimum (Cheiniria)* sp.
Thecaphora deformans Dur. & Mont., on *Astragalus wootoni* Sheld.
Uromyces astragali Sacc., on *Astragalus wootoni* Sheld.

Three additional species from Wooton's collections in San Andres Mountains in 1912 and 1914 cited by Standley (1916b) probably came from the experimental range:

Phyllachora graminis (Pers.) Fuckel, on *Muhlenbergia pauciflora* Buckl. (*M. neomexicana* Vasey).
Puccinia aristidae Tracy, on *Aristida adscensionis* L. (*A. bromoides* H. B. K.).
Puccinia lobata Berk. & Curt., on *Sida lepidota* A. Gray (*Disella lepidota* (A. Gray) Greene).

The list of fungi collected at Jornada Experimental Range by Forest Service men follows. A majority of these, 8 species, are additions to Standley's New Mexico list and are indicated by asterisks (*).

**Batarrea stevenii* (Libosch.) Fr.
**Calvatia polygonia* Lloyd
Coprinus sp.
**Ceaster coronatus* (Schaeff.) Schroet.
**Lenzites trabea* Pers.?
**Lepiota morgani* Peck.
**Montagnites candollei* Fr.
**Naucoria mexicana* Murr.?
**Phellorina strobilina* Kalchbr.

Thecaphora deformans Dur. & Mont. Smut on *Astragalus allochrous* and *A. crassicarpus.* Listed by Standley (1916b).
Tylostoma sp.
Ustilago hieronymi Schroet. Smut on *Triodia pulchella.*

LICHENES

The two named species of lichens from Jornada Range listed below were not mentioned in Lesdain's (1932) extensive report on the lichens of New Mexico. However, that study was based upon collections made by the late Brother G. Arsène in the northern part of the State.

Lecidea crenata (Tayl.) Stizenb. var. *dealbata* (Tuck.) Zahlbr.
Parmelia sp.
Ramalina populina (Ehrl.) Wainio.

Bryophyta

The bryophytes of Jornada Experimental Range, including 1 species of liverworts and 21 species of mosses, were enumerated in a separate paper by Little (1937b). A specimen of one additional moss species collected here was determined by Dr. A. J. Grout as *Weisia tortilis* (Schwaegr) C. Muell., which is rare in the United States. *Fissidens littlei* (Williams) Grout (*Moenkemeyera littlei* Williams), which has its type locality in gypsum sinks near Middle Well, Jornada Range, has been found also in Louisiana and Florida.

Ferns and Seed Plants

Each species name in the list of ferns (Pteridophyta) and seed plants (Spermatophyta) is followed by an abbreviation signifying geographical distribution or range, as discussed under the topic, Distribution of species. The abbreviations are:

NM—New Mexico	W—western	Tr—tropical
SW—southwestern	NA—North American	I—introduced

In the case of the seed plants, the first abbreviation following the name indicates the life form of the species according to Raunkiaer's classification. The standard abbreviations of Raunkiaer's life forms, which have been used here, are as follows:

S—stem succulents	Ch—chamaephytes
E—epiphytes	H—hemicryptophytes
MM—mesophanerophytes	G—geophytes
M—microphanerophytes	HH—helophytes and hydrophytes
N—nanophanerophytes	Th—therophytes

The specimens collected on the College Ranch adjacent to Jornada Experimental Range and Wooton's specimens deposited in the United States National Herbarium have been so designated in the list.

PTERIDOPHYTA

Polypodiaceae

Adiantum capillus-veneris L. Tr.
Cheilanthes feei Moore. W.
Cheilanthes villosa Davenp. SW.
Cheilanthes wootoni Maxon. W.
Notholaena fendleri Kunze. W.
Notholaena sinuata (Lag.) Kaulf. Tr.
Notholaena sinuata var. *integerrima* Hook.
Notholaena standleyi Maxon. W.
Pellaea atropurpurea (L.) Link. NA.
Pellaea intermedia Mett. SW.
Pellaea longimucronata Hook. W.
Woodsia mexicana Fée? SW.

Equisetaceae

Equisetum laevigatum A. Br. NA.

Selaginellaceae

Selaginella mutica D. C. Eaton. W.
Selaginella sheldoni Maxon ? W.

SPERMATOPHYTA
GYMNOSPERMAE
Pinaceae

Juniperus monosperma (Engelm.) Sarg. M; W.
Pinus edulis Engelm. M; W.

Ephedraceae

Ephedra aspera Engelm. N; SW.
Ephedra torreyana S. Wats. N; W.
Ephedra trifurca Torr. N; SW.

ANGIOSPERMAE
MONOCOTYLEDONEAE
Typhaceae

Typha angustifolia L. HH; NA.
Typha latifolia L. HH; NA.

Najadaceae

Potamogeton interior Rydb. HH; W.

Gramineae

Agrostis verticillata Vill. H; I.
Andropogon saccharoides Sw. H; Tr.
Aristida adscensionis L. Th; Tr.
Aristida barbata Fourn. (*A. havardii* Vasey.) H; SW.
Aristida divaricata Humb. & Bonpl. H; Tr.
Aristida glauca (Nees) Walp. H; SW.
Aristida longiseta Steud. H; W.
Aristida longiseta var. *robusta* Merr.
Aristida orcuttiana Vasey. (*A. schiediana* auth.) H; SW.
Aristida pansa Woot. & Standl. H; SW.
Aristida purpurea Nutt. H; W.
Avena sativa L. Th; I.
Bouteloua aristidoides (H. B. K.) Griseb. Th; SW.
Bouteloua barbata Lag. Th; SW.
Bouteloua curtipendula (Michx.) Torr. H; NA.
Bouteloua eriopoda (Torr.) Torr. H; SW.
Bouteloua gracilis (H. B. K.) Lag. H; W.
Bouteloua hirsuta Lag. H; W.
Bouteloua parryi (Fourn.) Griffiths. Th; SW.
Bromus catharticus Vahl. Th; I.
Cenchrus pauciflorus Benth. Th; NA.
Chloris cucullata Bisch. H; SW. College Ranch.
Chloris virgata Sw. Th. Tr.
Cynodon dactylon (L.) Pers. (*Capriola dactylon* (L). Kuntze.) H; I.
Digitaria sanguinalis (L.) Scop. Th; I.
Distichlis stricta (Torr.) Rydb. H; W.
Echinochloa crusgalli (L.) Beauv. Th; I.
Echinochloa crusgalli var. *mitis* (Pursh) Peterm.
Echinochloa crusgalli var. *zelayensis* (H. B. K.) Hitchc.
Eragrostis cilianensis (All.) Link. Th; I.
Eragrostis erosa Scribn. H; SW.
Eragrostis pectinacea (Michx.) Nees. (*E. caroliniana* (Spreng.) Scribn.) Th; NA.
Eragrostis pilosa (L.) Beauv. Th; I.
Festuca octoflora Walt. Th; NA.
Festuca octoflora var. *hirtella* Piper.

Heteropogon contortus (L.) Beauv. H; Tr.
Hilaria mutica (Buckl.) Benth. H; SW.
Koeleria cristata (L.) Pers. H; NA.
Leptochloa dubia (H. B. K.) Nees. H. Tr.
Leptochloa fascicularis (Lam.) A. Gray. Th; NA.
Leptoloma cognatum (Schult.) Chase. H; NA.
Lycurus phleoides H. B. K. H; W.
Muhlenbergia arenacea (Buckl.) Hitchc. (*Sporobolus auriculatus* Vasey.) H; SW.
Muhlenbergia arenicola Buckl. H; W.
Muhlenbergia asperifolia (Nees & Mey.) Parodi. (*Sporobolus asperifolius* (Nees & Mey.) Thurb.) H; W.
Muhlenbergia dubia Fourn. H; SW. L. N. Goodding M-286, M-287.
Muhlenbergia emersleyi Vasey. (*Epicampes emersleyi* (Vasey) Hitchc.) H; SW.
Muhlenbergia monticola Buckl. H; SW.
Muhlenbergia pauciflora Buckl. H; W.
Muhlenbergia porteri Scribn. Ch; W.
Muhlenbergia repens (Presl) Hitchc. H; SW.
Muhlenbergia rigens (Benth.) Hitchc. (*Epicampes rigens* Benth.) H; SW.
Muhlenbergia torreyi (Kunth) Hitchc. H; W. L. N. Goodding M-237.
Munroa squarrosa (Nutt.) Torr. Th; W.
Oryzopsis hymenoides (Roem. & Schult.) Ricker. H; W.
Panicum capillare L. var. *occidentale* Rydb. (*P. barbipulvinatum* Nash.) Th; NA.
Panicum hallii Vasey. H; SW.
Panicum hirticaule Presl. Th; Tr.
Panicum huachucae Ashe. H; NA.
Panicum obtusum H. B. K. H; W.
Pappophorum wrightii S. Wats. H; Tr.
Paspalum distichum L. H; NA.
Paspalum stramineum Nash. H; W.
Polypogon monspeliensis (L.) Desf. Th; I.
Scleropogon brevifolius Phil. H; W.
Setaria macrostachya H. B. K. (*Chaetochloa macrostachya* (H. B. K.) Scribn. & Merr.) H; W.
Setaria viridis (L.) Beauv. (*Chaetochloa viridis* (L.) Scribn.) Th; I.
Sitanion hystrix (Nutt.) J. G. Smith. H; W.
Sorghum halepense (L.) Pers. H; I.
Sporobolus airoides (Torr.) Torr. H; W.
Sporobolus cryptandrus (Torr.) A. Gray. H; NA.
Sporobolus flexuosus (Thurb.) Rydb. H; W.
Sporobolus giganteus Nash. H; SW.
Sporobolus nealleyi Vasey. H; SW.
Stipa columbiana Macoun. H; W.
Stipa eminens Cav. H; SW.
Stipa neomexicana (Thurb.) Scribn. H; W.
Stipa scribneri Vasey. H; W.
Tragus berteronianus Schult. (*Nazia aliena* auth.) Th; I.
Tragus racemosus (L.) All. (*Nazia racemosa* (L.) Kuntze.) Th; I.
Trichachne californica (Benth.) Chase. (*Valota saccharata* (Buckl.) Chase.) H; W.
Triodia mutica (Torr.) Scribn. H; W.
Triodia pilosa (Buckl.) Merr. H; W.
Triodia pulchella H. B. K. H; SW.

Cyperaceae

Carex hystricina Muhl. H; NA.
Cladium jamaicense Crantz. (*Mariscus jamaicensis* (Crantz) Britton.) HH; Tr.
Cyperus speciosus Vahl. Th; NA.
Cyperus uniflorus Torr. & Hook. H; SW.
Eleocharis geniculata (L.) R. & S. Th; Tr.
Eleocharis macrostachya Britton. HH; W.
Eleocharis rostellata Torr. HH; NA.

Scirpus acutus Muhl.? HH; NA.
Scirpus torreyi Olney? HH; I?

Commelinaceae

Commelina crispa Wooton. G; W.
Tradescantia occidentalis (Britton) *Smyth* var. *scopulorum* (Rose) Anderson & Woodson. (*T. scopulorum* Rose.) H; W.

Juncaceae

Juncus interior Wiegand. HH; W.
Juncus torreyi Coville. HH; NA.

Liliaceae

Allium cernuum Roth. G; NA.
Allium deserticola (Jones) Woot. & Standl. G; W.
Dasylirion wheeleri S. Wats. N; SW.
Nolina greenei S. Wats. H; W.
Nolina microcarpa S. Wats. H; SW.
Yucca baccata Torr. N; W.
Yucca elata Engelm. M; SW.

Amaryllidaceae

Agave parryi Engelm. (*A. neomexicana* Woot. & Standl.) Ch; SW.
Zephyranthes longifolia Hemsl. (*Atamosco longifolia* (Hemsl.) Cock.) G; SW.

DICOTYLEDONEAE

Salicaceae

Populus wislizeni (S. Wats.) Sarg. MM; W.
Salix amygdaloides Anderss. var. *wrightii* (Anderss.) C. Schneid. (*S. wrightii* Anderss.) M; NA.
Salix exigua Nutt. M; W.
Salix gooddingii Ball. M; SW.

Fagaceae

Quercus gambelii Nutt. (*Q. novomexicana* (A. DC.) Rydb.) M; W.
Quercus grisea Liebm. M; SW.
Quercus undulata Torr. M; W.

Ulmaceae

Celtis reticulata Torr. M; W.

Moraceae

Morus microphylla Buckl. M; SW.

Santalaceae

Comandra pallida A. DC. G; W.

Loranthaceae

Arceuthobium campylopodum Engelm. f. *divaricatum* (Engelm.) Gill. (*Razoumofskya divaricata* (Engelm.) Coville.) E; W.
Phoradendron bolleanum (Seem.) Eichl. E; SW.
Phoradendron cockerellii Trel. E; SW.
Phoradendron juniperinum Engelm. E; W.

Polygonaceae

Eriogonum abertianum Torr. Th; SW.
Eriogonum annuum Nutt. Th; W.
Eriogonum jamesii Benth. H; W.
Eriogonum pannosum Woot. & Standl. H; SW.
Eriogonum pinetorum Greene. Th; SW.
Eriogonum rotundifolium Benth. Th; SW.
Eriogonum trichopodum Torr. Th; SW.
Polygonum lapathifolium L. (*Persicaria lapathifolia* (L.) S. F. Gray.) Th; NA.
Rumex hymenosepalus Torr. G; W.
Rumex mexicanus Meisn. H; NA.

Chenopodiaceae

Atriplex canescens (Pursh) Nutt. N; W.
Chenopodium incanum (S. Wats.) Heller. Th; W.
Chenopodium leptophyllum (Moq.) Nutt. Th; W.
Corispermum nitidum Kit. Th; W.
Cycloloma atriplicifolium (Spreng.) Coult. Th; W.
Eurotia lanata (Pursh) Moq. N; W.
Salsola pestifer A. Nels. T; I.

Amaranthaceae

Acanthochiton wrightii Torr. Th; SW.
Amaranthus blitoides S. Wats. Th; W.
Amaranthus retroflexus L. Th; I.
Amaranthus torreyi (A. Gray) Benth. Th; W.
Brayulinea densa (Humb. & Bonpl.) Small. H; Tr.
Froelichia campestris Small. Th; W. College Ranch.
Tidestromia lanuginosa (Nutt.) Standl. Th; W.

Nyctaginaceae

Abronia angustifolia Greene. Th; SW.
Abronia fragrans Nutt. H; W.
Allionia incarnata L. (*Wedeliella incarnata* (L.) Cock.) H; Tr.
Allionia linearis Pursh. (*Mirabilis linearis* (Pursh) Heimerl.) H; W.
Boerhaavia caribaea Jacq. H; Tr. College Ranch.
Boerhaavia gracillima Heimerl. H; SW. College Ranch.
Boerhaavia intermedia Jones. Th; SW. College Ranch.
Boerhaavia torreyana (S. Wats.) Standl. Th; SW.
Cyphomeris gypsophiloides (Mart. & Gal.) Standl. H; SW.
Mirabilis multiflora (Torr.) A. Gray. (*Quamoclidion multiflorum* Torr.) H; W.
Selinocarpus chenopodioides A. Gray. H; SW.
Tripterocalyx cyclopterus (A. Gray) Standl. (*Abronia cycloptera* A. Gray.) Th; SW.

Illecebraceae

Paronychia jamesii Torr. & Gray. H; W.

Aizoaceae

Mollugo cerviana (L.) Seringe. Th; Tr.
Trianthema portulacastrum L. Th; Tr.

Caryophyllaceae

Drymaria holosteoides Benth. (*D. pachyphylla* Woot. & Standl.) Th; SW.
Silene laciniata Cav. H; SW.

Portulacaceae

Portulaca pilosa L. Th; Tr.
Portulaca retusa Engelm. Th; W.
Talinum angustissimum (A. Gray) Woot. & Standl. G; SW.
Talinum aurantiacum Engelm. G; SW.
Talinum pulchellum Woot. & Standl. G; SW.

Ranunculaceae

Anemone sphenophylla Poepp. G; Tr.
Aquilegia chrysantha A. Gray. H; SW.
Clematis drummondii Torr. & Gray. N; SW.
Clematis neomexicana Woot. & Standl. N; SW.
Delphinium virescens Nutt. var. *penardi* (Huth) Perry. (*D. camporum* Greene.) H; W.
Thalictrum wrightii A. Gray. H; SW.

Berberidaceae

Mahonia haematocarpa (Wooton) Fedde. (*Berberis haematocarpa* Wooton. *Odostemon haematocarpus* (Wooton) Heller.) N; SW.

Papaveraceae

Argemone platyceras Link & Otto. H; W.
Eschscholtzia mexicana Greene. Th; SW.

Fumariaceae

Corydalis montana Engelm. (*Capnoides montanum* (Engelm.) Britton.) H; W.

Cruciferae

Descurainia menziesii (DC.) O. E. Schulz var. *ochroleuca* (Wooton) O. E. Schulz. (*Sophia ochroleuca* Wooton.) Th; SW.
Dithryea wislizeni Engelm. Th; W.
Draba cuneifolia Nutt. Th; NA.
Dryopetalon runciniatum A. Gray. Th; SW.
Erysimum elatum Nutt. (*Cheirinia elata* (Nutt.) Rydb.) H; W.
Lepidium eastwoodiae Wooton. H; W.
Lepidium lasiocarpum Nutt. Th; W.
Lesquerella fendleri (A. Gray) S. Wats. H; W.
Lesquerella purpurea (A. Gray) S. Wats. H; SW.
Nerisyrenia camporum (A. Gray) Greene. H; SW.
Nerisyrenia linearifolia (S. Wats.) Greene. H; SW.
Selenia dissecta Torr. Th; SW.
Sisymbrium linearifolium (A. Gray) Payson. (*Thelypodium linearifolium* (A. Gray) S. Wats.) H; W.
Stanleyella wrightii (A. Gray) Rydb. (*Thelypodium wrightii* A. Gray.) H; W.
Streptanthus validus (Greene) Cory. (*Euklisia valida* (Greene) Woot. & Standl.) Th; SW.

Resedaceae

Oligomeris subulata (Delile) Webb. (*Dipetalia linifolia* (Vahl) Tidestrom.) Th; Tr.

Crassulaceae

Sedum griffithsii Rose. H; SW.

Saxifragaceae

Fendlera rupicola A. Gray. N; SW.
Fendlerella cymosa Greene. N; SW.
Heuchera leptomeria Greene? H; SW.
Philadelphus microphyllus A. Gray. N; W.
Ribes leptanthum A. Gray. (*Grossularia leptantha* (A. Gray) Coville & Britton.) N; W.

Rosaceae

Amelanchier utahensis Koehne. (*A. australis* Standl.) M; W. Wooton, Sept. 23, 1912 (U. S. Natl. Herb.), collected at Ropes Spring, is the type of *A. australis* Standl. Recorded by Wooton and Standley (1915, p. 323).
Cercocarpus breviflorus A. Gray. N; SW.
Fallugia paradoxa (Don) Endl. N; W.
Holodiscus dumosus (Nutt.) Heller. (*Sericotheca dumosa* (Nutt.) Rydb.) N; W.
Petrophytum caespitosum (Nutt.) Rydb. Ch; W.
Prunus virens (Woot. & Standl.) Shreve. M; SW.
Rosa neomexicana Cock. N; W.
Rosa stellata Wooton. N; SW.

Leguminosae

Acacia constricta Benth. M; SW.
Astragalus allochrous A. Gray. H; W.
Astragalus bigelovii A. Gray. H; W.
Astragalus crassicarpus Nutt. H; W.
Astragalus famelicus Sheld. H; W.
Astragalus missouriensis Nutt. H; W.
Astragalus nuttallianus DC. Th; W.
Astragalus pattersonii A. Gray. H; W.
Astragalus subcinereus A. Gray. H; SW.

Cassia bauhinioides A. Gray. H; SW.
Cassia lindheimeriana Scheele. H; SW.
Dalea formosa Torr. (*Parosela formosa* (Torr.) Vail.) N; W.
Dalea glaberrima S. Wats. (*Parosela glaberrima* (S. Wats.) Rose.) H; SW.
Dalea jamesii (Torr.) T. & G. (*Parosela jamesii* (Torr.) Vail.) H; W.
Dalea lemmoni Parry. (*Parosela lemmoni* (Parry) Heller.) Th; SW.
Dalea nana Torr. (*Parosela nana* (Torr.) Heller.) H; W.
Dalea scoparia A. Gray. (*Parosela scoparia* (A. Gray) Heller.) N; SW.
Dalea terminalis Jones. (*Parosela terminalis* (Jones) Heller.) N; SW.
Dalea wrightii A. Gray (*Parosela wrightii* (A. Gray) Vail.) H; SW.
Desmanthus cooleyi (Eaton) Trel. (*Acuan cooleyi* (Eaton) Britton & Rose.) H; W.
Hoffmanseggia densiflora Benth. G; SW.
Hoffmanseggia jamesii Torr. & Gray. G; SW.
Krameria secundiflora DC. H;
Lotus wrightii (A. Gray) Greene. H; W.
Mimosa biuncifera Benth. N; SW.
Petalostemum compactum (Spreng.) Swezey. H; W.
Phaseolus acutifolius A. Gray. Th; SW.
Prosopis juliflora var. *glandulosa* (Torr.) Cock. (*P. glandulosa* Torr.) M; W.
Prosopis pubescens Benth. (*P. odorata* Torr. & Frem.; *Strombocarpa odorata* (Torr. & Frem.) Torr.) M; SW.
Rhynchosia texana Torr. & Gray. (*Dolicholus texanus* (Torr. & Gray) Vail.) H; SW.
Robinia neomexicana A. Gray. M; W.
Schrankia occidentalis (Woot. & Standl.) Standl. (*Morongia occidentalis* Woot. & Standl.) H; NM.
Sophora stenophylla A. Gray. G; SW.

Linaceae

Linum aristatum Engelm. H; SW.
Linum australe Heller. H; W.
Linum lewisii Pursh. H; W.
Linum vernale Wooton. Th; SW.

Oxalidaceae

Oxalis amplifolia (Trel.) Knuth. G; SW.

Geraniaceae

Erodium cicutarium (L.) L'Her. Th; I.
Erodium texanum A. Gray. Th; SW.

Zygophyllaceae

Kallstroemia hirsutissima Vail. Th; W.
Larrea tridentata (DC.) Coville. (*Covillea tridentata* (DC.) Vail.) N; SW.
Tribulus terrestris L. Th; I.

Koeberliniaceae

Koeberlinia spinosa Zucc. N; SW. Also in Bolivia.

Malpighiaceae

Janusia gracilis A. Gray. N; SW.

Rutaceae

Choisya dumosa (Torr.) A. Gray. (*Astrophyllum dumosum* Torr.) N; SW.
Ptelea baldwinii Torr. & Gray. N; W.
Thamnosma texana (A. Gray) Torr. H; W.

Polygalaceae

Polygala alba Nutt. H; W.
Polygala longa Blake. H; SW.
Polygala macradenia A. Gray. Ch; SW.

Euphorbiaceae

Bernardia myricifolia (Scheele) S. Wats. N; SW.
Croton corymbulosus Engelm. H; SW.
Croton fruticulosus Engelm. N; SW.
Croton neomexicanus Muell. Arg. H; SW.
Croton texensis (Klotzsch) Muell. Arg. Th; W.
Euphorbia albomarginata Torr. & Gray. (*Chamaesyce albomarginata* (Torr. & Gray) Small.) H; W.
Euphorbia dentata Michx. (*Poinsettia dentata* (Michx.) Kl. & Garcke.) Th; NA.
Euphorbia exstipulata Engelm. (*Zygophyllidium exstipulatum* (Engelm.) Woot. & Standl.) Th; SW.
Euphorbia fendleri Torr. & Gray (Boiss.) Woot.
Euphorbia hyssopifolia L. Th; Tr.
Euphorbia lata Engelm. (*Chamaesyce lata* (Engelm.) Small.) H; W.
Euphorbia parryi Engelm. (*Chamaesyce parryi* (Engelm.) Rydb.) Th; SW.
Euphorbia serpyllifolia Pers. (*Chamaesyce serpyllifolia* (Pers.) Small.) Th; W.
Reverchonia arenaria A. Gray. Th; SW.
Tragia nepetaefolia Cav. (*T. ramosa* Torr.) H; NA.

Anacardiaceae

Rhus choriophylla Woot. & Standl. N; SW.
Rhus lanceolata (A. Gray) Britton. N; SW.
Rhus microphylla Engelm. M; SW.
Rhus trilobata Nutt. N; W.
Rhus trilobata var. *pilosissima* Engler. (*R. emoryi* (Greene) Wooton.)

Sapindaceae

Sapindus drummondii Hook. & Arn. N; W.

Rhamnaceae

Ceanothus fendleri A. Gray. N; W.
Ceanothus greggii A. Gray. N; SW.
Condalia lycioides (A. Gray) Weberb. N; SW.
Condalia spathulata A. Gray. N; SW.
Rhamnus smithii Greene subsp. *fasciculata* (Greene) C. B. Wolf. (*R. fasciculata* Greene.) N; W.
Rhamnus californica Esch. subsp. *ursina* (Greene) C. B. Wolf. (*R. ursina* Greene.) M; W.

Vitaceae

Vitis arizonica Engelm. M; SW.

Malvaceae

Abutilon parvulum A. Gray. H; SW.
Hibiscus denudatus Benth. (*H. involucellatus* (A. Gray) Woot. & Standl.) Ch; SW.
Sida hastata St. Hil. (*S. physocalyx* A. Gray.) H; SW.
Sida lepidota A. Gray. H; SW.
Sida procumbens Sw. (*S. diffusa* H. B. K.) H; Tr.
Sphaeralcea coccinea (Pursh) Rydb. var. *elata* (Baker f.) Kearney. (*S. elata* (Baker f.) Rydb.) H; W.
Sphaeralcea digitata (Greene) Rydb. var. *tenuipes* (Woot. & Standl.) Kearney. (*S. tenuipes* Woot. & Standl.) H; SW.
Sphaeralcea fendleri A. Gray. H; SW.
Sphaeralcea incana Torr. H; SW.
Sphaeralcea leptophylla (A. Gray) Rydb. H; W. Wooton, May 22, 1913 (U. S. Natl. Herb.)
Sphaeralcea subhastata Coult. var. *martii* (Cock.) Kearney. H; SW.
Sphaeralcea subhastata var. *pumila* (Woot. & Standl.) Kearney. Wooton, May 17, 1913 (U. S. Natl. Herb.)

Elatinaceae

Bergia texana (Hook.) Seubert. Th; W.

Tamaricaceae

Tamarix gallica L. N; I.

Fouquieriaceae

Fouquieria splendens Engelm. M; SW.

Violaceae

Hybanthus verticillatus (Ort.) Baill. (*Calceolaria verticillata* (Ort.) Kuntze.) H; W.

Loasaceae

Cevallia sinuata Lag. H; SW.
Mentzelia albicaulis Dougl. Th; W.
Mentzelia multiflora (Nutt.) A. Gray. H; W.

Cactaceae

Cereus greggii Engelm. (*Peniocereus greggii* (Engelm.) Britt. & Rose.) S; SW.
Echinocactus horizonthalonius Lem. S; SW.
Echinocactus uncinatus Galeotti var. *wrightii* Engelm. S; SW.
Echinocactus wislizeni Engelm. S; SW.
Echinocereus coccineus Engelm. S; W.
Echinocereus fendleri (Engelm.) Rümpl. S; W.
Mammillaria heyderi Mühlenpf. C; SW.
Mammillaria lasiacantha Engelm. S; SW.
Mammillaria macromeris Engelm. (*Coryphantha macromeris* (Engelm.) Lem.) S; SW.
Mammillaria engelmannii Cory. (*M. scheeri* Mühlenpf. 1847, not 1845.) S; SW.
Mammillaria tuberculosa Engelm. S; SW.
Opuntia engelmannii Salm-Dyck. S; SW.
Opuntia imbricata (Haw.) DC. S; W.
Opuntia kleiniae DC. S; SW.
Opuntia leptocaulis DC. S; SW.
Opuntia phaeacantha Engelm.? S; W.

Lythraceae

Lythrum linearifolium (A. Gray) Small. H; SW.

Onagraceae

Gaura coccinea Pursh. H; W.
Oenothera albicaulis Pursh. (*Anogra albicaulis* (Pursh) Britton.) Th; W.
Oenothera brachycarpa A. Gray var. *wrightii* (A. Gray) Leveille (*Lavauxia wrightii* (A. Gray) Small.) H; W.
Oenothera caespitosa Nutt. var. *australis* (Woot. & Standl.) Munz. (*Pachylophus australis* Woot. & Standl.) H; W.
Oenothera caespitosa var. *marginata* (Nutt.) Munz. (*Pachylophus marginatus* (Nutt.) Rydb.)
Oenothera hartwegi Benth. (*Galpinsia hartwegi* (Benth.) Brifton.) Ch; W.
Oenothera primiveris A. Gray. (*Lavauxia primiveris* (A. Gray) Small.) H; SW.
Oenothera runcinata (Engelm.) Munz. (*Anogra runcinata* (Engelm.) Woot. & Standl.) H; SW.

Umbelliferae

Pseudocymopterus montanus (A. Gray) Coult. & Rose. H; W.

Cornaceae

Garrya goldmanii Woot. & Standl. N; SW.
Garrya wrightii Torr. M; SW.

Oleaceae

Forestiera pubescens Nutt. M; W.
Fraxinus velutina Torr. MM; SW.
Fraxinus cuspidata Torr. N; SW.
Menodora scabra A. Gray. Ch; SW.

Apocynaceae

Amsonia arenaria Standl. G; SW.

Asclepiadaceae

Asclepias arenaria Torr. H; SW.
Asclepias brachystephana Engelm. H; W.
Asclepias galioides H. B. K. G; W.
Asclepiodora decumbens (Nutt.) A. Gray. H; W.
Funastrum heterophyllum (Engelm). Standl. H; SW.
Vincetoxicum productum (Torr.) Vail. H; SW.

Convolvulaceae

Convolvulus incanus Vahl. H; W. College Ranch.
Cuscuta umbellata H. B. K. Th; Tr.
Evolvulus pilosus Nutt. H; W.
Ipomoea costellata Torr. Th; SW.
Ipomoea hirsutula Jacq. f. Th; SW.

Polemoniaceae

Gilia aggregata (Pursh) Spreng. H; W.
Gilia filifolia Nutt. (*Welwitschia filifolia* (Nutt.) Rydb.) Th; W.
Gilia longiflora (Torr.) Don. Th; W.
Gilia pumila Nutt. Th; W.
Phlox stansburyi (Torr.) Heller. H; SW.
Phlox triovulata Thurb. H; SW.

Hydrophyllaceae

Nama dichotomum (Ruiz & Pavon) Choisy? (*Conanthus angustifolius* (A. Gray) Heller?) Th; W.
Nama hispidum A. Gray. (*Conanthus hispidus* (A. Gray) Heller.) Th; SW.
Phacelia intermedia Wooton. Th; SW.
Phacelia popei Torr. & Gray. Th; SW.
Phacelia rupestris Greene. H; SW.

Boraginaceae

Coldenia canescens DC. Ch; SW.
Cryptanthe crassisepala (Torr. & Gray) Greene. Th; W.
Cryptantha jamesii (Torr.) Payson. (*Oreocarya suffruticosa* (Torr.) Greene.) H; W.
Cryptantha micrantha (Torr.) Johnston. (*Eremocarya micrantha* (Torr.) Greene.) Th; W.
Cryptantha oblata (James) Payson. H; SW.
Heliotropium convolvulaceum (Nutt.) A. Gray. (*Euploca convolvulacea* Nutt.) Th; W.
Heliotropium curassavicum L. Th; NA.
Heliotropium greggii Torr. H; SW.
Lithospermum incisum Lehm. (*L. linearifolium* Goldie.) H; W.
Onosmodium molle Michx. var. *occidentale* (Mackenzie) Johnston. (*O. occidentale* Mackenzie.) H; W.

Verbenaceae

Lippia wrightii A. Gray. N; SW.
Verbena bracteata Lag. & Rodr. H; NA.
Verbena wrightii A. Gray. (*V. ambrosifolia* Rydb.) H; SW.

Labiatae

Agastache cana (Hook.) Woot. & Standl. H; SW.
Hedeoma drummondii Benth. H; W.
Hedeoma nanum (Torr.) Briq. H; SW.
Hedeoma oblongifolium (A. Gray) Heller. H; SW.
Salvia henryi A. Gray. Wooton, May 23, 1913 (U. S. Natl. Herb.)
Salvia lanceaefolia Poir. Th; W.
Salvia ramosissima Fernald. N; SW.

Salvia vinacea Woot. & Standl. N; NM.
Tetraclea angustifolia Woot. & Standl. H; SW.
Tetraclea coulteri A. Gray. H; SW.

Solanaceae

Chamaesaracha coronopus (Dunal) A. Gray. H; W.
Chamaesaracha sordida (Dunal) A. Gray. (*C. conioides* (Moric.) Britton.) H; W.
Datura meteloides DC. H; W.
Lycium berlandieri Dunal. N; SW.
Lycium pallidum Miers. N; W.
Nicotiana trigonophylla Dunal. Th; W.
Physalis hederaefolia A. Gray. H; W.
Physalis mollis Nutt. var. *cinerascens* (Dunal) A. Gray. H; W. College Ranch.
Solanum citrullifolium A. Br. (*S. heterodoxum* auth.) Th; W.
Solanum elaeagnifolium Cav. H; W.
Solanum jamesii Torr. G; W.
Solanum rostratum Dunal. Th; W.

Scrophulariaceae

Castilleja integra A. Gray. H; W.
Castilleja lanata A. Gray. H; SW.
Castilleja sessiliflora Pursh. H; W.
Cordylanthus wrightii A. Gray. (*Adenostegia wrightii* (A. Gray) Greene.) Th; W.
Maurandya antirrhiniflora Humb. & Bonpl. (*Antirrhinum antirrhiniflorum* (Humb. & Bonpl.) Hitchc.) Th; SW.
Maurandya wislizeni A. Gray. Th; SW.
Mimulus guttatus DC. (*M. cordatus* Greene.) Th; W.
Penstemon ambiguus Torr. H; W.
Penstemon fendleri A. Gray. H; W.
Penstemon torreyi Benth. H; W.

Orobanchaceae

Conopholis mexicana A. Gray. G; SW.
Orobanche multiflora Nutt. G; W.

Bignoniaceae

Chilopsis linearis (Cav.) Sweet. M; SW.
Tecoma stans (L.) Juss. var. *angustifolia* Rehd. (*Stenolobium incisum* Rose & Standl.) N; Tr.

Martyniaceae

Proboscidea arenaria (Engelm.) Decne. (*Martynia arenaria* Engelm.) Th; W.
Proboscidea parviflora (Wooton) Woot. & Standl. (*Martynia parviflora* Wooton) Th; W.

Acanthaceae

Carlowrightia linearifolia (Torr.) A. Gray. Ch; SW. College Ranch.
Stenandrium barbatum Torr. & Gray. H; SW.

Plantaginaceae

Plantago major L. H; I.
Plantago purshii Roem. & Schult. Th; W.

Rubiaceae

Galium asperrimum A. Gray. H; W.
Galium microphyllum A. Gray. H; SW.
Houstonia fasciculata A. Gray. N; SW.
Houstonia humifusa A. Gray. Th; SW.
Houstonia polypremoides A. Gray. Ch; SW.
Houstonia rubra Cav. H; SW.
Houstonia wrightii A. Gray. H; SW.

Caprifoliaceae

Lonicera albiflora Torr. & Gray var. *dumosa* (A. Gray) Rehd. (*L. dumosa* A. Gray.) N; W.
Symphoricarpos rotundifolius A. Gray. N; W.

Cucurbitaceae

Apodanthera undulata A. Gray. H; SW.
Cucurbita foetidissima H. B. K. H; W.
Ibervillea tenuisecta (A. Gray) Small. H; SW.

Lobeliaceae

Lobelia cardinalis L. subsp. *graminea* (Lam.) McVaugh. (*L. splendens* auth.) H; NA.

Compositae

Actinea odorata (DC.) Kuntze. Th; W.
Actinea scaposa (DC.) Kuntze var. *linearis* (Nutt.) Robinson. H; W.
Actinea vaseyi (A. Gray) Kuntze. H; MN.
Aphanostephus ramosissimus DC. Th; SW.
Aplopappus gracilis (Nutt.) A. Gray. Th; W.
Aplopappus spinulosus (Pursh) DC. var. *scabrellus* (Greene) Blake. H; W.
Artemisia albula Wooton. H; SW.
Artemisia filifolia Torr. N; W.
Artemisia carruthii Wood var. *wrightii* (A. Gray) Blake. H; W.
Aster ericoides L. H; NA.
Aster leucelene Blake. H; W.
Aster linearis (Greene) Cory. (*Machaeranthera linearis* Greene.) H; SW.
Aster tanacetifolius H. B. K. Th; W.
Baccharis emoryi A. Gray. N; W.
Baccharis glutinosa Pers. M; Tr.
Baccharis ramulosa (DC.) A. Gray. N; SW.
Baccharis wrightii A. Gray. Ch; W.
Bahia absinthifolia Benth. var. *dealbata* (A. Gray) A. Gray. (*B. dealbata* A. Gray.) H; SW.
Baileya multiradiata Harv. & Gray. H; SW.
Berlandiera lyrata Benth. H; SW.
Brickellia californica (Torr. & Gray) A. Gray. (*Coleosanthus californicus* (Torr. & Gray) Kuntze.) N; W.
Brickellia fendleri A. Gray. (*Coleosanthus fendleri* (A. Gray) Greene.) N; SW.
Brickellia laciniata A. Gray. (*Coleosanthus laciniatus* (A. Gray) Kuntze.) N; SW.
Calycoseris wrightii A. Gray. Th; SW.
Chrysactinia mexicana A. Gray. Ch; SW.
Chrysopsis fulcrata Greene. H; W.
Chrysothamnus pulchellus (A. Gray) Greene. N; W.
Chrysothamnus pulchellus var. *baileyi* (Woot. & Standl.) Blake. (*C. baileyi* Woot. & Standl.)
Chrysothamnus pulchellus var. *elatior* (Standl.) Kittell. (*C. elatior* Standl.) Wooton, Oct. 12, 1912 (U. S. Natl. Herb.), collected at Jornada Experimental Range, is the type specimen. Recorded by Wooton and Standley (1915, p. 663) and by Tidestrom and Kittell (1941, p. 394). Apparently known only from the type collection.
Chrysothamnus viscidiflorus (Hook.) Nutt. N; W.
Cirsium ochrocentrum A. Gray. H; W.
Conyza coulteri A. Gray. Th; W.
Dicranocarpus parviflorus A. Gray. Th; SW.
Dyssodia acerosa DC. Ch; SW.
Dyssodia papposa (Vent.) Hitchc. Th; W.
Erigeron bellidiastrum Nutt. Th; W.
Erigeron canadensis L. Th; NA.
Flourensia cernua DC. N; SW.
Franseria acanthicarpa (Hook.) Coville. (*Gaertneria acanthicarpa* (Hook.) Britton.) Th; W.

Gaillardia pinnatifida Torr. Th; W.
Gaillardia pulchella Foug. Th; W.
Gnaphalium chilense Spreng. Th; W.
Gutierrezia lucida Greene. Ch; W.
Gutierrezia sarothrae (Pursh) Britton & Rusby. Ch; W.
Gutierrezia sphaerocephala A. Gray. Th; SW.
Helianthus canus (Britton) Woot. & Standl. Th; SW.
Helianthus ciliaris DC. H; SW.
Helianthus petiolaris Nutt. Th. W.
Hymenopappus robustus Greene. H; SW.
Hymenothrix wislizeni A. Gray. Th; SW. College Ranch.
Iva dealbata A. Gray. Th; SW.
Kuhnia rosmarinifolia Vent. H; SW.
Malacothrix fendleri A. Gray. Th; SW.
Melampodium leucanthum Torr. & Gray. H; W.
Othake sphacelatum (Nutt.) Rydb. (*Polypteris sphacelata* (Nutt.) Trel.) Th; W.
Parthenium incanum H. B. K. N; SW.
Parthenium lyratum A. Gray. H; SW.
Pectis angustifolia Torr. Th; W.
Pectis filipes Harv. & Gray. Th; SW. College Ranch.
Pectis papposa Harv. & Gray. Th; SW. College Ranch.
Pectis prostrata Cav. Th; Tr.
Perezia nana A. Gray. H; SW.
Perezia wrightii A. Gray. H; SW.
Peritylе coronopifolia A. Gray. H; SW.
Pinaropappus parvus Blake. H; SW.
Porophyllum scoparium A. Gray. Ch; SW.
Psilostrophe tagetinae (Nutt.) Greene. H; W.
Pyrrhopappus multicaulis DC. (*Sitilias multicaulis* (DC) Greene.) H; SW.
Sanvitalia aberti A. Gray. Th; SW.
Sartwellia mexicana A. Gray. Th; SW.
Selloa glutinosa Spreng. Ch; SW.
Senecio longilobus Benth. Ch; W.
Senecio riddellii Torr. & Gray. H; W.
Sonchus asper (L.) Hill. Th; I.
Stephanomeria pauciflora (Torr.) A. Nels. (*Ptiloria pauciflora* (Torr.) Raf.) H; W.
Tetradymia filifolia Greene. N; NM.
Thelesperma longipes A. Gray. H; SW.
Thelesperma megapotamicum (Spreng.) Kuntze. (*T. gracile* (Torr.) A. Gray.) H; W.
Townsendia exscapa (Richards.) Porter. H; W.
Townsendia strigosa Nutt. H; W.
Trixis californica Kellogg. N; SW. College Ranch.
Verbesina encelioides (Cav.) Benth. & Hook. var. *exauriculata* Robins. & Greenm. Th; W.
Viguiera dentata (Cav.) Spreng. H; SW.
Viguiera longifolia (Robins. & Greenm.) Blake. T; SW.
Viguiera stenoloba Blake. N; SW.
Xanthium saccharatum Wallr. Th; NA.
Zexmenia brevifolia A. Gray. N; SW.
Zinnia grandiflora Nutt. Ch; W.
Zinnia pumila A. Gray. Ch; SW.

Summary

Jornada Experimental Range is an area of 302 square miles in Dona Ana County, southern New Mexico. Most of it is in the plain of Jornada del Muerto, 4,000 to 4,600 feet above sea level, with semidesert (Lower Sororan) grass and shrub vegetation; part is on the San Andres Mountains and foothills

that rise into the woodland (Upper Sonoran) zone to a maximum elevation of 8,000 feet.

A collection of specimens of 528 species of ferns and seed plants representing 301 genera and 82 families, together with a few lower plants, was made here by the Forest Service from 1915 to 1939. A list of the species is included. The families having greatest representation, with the numbers of species in each, are: Compositae, 87; Gramineae, 80; Leguminosae, 33; Cactaceae, 16; Cruciferae, 15; and Euphorbiaceae, 15. A few are State records and extensions of known range.

The flora is western and more distinctly southwestern in distribution. More than two-fifths of the species occur from western Texas to southern Arizona and northern Mexico and more than two-fifths additional range widely in the western half of the United States.

When the species were classified on the basis of Raunkiaer's life forms, hemicryptophytes and therophytes showed the greatest excesses in percentage over Raunkiaer's normal spectrum, and the percentage of phanerophytes was far below that standard. Approximately half the species are perennial herbs, one-fourth annual herbs, and one-fourth woody plants, mainly semidesert shrubs. Only 13 species here have the size and habit of trees. Most of the plants have unusually small leaves.

A statistical analysis of the vegetation is presented, based upon data compiled from range surveys and listing the species that make up nearly all the vegetation. Only about one-third of the vegetation has high value and the rest is of low forage value or none. The native vegetation is valuable chiefly as forage for livestock, which in this locality are mainly cattle grazed yearlong.

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FOREST SERVICE,
UNITED STATES DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

New Species and Transfers in Myxophyceae

Francis Drouet

Specimens listed here are to be found in herbaria designated by the following abbreviations: C, Herbarium of the University of California; D, Herbarium of F. Drouet; F, Farlow Herbarium of Harvard University; FM, Cryptogamic Herbarium, Field Museum of Natural History. Where their location has not thus been noted, it is to be understood that they are on file in Field Museum.

Entophysalis rivularis (Kütz.), comb. nov.

Hydrococcus rivularis Kütz. Linnaea **8**:380. 1833. *Oncobyrsa rivularis* Menegh. Mem. R. Accad. Torino 2. ser., **5**:96. 1848. *Hydrococcus Cesatii* Rabenh. Alg. Sachs. 65 & 66: 922. 1860. *Oncobyrsa Cesatiana* Rabenh. Fl. Eur. Alg. **2**:68. 1865.

The structure of the plants which pass in the literature under the names cited as synonyms above proves to be so very similar to that of *Entophysalis granulosa* Kütz. (*Placoma vesiculosa* Schousb.) that I find it imperative to propose this transfer.[1] I have not had the opportunity to see Kützing's original specimens of *Hydrococcus rivularis* from between Schleussingen and Sohl, Thüringen; I follow here the interpretation of the type by Edouard Bornet and by Anton Hansgirg, as indicated by the specimens which they determined.

Specimens seen: BOHEMIA: in aqueducto ligneo fontis in silva Hercynica ad Deffernik prope Eisenstein, *A. Hansgirg*, Aug. 1887 (as *Oncobyrsa rivularis*, Wittr. & Nordst. Alg. exs. 999: C, FM). ITALY: ad Fontinalem antipyreticam in rivulis all'Oropa Bugellens., Piedmont, *Cesati*, Aug. 1859 (isotype of *Hydrococcus Cesatii* and *Oncobyrsa Cesatiana*, Rabenh. Alg. Sachs. 922: C, FM; Erb. Crittogam. Ital. 456: C). FRANCE: Vosges, *ex herb. Lenormand* (D). NEW HAMPSHIRE: on hepatic, Chocorua, *W. G. Farlow*, 1906 (F); on *Hypnum Lescurii*, Bowls and Pitchers, Shelburne, *Farlow*, Oct. 1899 (F, FM); on *Hydrothyria venosa*, Ingalls brook, Shelburne, *E. Faxon*, Sept. 1886 (D, F). MASSACHUSETTS: on Lemanea, Waverly, *W. H. Weston, jr.*, June 1923 (FM). PENNSYLVANIA: on Lemanea, Wissahickon creek, Philadelphia, 1854 (F); Derry church, Dauphin county, *F. Wolle*, Oct. 1887 (D, FM). MINNESOTA: on *Lemanea torulosa*, Lester river, Duluth, *E. Butler*, Aug. 1902 (F, FM). MISSOURI: on mosses and rocks, Gravois spring, Gravois Mills, Morgan county, *Drouet 682, 882, 1234*, Sept. 1930, May 1931, Aug. 1934 (D). ALASKA: on mosses in a brook near Iliuliuk, Unalaska island, *W. A. Setchell & A. A. Lawson 5036*, June—Aug. 1899 (C, FM).

1 It would seem especially desirable to abandon separate generic status for *E. rivularis* since a portion of the type collection of *Oncobyrsa fluviatilis* Ag. Flora 629 (1827), type species of *Oncobyrsa* Ag. *loc. cit.*, found in the Farlow Herbarium, proves to contain only Chlorophyceae; this fact has been pointed out by Kützing, Trevisan, Forti, and others. Moreover, the publication of *Hydrococcus* Kütz. Linnaea **8**: 380 (1833) was made during the same year (or if I interpret Trevisan Sagg. Monogr. Alg. Coccot. 73 [1848] correctly, at a later date than this) as *Hydrococcus* Link Handb. **3**:268 (1833).