Presettlement vegetation and vegetational change in three valleys in central Utah

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PRESETTLEMENT VEGETATION AND
VEGETATIONAL CHANGE
IN THREE VALLEYS IN CENTRAL UTAH

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Fig. 1.—Map of Utah illustrating the general locations of the valleys and towns discussed in the text.
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ABSTRACT

Historical information, survey records, and relict vegetation were used as sources of data for determining the nature of the presettlement vegetation of Pavant, Round, and Juab Valleys in central Utah. The foothills were covered with bunch grasses (principally *Agropyron spicatum* and *Poa secunda*), scattered junipers (*Juniperus utahensis*), and sagebrush (*Artemisia tridentata*). Western wheatgrass (*Agropyron smithii*) was common on level areas within the foothills. Below the foothill region on the more gentle slopes and benchlands there was a broad belt dominated by bunch grasses. The grassy area intergraded into a zone dominated by northern desert shrubs, particularly sagebrush. Grasses were conspicuous also in the northern desert shrub zone. In the valley bottoms, wet meadows and salt desert shrub communities occurred.

Significant changes in the presettlement vegetation had occurred by 1900. In general, there was a transition from a predominance of perennial grasses to one of sagebrush throughout the foothills and benchlands, and grasses became less abundant in the shrub communities. After 1870 juniper increased in density and invaded areas that were formerly dominated by grasses. These changes accompanied the use of these areas as range lands for livestock. In this century several exotic species have become important components of the vegetation.

The rates of migration since 1870 of two groups of unstable sand dunes in Pavant Valley were determined to be 53.5 and 60.9 feet per year.
PRESETTLEMENT VEGETATION AND VEGETATIONAL CHANGE IN THREE VALLEYS IN CENTRAL UTAH

INTRODUCTION

Marked changes have occurred in the native vegetation in Utah valleys since settlement by the white man. Various aspects of these changes have been described by Utah biologists: Cottam 1926, 1929, 1945, 1947, 1961a, 1961b; Pickford 1932; Wakefield 1933, 1936; Bailey, Forsling and Becraft 1934; Cottam and Stewart 1940; Stewart, Cottam and Hutchings 1940; Tanner 1940; Stewart 1941; Stoddart 1941, 1945; Cottam and Evans 1945; Christensen 1950, 1962, 1963a, 1963b; Christensen and Welsh 1963; Mason 1963. In general these studies show that the vegetational changes have been particularly impressive in those areas of the foothills and valleys originally dominated by grass. Considerable change has also occurred in the pinyon-juniper woodland and mountain brush communities of the foothills and lower mountain slopes. Similar vegetational changes are documented for the valleys considered in this report.

In this paper a general description of the presettlement vegetation is given for three valleys in central Utah: Pavant, Round, and Juab Valleys. In addition, an outline of the gross changes of the vegetation of these valleys since settlement is given. The vegetation of the mountains surrounding the valleys is excluded for the most part from this discussion, the emphasis being placed on the vegetation of the foothills, benchlands, and valley floors.

Historical publications, pioneer journals, diaries of explorers, previous ecological studies, and survey records were searched for information. In addition, residents were interviewed and relict stands of vegetation were studied.

Pavant and Round Valleys are in the eastern part of Millard County, and Juab Valley is in the eastern part of Juab County. The towns of Kanosh, Meadow, Fillmore, and Holden are in Pavant Valley; Scipio is in Round Valley; and Levan, Nephi, and Mona are in Juab Valley. The Oak City area adjacent to Pavant Valley is also considered in this paper (Fig. 1).

Pavant Valley is bounded on the south and east by the Pavant Mountains, on the north by the Canyon Mountains, and on the west by the Black Rock and Sevier Deserts. Round Valley is bounded on the west by the Canyon Mountains, on the south by the Pavant Mountains, and on the east by the Valley Mountains. To the north there is a pass into Juab Valley. Juab Valley is bounded on the southwest by the Canyon Mountains, on the west by the West Hills and Long Ridge, on the east by the Wasatch Mountains and the San Pitch Mountains and on the south by the Valley Mountains. To the north there is a pass to Utah Valley.

PRESETTLEMENT VEGETATION

RECORDS AND JOURNALS OF EXPLORERS AND EARLY RESIDENTS

Pavant and Round Valleys. Descriptions of the vegetation of these valleys were made in varying degrees of detail by several early explorers and pioneers. The first of the explorers was Escalante, who travelled through central Utah in the fall of 1776 (Auerbach 1943). His party camped in Round Valley on September 30. He described Round Valley as a "plain with abundant pasture but without water" (p. 73). Leaving Round Valley, Escalante travelled west and south, essentially missing Pavant Valley. However, he described the xeric vegetation of the saline areas west of Pavant Valley.

In May of 1844 John C. Fremont and party passed through the Pavant Valley (Nevins 1956, p. 417). His path led him close to the Pavant Mountains. He wrote:

We had now entered a region of great pastoral promise, abounding with fine streams; the rich bunch grass—soil that would produce wheat and indigenous flax—growing as if it had been sown. Consistent with the general character of its bordering mountains, this fertility of soil and vegetation does not extend far into the Great Basin.
Local pioneers and California-bound emigrants made notes of their impressions of the area. Sheldon Young, travelling south with gold seekers bound for California, noted "some pleasant valleys" and "plenty of hares" after crossing the Sevier River on October 12, 1849 (Hafen and Hafen 1954, p. 64). In Pavant Valley he observed:

... good roads, plenty of grass, wood and water. There is a quantity of wild flax. . . . Went 12 miles [Kanosh area] . . . . Beautiful roads and plenty of grass and water. . . . Eight miles from camp . . . plenty of grass. This is the most pleasant valley that we have passed through.

Young observed "Grass very good" at the southern part of the Pavant Valley.

Addison Pratt, travelling with the same company, made comments about Round and Pavant Valleys (Hafen and Hafen 1954, pp. 72-73):

... The hares are so plentiful here [Seipio] that the ground would well compare with a sheep pasture . . . . As the valley was covered with grass except the farther side, there was plenty of sage brush and when we entered the hares commenced in every direction . . . . We then had a mountain to ascend and descend. We camped on Cedar Creek [Holden]. Here was plenty of dry cedar wood.

[Near Fillmore] the hunters surrounded a large sagebrush . . . . The bottoms are covered with dwarf cedars. 15th Travelled 12 miles and camped on Willow Flats [near Kanosh] here are low prairies covered with immense quantities of grass. Hares continue to be plentiful. 16th. Passed over some beautiful rich bottoms covered with green grass which is uncommon at this season of the year.

William Farrer also made observations on the vegetation of Round and Pavant Valleys in October of 1849 (Hafen and Hafen 1954, pp. 195-196):

... we came into a large wide Canyon feed growing very luxuriantly, we came into an extensive Valley little water sage Brush plentiful feed pretty good . . . .

... crossed another wider creek a little timber growing on it. traveled thru a good deal of Sage.

... we passed through a fine path of Ryegrass in this valley . . . struck a creek with some little timber in it but very little grass. . . . Camped on the bluff . . . feed rather thin but a good kind of grass called mountain bunch grass.

Joseph P. Hamelin, Jr., made an overland trip to California in 1849-50, passing through Juab, Round and Pavant Valleys (Hafen and Hafen 1961, p. 82). On November 14, 1849, he recorded the following:

Leaving the Sevier [River] we ascended by a gradual slope of nearly 3 miles to the summit of a cedar covered mountain. Keeping along the ridge for a short distance we descended to and crossed a beautiful valley seven miles in width.

[He] Travelled down the valley of Sevier Lake [and found the] Road good, though mixed with wild sage, any quantity of fine grass. The men killed any quantity of sage hens & large hare.

In January of 1850 Parley P. Pratt entered Pavant Valley from the south on his return to Salt Lake City from southern Utah (Richan 1957). He described the Meadow area of Pavant Valley as "a low well-watered valley of meadows and soil." He camped at "Prairie Creek" (now called Meadow Creek) near the town of Meadow. When Pratt camped on Chalk Creek in the vicinity of Fillmore there were 18 inches of snow on the ground, and he recorded "nothing for the cattle to eat, except a little browsing among the willows." He "found plenty of cottonwood fuel" on Chalk Creek. Pratt further described the area as follows:

It was in a country of shrub cedars which would afford some shelter for the animals, and richly clothed in bunch grass, and some portions of the hill sides where the snow had blown off being nearly bare, the cattle could live.

The following winter (late December 1850 and early January 1851), George A. Smith and company passed through this region going south (Smith 1956). After leaving the Sevier River on December 27 he stated:

... Camped in a beautiful valley [Round Valley]. Snow 12 inches deep. Good feed, bunch grass, plenty sage brush and cedar within half a mile, but no water.

Six miles north of Holden the company "camped in a little basin near some cedars" and the next day "passed through several deep ravines and scattering cedars" while travelling to Holden. "Good water and plenty of bunch grass" was observed along the way.

Between Holden and Fillmore the company

... passed through a pleasant country dotted with cedar, some excellent spots of land covered with rich bunch grass. Arrived at Camp Creek [Chalk Creek] at 4 p.m. Some few cottonwoods scattered along its banks, I sent men to see if there was any timber suitable for bridging the creek. But they reported unfavorably the wood being too small for that purpose . . . .

Our cattle fared sumptuously on bunch grass.

[The company] moved on to Meadow Creek, distance 11 miles. The road was level, passing through a plain of sage . . . Here we are on a rich strip of land and abundance of
grass... Brother Shirts went down Meadow Creek for about eight miles hunting deer. He reported some cottonwood on the creek stream rapid, and as large as that of Camp Creek [Chalk Creek]. It sinks at this place and forms a large meadow, excellent soil of a dark reddish color.

Br. Peter Shirts went up the Creek hunting deer. Found the land excellent all the way except about ½ mile of sage brush. Went up the mountain... about 3 miles. He could see the open valley as far as the eye could extend, also a lake, which he thinks is 70 miles long and many bodies of cedars on the plains.

Smith's company camped near Kanosh on Corn Creek. Smith reported:

... This country is capable of sustaining a very extensive settlement. About 2 miles from Corn Creek we passed a fine running stream, with rushes on each side. Br. Shirts went up Corn Creek 6 miles and reported abundance of excellent land; also iron ore and other mineral rocks, abundance of cedar and oak and some maple.

Leaving Kanosh the company went into the hills at the south end of Pavant Valley through a cedar grove and camped at the mouth of a canyon. 'There cattle feasted on bunch grass and frost. There was no water.'

In March and April, 1851, Parley P. Pratt made his second trip through the area (Stanley and Camp 1935, pp. 62-63). He described the early springtime:

[From Sevier River to Scipio he] Traveled 13 m.s. through a pass where the hills were very rich in grass and fuel... Thence through a valley [near Scipio] rich in grass and soil. Beautiful and extensive and abundantly supplied with fuel on its borders... 

... encamped at a beautiful spring brook [Holden] among grassy hills interspersed with cedar like an orchard. Our road today led through a pass in the mountains by a gradual ascent of 3 m.s., and then down very gradually for 10 miles. Among hills, plains and little vales, more rich in bunch grass and cedar fuel and more varied and beautiful than any other country I ever beheld in the State or in these mountain countries. Every high hill, every dell, every vale or knoll seemed thickly coated with a living green of rich grass and set about with cedars from 12 to 25 feet high like an old orchard.

Wednesday, April 2d. On the east the high mountain chain [Pavant Range] appeared at several m.s. dis. snowy and timbered and pierced with gorges accessible for roads to be made to the timber... To our South, West and North west the view is Almost Boundless. Consisting of a vast valley [the Sevier Desert] interspersed with fertile meadows, desert spots, known by their darker hew, lakes, rivulets distinguished by the yellow meadow grasses and red willow streaks and hills here and there, dotted with cedars and the whole bounded in the vast dim distance by dark mountains, not very high... There are resources for farming, stock raising, fuel, etc., in site of our present encampment probably more than sufficient to sustain the present population of Rhode Island...

... we at length left the valley and journeyed 26 m.s. over a hilly country well supplied with cedar and scrub pines, for fuel and bunch grass for feed...

Later in the year, October 1851, a party accompanied by Brigham Young set out to locate the site of Pavant Valley's first settlement (Cooley, 1955). The following report was prepared and sent to the territorial legislature as a result of this exploration. Orson Pratt, Albert Carring-ton, Jesse W. Fox, and William C. Staines signed the report. The site chosen for the first settlement later became Fillmore, the first territorial capital.

Pavant is a very large, fertile valley, reaching northwesterly across the Sevier [Desert], & South plasterly to the Cañon of Corn Creek [near Kanosh]... This large area presents a rich & picturesquely diversified landscape; the table lands, their rounded points being thickly studded with cedar, & the beauty of the valley proper increased by low, short ranges of hills & isolated mounds, with the dark shade of their cedars ever richly contrasting with the lighter green of the summer, or the paler hue of the Autumn grass that waves so abundantly & luxuriantly over the remaining level, and very fertile portions...

On April 30, 1853, Anson Call, the leader at the Fillmore settlement, published a letter in the Desert News dated March 27, 1853 (Call 1956, p. 98). In it he stated:

... Our stock have wintered well, universally, many of our cattle were driven through from the states last season and have improved in flesh on the range and I do not know of the first head being lost. We think our valley is not surpassed for range in these mountains.

In October of 1853 a party of explorers headed by Captain J. W. Gunnison passed through the area. A report of the expedition was prepared by Beckwith (1855). While in Round Valley, Beckwith wrote (p. 71):

... Sage grows luxuriantly... The range is thinly covered with grass quite down to the sage plains, and is dotted with a growth of small cedar and oak, and is a fine pastoral district.

The group camped at Holden (pp. 71-72) and then travelled northwest toward the Sevier River. The following day they
reached the Sevier river at a point well supplied with dry grass, which our animals required after a march of 25.43 miles, on which we were engaged for twenty-two hours, over large, rank sage-brushes and a friable soil, occasionally sandy. Indeed, this whole valley, some fifty or sixty miles in diameter, is one vast artemisia plain surrounded by grassy mountains.

Captain Gunnison and part of his company were killed by Indians. The remainder of the company later returned to Holden by a different route. From a point north of where they first encountered the Sevier River, they travelled 

... 7.14 miles in a southeast course, beyond a border of small cedars a mile wide, among which the sand was so drifted that it was only by innumerable windings and contractions of teams and wagons, that we at last escaped from it and reached the plain of grass a mile or two wide, which lies on the gradual slope of the mountain [Oak City area].

In 1855 Linforth made descriptions of parts of Utah based on a variety of sources, many of which were not given. He described Round Valley (p. 99) as being "well grassed" and with "well wooded" mountain slopes. Concerning Pavant Valley, Linforth wrote (p. 99):

... Its forests of cedar extend into the plain, and it has all the varieties of soil and landscape, from the lofty mountain and rich valley, to the level plain and bleak desert. The Canyon of Chalk Creek ... contained an extensive supply of red and white pine timber ... the hills and plains are covered with bunch grass.

The Frenchman, Jules Remy, and his party passed through the area in late October of 1855 (Remy 1861, p. 340). Remy described Round Valley as "a desert and barren plain, where our cattle had nothing to eat but the bread and corn we gave them." However, the northern part of Pavant Valley was described as being "a valley of much less dreary aspect than those through which we had been for some time passing." Remy noted that in the mountain brush zone, "Oaks, wild rose-trees, Cowania, Juniperus, covered the edges" of Pavant Valley, and observed "numbers of hares and grouse were to be seen skinning away from us under these stunted trees." It is evident from the following statement that the treeless areas of the valley benchlands and bottoms were considered "barren" of vegetation by Remy:

... On leaving the valley we found ourselves upon an open piece of ground, from which we could see on all sides well wooded mountains contrasting strongly with the bare-

ness we had of late been used to. The sight before us was certainly not worthy of being sung by a poet, but for Utah it was a landscape extraordinarily picturesque and even fertile. ...

Remy listed scientific names for woody species of the region, but his descriptions of the vegetation in general are not as detailed as many of the other descriptions made of the area. This is particularly true of the treeless parts of the valleys.

In late December, 1866, William H. Jackson, the frontier photographer, passed through the region (Hafen and Hafen 1959, pp. 104-105). He spoke of going through Round Valley and into Pavant Valley:

... all the way up over the Divide down into Round Valley ... Poor chance for water & woods. Used sage. Plenty of cedar in the hills we passed. Pulled up over high rolling hills pretty well covered with cedar to Cedar Creek [Holden], some 10 miles. Any quantity of wood. ...

On Christmas Eve, 1867, Clamptt (1890) travelled from the Sevier River to Round Valley. He described the vegetation of the area (p. 351):

After crossing the Sevier our road led to the uplands, and our course was quite hilly. In these higher altitudes snow had mingled with the rain, and the ground was covered with quite a depth. This was a grazing country, and herds of fat and lean cattle were seen at intervals. I now beheld the novel sight, new to me at that time, of the cattle feeding on the short, sweet and dried buffalo grass, with which the hills abounded, all of which was beneath snow. The cattle would plant themselves firmly on their hindquarters and with their fore legs paw the ground swiftly, causing the snow to fly in a silvery spray and rapidly uncover the ground, exposing the grass upon which they would feed. All winter long they sustain themselves upon this dried grass, which is truly nutritious. Cattle that have been worked thin and poor from hard continuous labor through the spring summer and fall months are, at the close of the season, turned out to graze all winter upon the grass, and in the spring are returned to their work fat and sleek and strong.

Powell (1879) described the area drained by the waters which flow into the Sevier Lake (p. 106):

In the valleys among the high plateaus, and along their western border, the grasses are good, and many pasture farms may be selected. ... The summits of the plateaus will afford an abundant summer pasturage.

Westward among the Basin Ranges ... there is little timber of value, but the lower
mountains and foot hills have cedar and píion pines…. The cedar and píion hills bear scant grasses. The valleys are sometimes covered with sage, sometimes with grease wood, sometimes quite naked.

George C. Yount travelled through Utah territory in 1830 and spoke of passing through some pleasant valleys in the central part of the state (Camp 1923). It seems probable, however, that he never entered Pávant Valley but travelled south along the Sevier River Valley, the valley east of the Pávant Range.

Juab Valley. On September 27, Escalante (Auerbach 1943, p. 71) described Juab Valley as

... fourteen leagues from north to south, and about five from east to west. The whole of it is flat; it has very abundant springs and pastures.

The southern part of Juab Valley was described as "a valley of good pasturage" by Escalante, and he also noted the "small glades and barren hills" of the vicinity. The northern desert shrub type of the area near the southern end of Juab Valley was observed as "a plain covered by chamiso thickets, very annoying to the animals" by Escalante (Auerbach 1943, pp. 72, 73).

Based on a study of early historical information Worthington (1958, p. 3) described the presettlement condition of Juab Valley in the following way:

Before the coming of permanent settlers Juab Valley presented a very beautiful appearance. Wherever water was abundant, and this included most of the valley with the exception of what is now Levan Ridge, there was beautiful grass waist high. The hills were covered with green vegetation and cedar trees. Higher up on the mountains were maple, pine, and quaking aspen. Toward the west mountains in the valley was, of course, much sage and rabbit brush.

In 1844, Fremont described Juab Valley as "a handsome mountain valley covered with fine grass" (Nevins 1956, p. 418), and Sheldon Young observed "Plenty of grass" in Juab Valley in 1849 (Hafen and Hafen 1954, p. 63).

William Farrer journeyed through Juab Valley in October, 1849, entering the valley from the north. He mentioned the "prairie" and "very little timber" in the valley. He also made the observation that "the hills were covered with scrub Cedar" (Hafen and Hafen 1954, pp. 194-195).

Martha Spence Heywood described the streamside vegetation of Salt Creek near Nephi in 1851 as "beautifully adorned with trees ac-

cording to my heart's desire" (Worthington 1958, p. 16).

In March of 1851 Parley P. Pratt described the Mona area in the northern part of the valley as "rich in grass" and noted that "the hills, valleys, and table lands [of Juab Valley] afford some cedar fuel, and vast resources for pasture." On March 27, 1851, Pratt travelled for 15 miles south of Nephi "over a smooth swell of land without water but bordered by beautiful hills of bunch grass and cedar fuel, and encamped on a spring run, which gives rise to a swall, or swampy meadow." Pratt was obviously travelling along Levan Ridge between Nephi and Levan. He camped on the banks of the Sevier River on March 28 and recorded: "This day we passed through about 10 m. s. of waste country, with some grassy spots and Cedar groves." After crossing the Sevier River, he wrote: "The hills afford some scattered bunch grass which is very good" (Stanley and Camp 1935, pp. 61-62).

Addison Pratt camped on the Sevier River on October 9 and 10, 1849, writing about the country as "a barren waste covered with sage brush save the river bottoms which are covered with grass, on the hills were a few dwarfish cedars" (Hafen and Hafen 1954, p. 71).

After travelling through central and southern Utah in 1849, Granger (Hafen 1959, p. 14) described the valleys along what is essentially the modern Highway 91 in the following manner:

From the valley of the Great Salt Lake to the Santa Clara [in southwestern Utah], is a succession of little vallies abounding with rich grasses; along the line of the great Wasatch range, which takes a southerly course.

Linforth (1855, p. 98) described Juab Valley as "a long, moderately wide, and well-grassed valley."

In the fall of 1855, Remy (1861, pp. 336-337) "journeyed across a desert plain, part of a large valley enclosed between barren hills [Juab Valley]. On our well-worn track was to be seen at intervals a species of mallow with pretty flowers of a pale red. In the plain nothing was to be found but Artemisia, Fremontia,1 and Greasewood." Remy camped on the banks of Chicken Creek in the southern part of Juab Valley in a "dried-up pasture," stating that "It was impossible, though we went some distance for it, to find even the least brushwood to make a fire with." In the creek "specimens of Chara, Polygonum, and Hippurus" were observed.

1Fremontia is an old name for greasewood, Sarcobatus vermiculatus. Remy uses "Grease-wood" in reference to Opuntia cactus (p 503).
The botanist Tracy (1888, p. 26) described the vegetation near Juab, Utah, in August 1857:

On the mountains, 8 miles east, _Agropyrum [sic] divergens_ is one of the prevailing species. The range here is said to be much more barren than it was five years ago, prior to the introduction of sheep. West of the town there are barren, treeless hills, with scanty growth of the above-mentioned grass, together with _Orzopsis cespitata._ White sage ( _Atriplex_ ) is the main reliance for winter range.

... Considerable Redtop is found on the lower lands and _Agropyrum divergens_ and _Erodium cicutarium_ are found to some extent. [Redtop and _Erodium cicutarium_ are introduced species.]

**Recollectons of Early Residents**

In addition to the on-the-spot observations recorded in journals, reports, and diaries, information was obtained through personal interviews and from recorded recollections of old-time residents. The following is an unpublished statement which was given to James Jacobs, Forest Service, in 1947 by Hyrum Bevan Johnson, an early pioneer of Holden:

My parents, Mr. and Mrs. Richard Johnson, were sent down here to Holden (then Cedar Springs) in February, 1856, and started building the rock fort (Buttermilk). I was born in the corner of the fort where my home now stands on June 5, 1856. I have lived on that same spot all my life.

I have been around livestock all my life, and worked with them most of it. I remember how the range looked. When I was a boy the flats were covered with bluegrass in a good sod. There was a little sagebrush in them, but scarcely enough to stake a horse to. (We would often stake a horse which we would use for a wrangle horse.) The foothills were covered with bunchgrass. It was not what we called wheatgrass, but was shorter and much finer. There was also a lot of sand grass _[Orzopsis]._ The foothill bunchgrass grew about two feet high in places. When I rode my pony through it, it was tall enough to tickle my bare feet. There was a little sagebrush, but not much.

They used to cut hay on the meadows at Clear Lake 20 miles west of Holden, seven miles west of Holden, and over at Seipio Lake. Some bluegrass was cut on flats near Holden, but this did not yield enough. The hay was cut with scythes. There was only a very little hay put up for many years as the grass was so good that the stock could get all the feed they needed.

When I was about 12-15 years old (1868-1871) the church sent about 1000 head of cattle and about 75 horses from the islands of Great Salt Lake and grazed them on this good grass. ... The grass was so good that the cattle were fat all winter. We could get a beef any time. As the grass was grazed off and killed out, sagebrush came in.

There were many sheep here in the early days, which ranged here year long. My brother and I used to run the co-op herd on shares. About 1880 there were 20,000 sheep here. ... Many sheep would come from Sanpete and some as far as Salt Lake ... There were 1500 to 2000 cattle here then. The cattle did not run upon the high mountains—that was all used by sheep. There were many bands of outside sheep, but not many of those were on the mountains. That was used by other local sheep.

William Hardin Ashby came to live in Holden in 1872. Previous to this he had spent several years of his life working for the Mormon Church as a cowboy. In reward for his services Brigham Young gave him a choice of receiving the church farm in Cache Valley in northern Utah or the Church Spring north of Holden. Hardin's son Robert related the following (Ashby 1944, p. 27):

Father was familiar with the Church Farm in Cache Valley, and he went to Holden to look things over there. He found the valley around Holden a waving field of blue grass. Some of the people were moving it for hay. To a cowboy this spelled paradise—so the choice was Holden. Years later when Millard was found to be so dry and the grass failed to wave like harvest grain, Father always said he made a poor choice.

He was allowed besides the Church Spring property, a forty-acre piece of meadow hay land, 8 miles west of Holden (which during the next few years was buried by drifting sand hills) ... .

Robert L. Ashby (1955-56, pp. 11-12) described his impression of the original vegetation near Holden in his _History of Holden, Utah:_.

The name Cedar Springs suited the place well, and but for the tragedy of Elijah Edward Holden's death in 1858, this likely would have been the permanent name of the town. There were numerous springs around the foot hills, and Cedar trees grew most everywhere. The hills and valleys were covered with grass—mostly a native close-sodding blue grass. This grass served well for feed for their animals. Some was cut and stacked for winter use. Sage brush grew throughout the region.

The meadow land seven miles west of Holden was important in the early history of Holden:

Near these sand dunes was pioneer Hay Ground. Here rainbow grass and various water grasses grew in abundance and made most beautiful meadows. Water holes filled with tiny minnows dotted the meadows. . . .

This was the valley where the Church in these early days brought vast herds of cattle.
Armina S. Nixon, an old resident, recorded the following in her history of Holden (Day and Ekins 1951, pp. 290-291):

The hills and valleys in this section were covered with grass which served as feed for their cattle, horses and oxen. It was cut and stacked in the summer and fall for winter feeding.

... All west of that [present Highway 91] was grass and sagebrush. What is now the meeting house grounds was covered with cedar trees, sage brush and grass.

Day and Ekins (1951, p. 6) record that herders were hired the “first summer to herd the stock on the wild grass seven miles west of Fillmore.”

The following conditions of the vegetation and range in 1867 were reported in the History of Oak City (Day and Ekins 1951, p. 475):

At that time the flat where the town was later built was covered with grass so thick that it waved like a field of grain. . . .

The brethren there [Desert City] have adopted a wise policy in relating to keeping stock. They have all their animals not in use herded some twenty miles northeast on a good herd ground [Oak City area]. . . .

Analysis of 1869-70 Survey Data

Government surveys (Bureau of Land Management) were made in portions of this area in 1869 and 1870. The field records of ten townships located in the Holden-Fillmore area of Pavan Valley were studied and were found to contain some interesting vegetational information. The description of almost every section line ended with a comment on the soil and the vegetation occurring along the line. Designations such as “soil second rate, rolling grassland” and “soil second rate, level, sagebrush greasewood” were used. The information from these records was copied and then transferred in color code to a map for analysis.

It is interesting to note that of the 363 section lines analyzed, 102 (28%) had grass listed as being the most conspicuous plant. Two hundred and fifty-eight (71%) had sagebrush growing either abundantly or scattered along them. Eighty-nine (25%) had greasewood. Cedar (juniper) occurred in 12 (3.3%). A small number, 10.5 (2.7%), were under cultivation. The lines surveyed where vegetation was not mentioned numbered fourteen. The surveys did not extend far into the foothills or more grassland would surely have been recorded. Almost two-thirds of the grasslands surveyed were of the wet meadow type occurring in the valley bottom.

The following is a generalized description of the distribution of the plant communities of northern Pavan Valley based on the survey data. Near the base of the Pavan Range, just below the juniper-covered foothills, a zone of grassy plains occurred. The grass was sometimes in pure stands but more often had occasional or scattered sagebrush. Farther into the valley away from the mountains there occurred a zone dominated by sagebrush. In some places sagebrush was conspicuously the leading dominant. In other places considerable grass was present even though the sagebrush was the most conspicuous species. This is concluded because in the general description of some brush-covered townships the statement is made that the area had high grazing value, even though no mention is made of grass in the section line descriptions.

Greasewood and sagebrush often occurred in the same general area. Wet meadow vegetation was located in the lowest parts of the valley.

Relict and Protected Areas

Christensen (1963a) studied 71 small foothill grass stands in the central Utah region in-

<p>| Table 1 |
| QUANTITATIVE DATA FROM A PROTECTED AREA AT MONA CEMETERY, JUAB VALLEY, UTAH |</p>
<table>
<thead>
<tr>
<th>Species*</th>
<th>Percent Composition</th>
<th>Percent Frequency</th>
<th>Density Per Quadrat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agropyron spicatum (bluebunch wheatgrass)</td>
<td>87.3</td>
<td>100</td>
<td>7.0</td>
</tr>
<tr>
<td>Poa secunda (Sandberg bluegrass)</td>
<td>5.5</td>
<td>92</td>
<td>7.4</td>
</tr>
<tr>
<td>Sphaeralcea coccinea (globe mallow)</td>
<td>1.8</td>
<td>52</td>
<td>2.9</td>
</tr>
<tr>
<td>Phlox longifolia (phlox)</td>
<td>1.6</td>
<td>36</td>
<td>6.8</td>
</tr>
<tr>
<td>Artemisia tridentata (sagebrush)</td>
<td>1.0</td>
<td>2</td>
<td>0.02</td>
</tr>
<tr>
<td>Gutierrezia sarothrae (snakeweed)</td>
<td>0.7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chrysothamnus viscidiflorus (rabbitbrush)</td>
<td>0.6</td>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td>Bromus tectorum (cheatgrass)</td>
<td>0.3</td>
<td>8</td>
<td>0.1</td>
</tr>
<tr>
<td>Other species</td>
<td>1.2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Foliage cover (all species)</td>
<td>44.6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Density per quadr. (all species)</td>
<td>—</td>
<td>—</td>
<td>26.3</td>
</tr>
</tbody>
</table>

including the area considered in this paper) that were judged to be undisturbed essentially. Perennial grasses made up 73.8 percent of the vegetative cover of these communities. Sagebrush and other woody species accounted for 20.5 percent of the cover, and broadleaf herbaceous plants made up 5.7 percent. Pickford (1932) studied nine plots in the foothills from southern Utah Valley to Beaver City that had been protected for several years. Composition data for the 9 plots were presented and Pickford stated:

Perennial grasses, principally blue bunch wheat, beardless bunch wheat (Agropyron smithii), Sandberg's blue, and rice grass (Oryzopsis hymenoides), with a density of 0.19 occupy 56 percent of the total plant cover. Downy brome and good perennial weeds are relatively unimportant representing only 4 percent of the plant cover respectively. Poor perennial and annual weeds, principally globe mallow, phlox (Phlox longifolia), sunflower, milk vetch (Astragalus sp.) and wild lettuce; sagebrush, and shrubs other than sagebrush, principally rabbitbrush (Chrysothamnus sp.), gambel oak (Quercus gambelii), bitterbrush and serviceberry (Amelanchier alnifolia), occupy 13, 12, and 11 percent of the plant cover, respectively.

The eastern part of Mona Cemetery has been protected to a considerable degree from disturbance, although some woody plants may have been removed from the stand. In 1956 this relict stand was studied by means of line intercept and quadrat methods. The composition data are presented in Table 1.

**DISCUSSION — ORIGINAL VEGETATION**

A generalized description of the presettlement vegetation of Pavant, Round, and Juab Valleys can be made based on the historical descriptions, recollections of early residents, land surveys, and observations of relict undisturbed plant communities presented.

Although there is variation among the various descriptions made by the explorers and early residents of Pavant, Round, and Juab Valleys, one is impressed more by the similarities than by the variations. There are some exceptions such as the observations of Remy (1861), who viewed the Utah landscape as generally barren, particularly the areas lacking trees. Variations in the descriptions by the early observers were due, in some cases, to the fact that the routes taken by the observers were in different parts of the valleys. The seasons of the year also accounted for some variation in description of the areas. It is apparent that personal factors would also account for some differences in observation.

A study of the historical sources and field observations indicates that the plant communities occurred more or less in belts along the contours of the valley slopes. It is apparent that the foothills were covered with grasses, scattered junipers (Juniperus utahensis), and sagebrush (Artemisia tridentata). The grass of this region has been called "bunchgrass" and, doubtless, it refers principally to Agropyron spicatum and Poa secunda. In level areas among the foothills western wheatgrass (Agropyron smithii) was common. This grass species (locally called "bluegrass") forms a heavy sod and is one species that was sometimes cut for hay. The former abundance of grasses in the juniper woodland of foothills of the mountain ranges in western Millard County was pointed out by Stewart, Cottam, and Hutchings (1940, p. 313), and a list of characteristic grass species of the community was presented, the most important being blue-bunch wheatgrass. Western wheatgrass was not included in the list from western Millard Co. Stewart, Cottam, and Hutchings observed (p. 312) that species of sagebrush "are the principal understory shrubs, with big sagebrush occupying the alluvial deeper soils and black sagebrush dominating shallow rocky ones." Seven other shrubs were listed as frequently encountered species.

Below the foothill region and on the more gentle slopes leading into the valley bottoms there were extensive areas of grass. This grassy zone appears to have varied from one to several miles in width. Sagebrush was common and in some places probably was the most conspicuous species present. The grass community growing in this region was composed of the same species as those on the foothills. This grassy area graded into a zone where sagebrush was definitely the most conspicuous plant. It should be emphasized that "sage" and "sagebrush" as used by early explorers and pioneers does not always mean Artemisia tridentata. It seems apparent that such plants as white sage,
*Eurotia lanata*, and shadscale, *Atriplex confertifolia*, were often lumped with the true *Artemisia* under the designation "sage" or "sagebrush."

The upper parts of this brush area must have contained considerable grass since in the old survey reports of some townships in which only sagebrush was listed, the general statement was made that the areas were excellent for grazing. Stewart, Cottam and Hutchings (1940, p. 300) have determined that in the valleys of western Millard County grasses "were originally important members of practically all" of the desert-shrub communities and that "big sagebrush and black sagebrush (black sage), with abundant grasses interspersed, dominated the foothills." This is certainly similar to the situation in valleys of eastern Millard and Juab Counties considered in this paper. Stands of white sage and bud sage, *Artemisia spinescens*, grew in this zone. An area just north of Holden is currently called "Whitebush" because of the white sage that formerly grew in the area. (In 1962 the authors could find only one white sage plant in this area.)

Lower in the valleys, below the sagebrush zone, wet meadow lands occurred. Greasewood stands, sagebrush communities, and other northern desert shrub types also occurred in the lower portions of the valleys. Sand dunes with very sparse vegetation occurred in the western part of Pavant Valley. The historical information of these communities is limited. Most of the routes of travel were through the grass and grass-sagebrush communities near the eastern parts of the valleys, and consequently little was written about northern desert shrub types.

The larger streams were apparently well wooded, at least in the vicinity of the foothills.

**VEGETATIONAL CHANGE**

Grass-Sagebrush Communities. The vegetation of the valleys has changed considerably in the last 100 years. Great change has occurred in the grassy zone at the base of the foothills. Much of this area is under cultivation today. Cultivation of these areas was begun in most of the region between 40 and 50 years ago. It is used largely for raising dry land wheat. The change from native perennial vegetation to cultivated wheat is drastic, but it is interesting to note that other significant changes occurred before cultivation began. Many of the people now living in the small town of East Millard remember the time when dry land farming increased greatly in acreage in the Pavant Valley. They remember that most of the land was plowed out of sagebrush. Men that are 70 years old remember this region as being a sagebrush zone and not one of grass. Similarly, Cardon (1913) recorded the change from grass to sagebrush from 1863 to 1903 in Juab Valley. In 1911, Meinzer described the "large and luxuriant sagebrush" on the alluvial slopes of the area (p. 24). The transition from a predominance of perennial grass and increase of sagebrush prior to cultivation is well documented. The major decline of grass and increase of sagebrush probably occurred between 1870 and 1900. In this century, several exotic species have become important components of the vegetation (Pickford 1932, Christensen 1962, 1963a, b).

In the 1870's the pasturage of Pavant Valley must have been abundant since during this time large herds of livestock were brought from as far as Salt Lake City to graze the good grass of the valley according to the recollection of Hyrum Bevan Johnson (1947). After this time references are made to the diminishing quantity of forage. Livestock census reports indicate that there was a great increase in grazing pressure during this period (Richan, 1957).

In 1887 Samuel Pitchforth writing to the *Deseret News* related that there were "hundreds of thousands of sheep roaming the hills and finding pasturage in the rich mountains" of the southern counties and that "year after year their number increases." He stated that "Juab County is a natural winter range for sheep, and within the immediate vicinity of Nephi there are 200,-000 sheep wintered" (Worthington 1958, pp. 60-61). After the arrival of the railroad in 1879, Nephi became the shipping point for wool, cattle, and sheep, the latter being driven from southern Utah ranges.

Changing range conditions in Pavant Valley were indicated by two articles appearing in the *Deseret News*, January 18, 1871, and August 11, 1875 (Richan, 1957):

**January 18.** All the sheep are taken from the settlements in the summer season on to high mountain ranges heretofore not pastured, thus leaving the grass in the vicinity of our settlements for cows and work animals.

**August 11.** The long-eared denizens of the sagebrush have taken about one half of the wheat crop of this country, they, the rabbits being unreasonably fond of the "staff of life"
and owing to the drought, all kinds of grain crops will be light. Taking the above dark outlook in connection with the fact that our cattle range has dried up and blown away, i.e., the small amount left by the imported root pullers of Texas, with a light crop of hay, and nothing to export... Our fruit crop is among the things not to be recorded as a failure as it has never been surpassed in this place.

Bracken (1940) stated that in 1851 when Juab Valley was settled the valley floor was covered with western wheatgrass, but following 1881, "the grass was so severely over-grazed that it was largely replaced by sagebrush."

Jack rabbits may have aided greatly in the deterioration of the grasslands. It seems that their population must have reached a peak during this same period (1850-81). Ashby (1955-56, p. 89) relates:

Rabbits were very thick everywhere, and there was nothing for them to eat. They gnawed the sage brush down to stumps. They came into town, into the yards of the people, and ate almost everything in sight. Cedar posts had the bark eaten off in a circle where the rabbits could reach. Trees were barked and hay stacks, where not protected, were undermined.

**Invasion by Juniper.** An invasion of juniper into the original grass and sagebrush zones has occurred. This invasion was particularly well documented in Pavan Valley. Juniper was common in Pavan Valley in the days of the early pioneers. Written records indicate an adequate supply of "cedar" fuel along the valley's eastern border. The descriptions of P. P. Pratt (Stanley and Camp 1935, Richan 1957) and Jules Remy (1861) indicate that the juniper stands must have been mostly rather open and of mature age. Although some small patches of the old junipers may have been located in lower parts of the valley, most of the junipers were restricted to the hills, but not in dense stands as they are today.

The extent of the invasion by juniper was determined by comparing the vegetation descriptions of 1870 survey lines with the vegetation currently growing along those lines which have not been cultivated. In T20S, R4W the line between sections 30 and 31 was described as being covered with grass with sagebrush. Now young junipers and oaks are very prominent along this line. Between sections 16 and 21 of T21S, R4W, sagebrush was listed as the vegetation type in the survey records. This line is now covered with juniper. General observations indicate that junipers are reproducing rapidly in both the areas of invasion and in the old stands of juniper. A similar invasion of juniper has occurred in the Pine Valley Mountains of southwestern Utah (Cottam and Stewart, 1940), in Pine Valley and Wah Wah Valley in western Utah (Stewart et al. 1940, Cottam 1947), and in the valleys of Tooele County (Cottam 1961b).

The grass cover of the foothills has been greatly reduced, and the sagebrush and juniper have become more abundant in the foothill zone.

**Sand Dune Migration.** Sand movement in the lower portions of Pavan Valley has changed and modified the local plant communities. The sand dunes west of Holden in T19S, R5W were studied to determine migration rates. Several groups of dunes are located within the township. The dunes considered in this discussion are located in sections 25, 26, and 27.

Methods of calculating the extent of movement are rough, but different measurements give results of the same magnitude. The sand in this region drifts in a northeast direction due to the prevailing winds from the southwest. Maps of the 1944 soil survey of East Millard and the vegetation and soil map constructed from the 1869-70 land survey were used to determine the rates of movement. The migration from 1957 to 1962 was observed by the authors. The survey of 1870 shows that the forward dunes of the group now in section 27 were then at the southwest corner of section 27, and the ones now in section 25 were at the southwest corner of section 25. The migration rates vary between 50 and 66 feet per year, with the long term rates being 53.5 and 60.9 feet per year (Table 2). This rate of migration is over twice as great as that reported for disturbed dunes in Pine Valley in western Utah by Stewart et al. (1940).

The invasion of tamarix (Tamarix pentandra) into the lowland areas of the valleys since 1925 is a conspicuous feature of the vegetational change of the valleys (Christensen 1962). The naturalization of tamarix has occurred in a striking manner on the sand dunes of Pavan Valley. This species has helped to reduce the movement of the sand in recent years.

**Table 2**

<table>
<thead>
<tr>
<th>Migration of Sand Dunes in Pavan Valley, 1870-1962</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>1870-1944</td>
</tr>
<tr>
<td>1870-1962</td>
</tr>
<tr>
<td>1944-1962</td>
</tr>
<tr>
<td>1957-1962</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dunes in Sections 26 and 25</th>
</tr>
</thead>
<tbody>
<tr>
<td>1870-1944</td>
</tr>
</tbody>
</table>
REFERENCES

——— and GEORGE STEWART. 1940. Plant succession as a result of grazing and of meadow desiccation by erosion since settlement in 1862. Jour. Forestry, 38:613-626.
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