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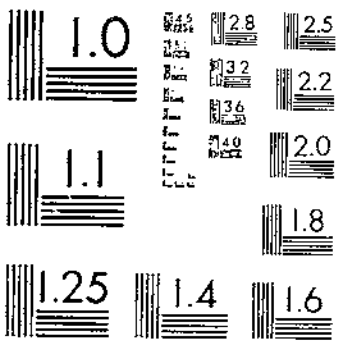
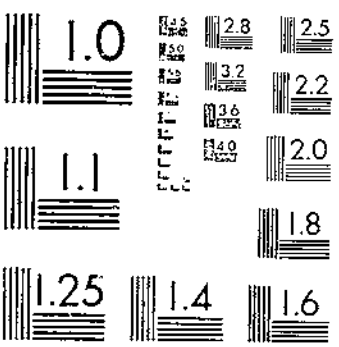
AGRICULTURAL INVESTIGATIONS ON THE NEWLANDS (NEV.) RECLAMATION PROJECT.

KNIGHT, E W

# START




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

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# AGRICULTURAL INVESTIGATIONS ON THE NEWLANDS (NEV.) RECLAMATION PROJECT

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The Bureau of Plant Industry in Cooperation with the Nevada Agricultural Experiment Station

CONTENTS



## LOCATION OF THE NEWLANDS PROJECT

The Newlands reclamation project is located in the west-central part of Nevada, near the towns of Fallon and Fernley, in western Churchill and eastern Lyon Counties. The general topography of this area is a large flat plateau lying about 4,000 feet above sea level. A low, nearly continuous range of mountains extends around three sides of the area. To the north the rolling desert plain reaches for some 75 miles until broken by the Carson Sink and still more distant mountains. On the north, east, and south the mountains are barren desert hills, but on the west several smaller ranges finally give way to the wooded and snow-covered Sierras along the eastern California border. It is from the watersheds of these latter mountains that the project obtains its supply of irrigation water.

Two rivers, the Carson and the Truckee, flow in an easterly direction, bringing the water from the melting snows of these mountains. On the Carson River about 18 miles west of Fallon lies the Lahontan storage reservoir with a capacity of 294,000 acre-feet. The natural flow of the Carson is augmented here by the flow diverted from Truckee River. A dam on the Truckee River diverts a part of this stream into a supply canal that flows along the Truckee Canyon for several miles, then south through some desert bench land, finally emptying into Lahontan Reservoir. This supply canal is about 31 miles long and has a carrying capacity of approximately 800 second-feet. The original designed capacity down to what is known as the "Pyramid headworks" was 1,500 second-feet, with 1,200 second-feet capacity below that point. A part of the project, comprising about 4,600 acres lying near the towns of Fernley and Hazen, obtains its irrigation water from this supply canal. This area is higher than the elevation of the stored water in the Lahontan Reservoir and consequently is dependent upon Truckee River flow for its irrigation water supply.

## SOIL OF THE NEWLANDS PROJECT

In comparatively recent geologic time the area now comprising the Newlands project was part of a vast lake known as "Lake Lahontan." Remnants of this lake, which at one time covered the greater part of western and northern Nevada, are to be found in Pyramid and Walker Lakes. The former lies about 50 miles northwest of Fallon, and the latter about 40 miles to the south.

During the life of Lake Lahontan a great quantity of material eroded from the surrounding hills was carried by streams into the lake and deposited on its bottom. This material today forms the soil of this area. Since the deposition of this soil in the waters of the lake it has undergone some rearrangement owing to the rise and fall in the lake elevation and also to the action of winds and streams since the disappearance of the lake.

In general the soil types of the Newlands project range from a rather coarse sand, through the fine sandy loams, to clay. In much of the area the soil is extremely spotted, there being places of nearly pure sand bordering on areas more or less adobelike in character. The depth of the different soil types varies from a few inches to several feet. In general the soils of the greater depths are composed of rather coarse gravel.

Since Lake Lahontan was an inland body of water, with inflowing streams and no outlets, the mineral content of its water became progressively more concentrated as the water receded, and the soluble salts were deposited during the process of evaporation. As a result the soils of the region often contain appreciable quantities of soluble salts, the heavier soils, or fine clays, containing greater quantities than the fine sands or coarser material. It is characteristic to find areas ranging from a few feet to several miles in diameter that are hard and smooth and devoid of vegetation. These are commonly called "slick spots." As a rule, such areas are composed of fine clays rather high in salt content and impervious to water. The soils over the entire area of the project contain more or less of the salts of sodium. In some districts the amount present is not harmful, while in others it is enough to prohibit the successful growing of crops until the condition is corrected.

Where a high underground water table exists serious production problems have developed. In certain sections it was a matter of only a few years after the completion of a storage and irrigation system until the water table became a menace. This condition became so serious by 1921 that a drainage program was inaugurated. Large open drains were constructed throughout the project in order to lower the water table. Where adequate drainage was provided, effective progress has been made in reclaiming many of the seeped areas.

## WEATHER CONDITIONS

Weather records are kept at the Newlands Field Station, near Fallon, in cooperation with the United States Weather Bureau and with the Division of Genetics and Biophysics of the Bureau of Plant Industry. The observations are summarized in table 1. Detailed records for the years 1928 to 1932 are given to indicate the fluctuations that may be expected from year to year.

TABLE 1.—*Summary of climatological observations at the Newlands Field Station for the 27-year period, 1906–32*

PRECIPITATION (INCHES)

| Item | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average for 27 years [1] | 0.57 | 0.55 | 0.39 | 0.56 | 0.51 | 0.33 | 0.14 | 0.25 | 0.35 | 0.36 | 0.32 | 0.55 |
| 1928 | .08 | .12 | 1.09 | .24 | T | .20 | T | 0 | 0 | .21 | .41 | .20 |
| 1929 | .28 | .53 | .70 | .10 | 0 | .26 | .02 | .03 | 0 | .02 | 0 | .19 |
| 1930 | .45 | .34 | .36 | .47 | 2.28 | 0 | .10 | .10 | .67 | .30 | 1.07 | 0 |
| 1931 | .20 | 1.45 | .09 | .40 | .31 | .56 | .19 | .07 | 1.08 | .07 | .50 | 2.15 |
| 1932 | .31 | 1.03 | .11 | 1.80 | 1.02 | .23 | T | .02 | .18 | .32 | T | .12 |

EVAPORATION (INCHES)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average for 23 years [1] | 1.02 | 1.69 | 3.88 | 5.74 | 7.55 | 8.77 | 9.77 | 8.67 | 5.90 | 3.62 | 1.80 | 0.89 |
| 1928 | .47 | 1.16 | 3.11 | 5.02 | 7.63 | 8.69 | 8.76 | 8.38 | 5.57 | 3.36 | 1.41 | .63 |
| 1929 | ..... | 1.13 | 2.94 | 4.15 | 6.75 | 6.99 | 8.43 | 7.71 | 5.61 | 3.55 | 1.68 | 1.20 |
| 1930 | ..... | 1.25 | 4.29 | 5.52 | 4.47 | 7.83 | 7.97 | 6.66 | 4.69 | 3.07 | 1.44 | ..... |
| 1931 | ..... | 1.80 | 3.35 | 4.77 | 6.36 | 6.79 | 7.57 | 6.60 | 4.60 | 3.29 | 1.27 | ..... |
| 1932 | ..... | 2.04 | 3.69 | 4.78 | 5.97 | 6.28 | 8.79 | 6.58 | 4.58 | 3.42 | 2.07 | ..... |

DAILY WIND VELOCITY (MILES PER HOUR)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average for 24 years [1] | 2.41 | 3.07 | 4.06 | 4.80 | 4.18 | 3.53 | 2.72 | 2.45 | 2.42 | 2.17 | 2.20 | 2.20 |
| 1928 | 1.74 | 2.32 | 3.45 | 4.22 | 3.45 | 4.07 | 2.34 | 2.17 | 1.78 | 1.66 | 1.45 | 1.50 |
| 1929 | 2.14 | 2.56 | 3.30 | 4.84 | 3.46 | 3.00 | 2.26 | 1.70 | 1.70 | 1.22 | .76 | 2.00 |
| 1930 | 2.24 | 2.68 | 3.58 | 3.38 | 4.06 | 2.86 | 2.21 | 2.12 | 2.03 | 1.75 | 1.71 | .82 |
| 1931 | 1.24 | 2.18 | 3.44 | 3.96 | 3.14 | 3.48 | 2.16 | 2.05 | 2.48 | 2.09 | 2.61 | 2.16 |
| 1932 | 2.56 | 2.01 | 3.04 | 4.38 | 3.82 | 2.50 | 2.99 | 2.39 | 1.33 | 1.79 | 2.20 | 2.23 |

TEMPERATURE (° F.)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average for 27 years: [2] | | | | | | | | | | | | |
| Absolute maximum | 59.3 | 64.3 | 74.2 | 80.7 | 88.1 | 96.6 | 100.4 | 98.7 | 92.1 | 82.8 | 71.9 | 60.3 |
| Daily maximum | 43.1 | 49.9 | 59.1 | 66.2 | 73.5 | 83.7 | 93.1 | 90.8 | 80.6 | 68.4 | 56.1 | 43.8 |
| Absolute minimum | −1.1 | 8.0 | 15.1 | 20.0 | 28.6 | 35.8 | 43.9 | 40.4 | 23.3 | 19.7 | 9.4 | 1.8 |
| Daily minimum | 16.8 | 23.2 | 27.5 | 34.1 | 40.9 | 47.3 | 53.8 | 51.0 | 42.0 | 32.4 | 23.7 | 17.8 |
| Monthly mean | 29.9 | 36.4 | 43.3 | 50.2 | 57.4 | 65.5 | 73.5 | 70.9 | 60.9 | 50.4 | 40.6 | 30.8 |
| 27-year record: | | | | | | | | | | | | |
| Highest recorded | 70 | 78 | 79 | 89 | 102 | 102 | 106 | 103 | 97 | 80 | 84 | 72 |
| Lowest recorded | −25 | −12 | 8 | 13 | 21 | 28 | 38 | 34 | 22 | 13 | −1 | −17 |
| 1928: | | | | | | | | | | | | |
| Absolute maximum | 63 | 61 | 77 | 80 | 90 | 97 | 103 | 99 | 94 | 84 | 67 | 58 |
| Mean maximum | 44.7 | 52.3 | 61.4 | 65.1 | 80.4 | 83.1 | 93.3 | 90 | 77.3 | 68.7 | 54.6 | 41.3 |
| Absolute minimum | 3 | 5 | 20 | 19 | 31 | 39 | 43 | 41 | 28 | 19 | 8 | 1 |
| Mean minimum | 18.0 | 17.6 | 31.9 | 31.7 | 44.8 | 46.3 | 52.4 | 48.6 | 40.3 | 32.1 | 23.6 | 14.7 |
| Mean | 31.3 | 34.6 | 46.7 | 48.4 | 62.6 | 64.7 | 72.8 | 69.3 | 58.8 | 50.4 | 39.1 | 28.0 |
| 1929: | | | | | | | | | | | | |
| Absolute maximum | 57 | 63 | 76 | 78 | 87 | 99 | 97 | 102 | 97 | 80 | 73 | 68 |
| Mean maximum | 44.6 | 47.4 | 59.1 | 61.6 | 76.0 | 81.5 | 93.6 | 93.6 | 79.5 | 72.0 | 57.9 | 55.8 |
| Absolute minimum | −3 | 1 | 14 | 14 | 26 | 28 | 44 | 45 | 25 | 15 | 3 | 6 |
| Mean minimum | 15.0 | 17.4 | 26.0 | 29.4 | 39.8 | 45.1 | 53.5 | 55.0 | 35.6 | 29.0 | 15.3 | 22.4 |
| Mean | 29.8 | 32.4 | 42.6 | 45.5 | 57.9 | 63.3 | 73.5 | 74.3 | 58.1 | 50.5 | 36.6 | 39.1 |

See footnotes at end of table.

TABLE 1.—*Summary of climatological observations at the Newlands Field Station for the 27-year period, 1906–32*—Continued

TEMPERATURE (° F.)—Continued

| Item | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1930: | | | | | | | | | | | | |
| Absolute maximum | 60 | 72 | 77 | 83 | 84 | 98 | 100 | 94 | 88 | 78 | 71 | 52 |
| Mean maximum | 37.2 | 56.5 | 66.3 | 70.0 | 67.2 | 85.7 | 92.1 | 88.8 | 77.7 | 66.5 | 53.1 | 42.0 |
| Absolute minimum | −6 | 14 | 8 | 24 | 30 | 38 | 46 | 42 | 28 | 19 | 1 | −1 |
| Mean minimum | 14.8 | 23.6 | 25.6 | 35.8 | 39.3 | 45.7 | 53.0 | 52.0 | 42.4 | 31.4 | 20.0 | 9.5 |
| Mean | 26.0 | 40.1 | 43.6 | 52.9 | 53.3 | 65.7 | 72.5 | 70.4 | 60.1 | 48.9 | 36.5 | 25.8 |
| [illegible] 1: | | | | | | | | | | | | |
| Absolute maximum | 58 | 63 | 77 | 80 | 90 | 92 | 106 | 100 | 96 | 84 | 81 | 51 |
| Mean maximum | 40.7 | 51.2 | 66.1 | 67.9 | 78.4 | 85.4 | 96.5 | 93.3 | 77.9 | 72.3 | 51.4 | 38.0 |
| Absolute minimum | 5 | 14 | 9 | 18 | 31 | 35 | 47 | 42 | 28 | 20 | 1 | −7 |
| Mean minimum | 14.7 | 25.3 | 25.6 | 34.7 | 42.5 | 47.7 | 56.4 | 53.6 | 41.2 | 33.7 | 20.3 | 13.5 |
| Mean | 30.7 | 38.3 | 42.9 | 51.3 | 60.4 | 65.6 | 76.5 | 73.4 | 59.6 | 53.0 | 35.9 | 25.8 |
| 1932: | | | | | | | | | | | | |
| Absolute maximum | 63 | 64 | 70 | 79 | 85 | 98 | 97 | 98 | 94 | 85 | 72 | 64 |
| Mean maximum | 39.1 | 41.4 | 60.1 | 64.3 | 71.1 | 82.7 | 89.9 | 89.0 | 84.9 | 69.0 | 62.3 | 39.5 |
| Absolute minimum | 1 | 3 | 15 | 18 | 34 | 36 | 42 | 34 | 38 | 18 | 16 | −17 |
| Mean minimum | 17.9 | 19.2 | 28.4 | 32.9 | 42.3 | 50.5 | 51.2 | 48.0 | 43.6 | 31.5 | 25.6 | 8.7 |
| Mean | 28.5 | 30.3 | 44.3 | 48.6 | 56.7 | 66.6 | 70.5 | 68.8 | 64.3 | 50.3 | 43.9 | 24.1 |

ASPECT OF THE SKY (DAYS)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average for 27 years:[4] | | | | | | | | | | | | |
| Clear | 13.5 | 14.0 | 17.0 | 17.2 | 18.0 | 22.6 | 24.3 | 25.2 | 22.9 | 23.0 | 17.9 | 14.7 |
| Partly cloudy | 7.5 | 6.0 | 6.5 | 5.9 | 7.0 | 3.9 | 4.1 | 3.2 | 3.6 | 3.5 | 5.1 | 6.3 |
| Cloudy | 10.0 | 8.2 | 6.9 | 6.9 | 4.9 | 3.6 | 2.6 | 2.6 | 3.4 | 4.5 | 7.0 | 10.0 |
| 1928: | | | | | | | | | | | | |
| Clear | 11 | 15 | 10 | 16 | 17 | 25 | 24 | 28 | 23 | 18 | 10 | 17 |
| Partly cloudy | 5 | 2 | 4 | 0 | 5 | 3 | 1 | 2 | 2 | 2 | 6 | 5 |
| Cloudy | 15 | 12 | 17 | 14 | 9 | 2 | 6 | 1 | 5 | 11 | 14 | 9 |
| 1929: | | | | | | | | | | | | |
| Clear | 13 | 15 | 11 | 9 | 16 | 22 | 28 | 29 | 28 | 30 | 30 | 16 |
| Partly cloudy | 5 | 4 | 9 | 6 | 8 | 0 | 1 | 1 | 2 | 1 | 0 | 5 |
| Cloudy | 13 | 9 | 11 | 15 | 7 | 8 | 2 | 1 | 0 | 0 | 0 | 10 |
| 1930: | | | | | | | | | | | | |
| Clear | 4 | 10 | 22 | 22 | 20 | 20 | 28 | 25 | 17 | 25 | 24 | 27 |
| Partly cloudy | 8 | 8 | 5 | 4 | 4 | 1 | 1 | 3 | 4 | 2 | 0 | 1 |
| Cloudy | 19 | 10 | 4 | 4 | 7 | 0 | 2 | 3 | 9 | 4 | 6 | 3 |
| 1931: | | | | | | | | | | | | |
| Clear | 17 | 17 | 21 | 20 | 25 | 22 | 30 | 25 | 27 | 27 | 18 | 10 |
| Partly cloudy | 4 | 2 | 4 | 1 | 4 | 5 | 1 | 0 | 1 | 4 | 2 | 6 |
| Cloudy | 10 | 9 | 6 | 9 | 2 | 3 | 0 | 6 | 2 | 0 | 10 | 15 |
| 1932: | | | | | | | | | | | | |
| Clear | 14 | 19 | 22 | 18 | 19 | 26 | 30 | 31 | 30 | 27 | 23 | 17 |
| Partly cloudy | 13 | 1 | 3 | 3 | 5 | 0 | 1 | 0 | 0 | 1 | 4 | 6 |
| Cloudy | 4 | 9 | 6 | 9 | 7 | 4 | 0 | 0 | 0 | 3 | 3 | 8 |

KILLING FROSTS

| Year | Last in spring | First in autumn | Frost-free period (days) | Year | Last in spring | First in autumn | Frost-free period (days) |
|---|---|---|---|---|---|---|---|
| 1906 | May 31 | Oct. 4 | 126 | 1921 | May 29 | Sept. 13 | 107 |
| 1907 | May 14 | Sept. 19 | 128 | 1922 | May 27 | Oct. 4 | 130 |
| 1908 | May 30 | Sept. 25 | 118 | 1923 | June 13 | Sept. 24 | 103 |
| 1909 | May 24 | Sept. 22 | 121 | 1924 | May 7 | Sept. 21 | 137 |
| 1910 | May 16 | Sept. 13 | 120 | 1925 | May 8 | Sept. 22 | 137 |
| 1911 | May 27 | Sept. 18 | 114 | 1926 | May 11 | Sept. 19 | 131 |
| 1912 | May 22 | Sept. 25 | 126 | 1927 | May 29 | Sept. 8 | 102 |
| 1913 | May 13 | Sept. 24 | 134 | 1928 | May 4 | Sept. 9 | 128 |
| 1914 | Apr. 25 | Sept. 9 | 137 | 1929 | June 2 | Sept. 8 | 98 |
| 1915 | May 20 | Sept. 14 | 117 | 1930 | May 22 | Sept. 25 | 126 |
| 1916 | June 1 | Sept. 10 | 101 | 1931 | May 19 | Sept. 9 | 113 |
| 1917 | May 21 | Sept. 25 | 127 | 1932 | Apr. 28 | Oct. 10 | 165 |
| 1918 | May 29 | Oct. 7 | 131 | | | | |
| 1919 | May 6 | Sept. 22 | 139 | Average | May 19 | Sept. 21 | 125 |
| 1920 | May 3 | Sept. 25 | 145 | | | | |

[1] The records for January, February, and March cover only 26 years.

[2] T = trace.

[3] January records are for 14 years. Records for February and December are for 18 and 17 years, respectively, and for March, 21 years; the other months have records for 23 years.

[4] The records for January, February, March, and November cover only 22 years; those for April, October, and December cover 23 years; the records for the remaining months cover 24 years.

[5] The records for March and October cover only 26 years in all averages. August averages cover a 27-year period with the exception of the daily maximum and monthly mean tables; in these cases it covers 26 years.

[6] The records for January, February, March, and October cover only 26 years.

The situation of the Newlands project, on a high plateau 4,000 feet above sea level and completely surrounded by mountains, materially modifies the climatic conditions of this locality. Most of the prevailing storms come from the west, off the Pacific Ocean. The high barrier of the Sierra Nevada causes most of the storm clouds to precipitate their moisture on the western slope of the mountains in California. As a result the basin has a rather arid climate. Data compiled from the records kept at the station over a 27-year period have shown an average yearly rainfall of 4.88 inches, the greater portion falling during the period from December to April, inclusive. As a general rule there is the least rain in July and August. There is little snowfall.

The temperature ranges from subzero weather in January to a maximum of over 100° F. in July. There is an average yearly range from a mean absolute minimum of —1.1° in January to a mean absolute maximum of 100.5° in July. The extreme temperatures recorded were —25° in January 1917 and 106° in July 1931. The average daily temperatures during this 27-year period have ranged from a mean minimum of 16.8° in January to a mean minimum of 53.8° in July, and a mean maximum range from 43.1° in January to 93.1° in July. The monthly mean temperatures range from 29.9° in January to 73.5° in July. January is the coldest month and July the warmest. Even the warmest days in July are usually followed by cool nights. It is only rarely that the temperature does not fall below 60° during the night. The general 24-hour range during the hottest days is about 45°.

The average yearly evaporation over a 23-year period has been 59.27 inches, the greater portion occurring during May, June, July, and August. The frequency and amount of the irrigations required during the growing season are influenced by this high evaporation.

There are comparatively few days throughout the year when the sky is completely overcast. Out of a total of 365 days, the 27-year period shows the yearly average to have been 231.5 clear days, 63.2 partly cloudy days, and 70.6 cloudy days.

The average frost-free period has been 125 days, extending from May 19 to September 21. The longest period without frost, 165 days, occurred in 1932, from April 28 to October 10. The shortest frost-free period, 98 days, was recorded in 1929 when a killing frost occurred on June 2 and the first one in the fall occurred on September 8. The bench land of the project has a little longer frost-free period, usually from 2 to 3 weeks longer, and such locations are considered the better fruit lands of the locality.

Normally 125 days would be ample time to mature most varieties of corn and sorghum, but the cool nights so retard the growth of such crops that only the shorter season varieties of corn can be matured, and occasionally some grain sorghums. Generally the planting of such sorghums as milo, feterita, amber cane, etc., is not advocated.

## AGRICULTURAL CONDITIONS

The Bureau of Reclamation of the United States Department of the Interior has compiled a yearly census of the agricultural conditions of the Newlands project. During the years 1929 to 1932 the Department of Farm Development of the Nevada Agricultural Experiment Station cooperated in the tabulation of these data.

These reports are summarized in tables 2 to 5 to indicate the acreage trends for the different crops and also to what extent livestock has been a factor in the agricultural pursuits of the project.

TABLE 2.—*Acreage of principal crops grown on the Newlands reclamation project during the 21-year period, 1912–32*

[Based on reports made by the Bureau of Reclamation]

| Year | Total net acreage irrigated [1] | Old alfalfa | New alfalfa | Wheat | Barley | Oats | Corn and sorghum | Potatoes | Sugar beets | Garden | Fruit | Cantaloups | Hay | Miscellaneous | Natural pasture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1912 | 36,620 | 12,012 | 3,319 | 2,484 | 2,259 | 300 | ..... | 483 | 254 | 150 | 180 | ..... | 284 | 135 | 15,004 |
| 1913 | 42,043 | 13,000 | 4,523 | 1,590 | 1,880 | 283 | ..... | 416 | 1,079 | 180 | 132 | ..... | 3,467 | 374 | 18,352 |
| 1914 | 30,285 | 13,212 | 3,344 | 1,446 | 1,329 | 417 | ..... | 283 | ..... | ..... | ..... | ..... | 1,591 | 666 | 19,398 |
| 1915 | 38,495 | 18,273 | 2,070 | 2,682 | 1,733 | 423 | 97 | 196 | ..... | 173 | 134 | ..... | 936 | 1,171 | 11,590 |
| 1916 | 39,449 | 19,541 | 1,004 | 2,861 | 1,658 | 107 | 95 | 177 | ..... | 187 | 98 | ..... | 1,310 | 133 | 10,872 |
| 1917 | 40,392 | 20,360 | 2,141 | 2,532 | 1,116 | 27 | 86 | 322 | 2,168 | 200 | 132 | ..... | 940 | 137 | 10,100 |
| 1918 | 42,311 | 21,542 | 3,725 | 5,024 | 1,374 | 44 | 80 | 334 | ..... | 252 | 136 | ..... | 1,124 | 164 | 6,602 |
| 1919 | 44,324 | 24,188 | 3,864 | 5,423 | 519 | 31 | 201 | 152 | ..... | 261 | 134 | ..... | 351 | 102 | 10,247 |
| 1920 | 45,611 | 26,540 | 4,254 | 3,586 | 769 | 68 | 64 | 354 | ..... | 277 | 195 | ..... | 505 | 117 | 9,720 |
| 1921 | 45,461 | 28,287 | 2,923 | 2,443 | 732 | 60 | 65 | 484 | [2] 1,550 | 276 | 48 | 129 | 247 | 1,063 | 7,874 |
| 1922 | 44,963 | 29,043 | 1,163 | 2,410 | 437 | 72 | 160 | 570 | ..... | 278 | 164 | 336 | 114 | 204 | 6,401 |
| 1923 | 44,886 | 28,210 | 1,007 | 3,116 | 451 | 70 | 367 | 659 | ..... | 229 | 160 | 350 | 180 | 82 | 5,090 |
| 1924 | 44,280 | 30,052 | 1,166 | 4,081 | 297 | 62 | 259 | 273 | ..... | 158 | 200 | 532 | 157 | 96 | 3,625 |
| 1925 | 41,908 | 28,183 | 2,459 | 4,670 | 762 | 67 | 378 | 152 | ..... | 216 | 201 | 510 | 227 | 109 | 2,050 |
| 1926 | 45,450 | 28,961 | 2,186 | 5,836 | 920 | 28 | 328 | 249 | ..... | 212 | 214 | 385 | 193 | 126 | 4,313 |
| 1927 | 40,255 | 29,849 | 1,977 | 4,829 | 1,209 | ..... | 424 | 542 | 1,073 | 191 | 182 | 261 | ..... | 289 | 7,120 |
| 1928 | 49,070 | 29,511 | 3,012 | 5,715 | 1,615 | ..... | 272 | 111 | 25 | 161 | 198 | 221 | ..... | 248 | 8,573 |
| 1929 | 54,040 | 28,922 | 3,169 | 5,286 | 1,031 | ..... | 215 | 101 | ..... | 176 | 199 | 318 | ..... | 117 | 13,243 |
| 1930 | 53,562 | 30,507 | 3,220 | 3,830 | 931 | ..... | 284 | 125 | ..... | 221 | 197 | 281 | ..... | 1,149 | 13,045 |
| 1931 | 49,851 | 32,596 | 1,273 | 4,152 | 732 | ..... | 161 | 156 | ..... | 194 | 233 | 259 | ..... | 1,222 | 1,244 |
| 1932 | 51,927 | 30,770 | 3,798 | 3,250 | 1,030 | 52 | 304 | 208 | ..... | 395 | 230 | 258 | ..... | 1,395 | 9,877 |

[1] As a general rule the net acreage irrigated is less than the total area growing crops. This is because of 2 crops being grown on the same area in 1 season. Some years the net acreage irrigated exceeds the sum of the cropped area. This is because of areas being irrigated without crop.
[2] Crop a failure owing to curly-top disease.

TABLE 3.—*Acreage in alfalfa, grain, miscellaneous crops, and pasture expressed as a percentage of the entire cropped acreage on the project for the 21-year period, 1912–32*

| Year | Alfalfa | Grain | Miscellaneous | Natural pasture | Year | Alfalfa | Grain | Miscellaneous | Natural pasture |
|---|---|---|---|---|---|---|---|---|---|
| 1912 | 43 | 14 | 4 | 39 | 1924 | 72 | 10 | 4 | 14 |
| 1913 | 40 | 8 | 12 | 40 | 1925 | 75 | 14 | 4 | 7 |
| 1914 | 40 | 8 | 6 | 46 | 1926 | 71 | 15 | 4 | 10 |
| 1915 | 52 | 12 | 7 | 29 | 1927 | 66 | 13 | 6 | 15 |
| 1916 | 56 | 12 | 5 | 28 | 1928 | 65 | 15 | 3 | 17 |
| 1917 | 56 | 9 | 10 | 25 | 1929 | 61 | 12 | 2 | 25 |
| 1918 | 58 | 15 | 5 | 22 | 1930 | 63 | 9 | 4 | 24 |
| 1919 | 62 | 13 | 3 | 22 | 1931 | 80 | 12 | 5 | 3 |
| 1920 | 66 | 10 | 3 | 21 | 1932 | 67 | 8 | 5 | 19 |
| 1921 | 68 | 7 | 8 | 17 | | | | | |
| 1922 | 73 | 7 | 5 | 15 | Mean | 62 | 11 | 5 | 22 |
| 1923 | 72 | 9 | 5 | 14 | | | | | |

## CROP CONDITIONS

In 1929 the irrigated acreage of the project reached its maximum. The agricultural census for that year indicated an irrigated area of 54,000[1] acres, of which about 39,500 acres were actually under cultivation. The remaining 14,500 acres were listed in the census summary as natural pasture and areas irrigated without crop. The natural pasture included 6,000 acres of native grasses and tule

[1] Totals are given in the nearest hundreds.

swamps about 9 miles south of Fallon in the Carson Lake community pasture, and slightly less than 800 acres east and northeast in small leased tracts. The remainder of the 14,500 acres is land that was being irrigated without crop on private farms in order to obtain some pasture and also as a procedure preliminary to reclamation.

By 1920 the irrigated areas of the project had reached an aggregate of 45,600 acres. The decline in the irrigated area during the 5 years following 1920 was probably due to adverse economic conditions. The greatest decrease occurred in 1925, following the quarantine placed against Nevada hay by the State of California. The increases of the next 4 years can be attributed largely to the gradual improvement in agricultural conditions following the period of adjustment from 1921 to 1925. Likewise, the decline in the irrigated area during the period 1930 to 1932 was probably due to the general depressed economic conditions existing throughout the country. However, a substantial portion of this yearly fluctuation of area under irrigation is directly due to the irrigation of large areas of seeped land with a view to reclamation, after drains had been constructed, and to stimulate the growth of native grasses for pasturage.

A better means of determining the growth of the project from 1912 to 1932 is afforded by comparing the actual cropped area under irrigation, that is, the number of acres on which some farm crop was produced other than native pasture. In 1912 this area totaled about 23,000 acres. This had increased to about 41,000 acres by 1932, or about 78 percent in 20 years. The greater part of this increase took place prior to 1923. About 28 percent of the total increase of 78 percent occurred during the last 10 years of the period. The annual growth in the actual cropped area and the relationship it bears to the whole irrigated area is shown in table 4.

TABLE 4.—*Actual area cropped, exclusive of natural pasture, and its relationship expressed in percentage of the entire net acreage irrigated*

| Year | Cropped area | Irrigated area | Year | Cropped area | Irrigated area | Year | Cropped area | Irrigated area |
|---|---|---|---|---|---|---|---|---|
| | *Acres* | *Percent* | | *Acres* | *Percent* | | *Acres* | *Percent* |
| 1912 | 22,868 | 62 | 1919 | 33,049 | 75 | 1926 | 39,472 | 87 |
| 1913 | 27,884 | 65 | 1920 | 34,853 | 76 | 1927 | 40,242 | 82 |
| 1914 | 22,261 | 57 | 1921 | 35,559 | 78 | 1928 | 39,852 | 80 |
| 1915 | 26,905 | 67 | 1922 | 35,992 | 80 | 1929 | 39,415 | 73 |
| 1916 | 27,377 | 69 | 1923 | 35,436 | 79 | 1930 | 39,618 | 74 |
| 1917 | 29,136 | 72 | 1924 | 37,033 | 86 | 1931 | 40,505 | 81 |
| 1918 | 31,828 | 75 | 1925 | 30,910 | 90 | 1932 | 41,008 | 79 |

Since the inception of the project more acreage has been devoted to the production of alfalfa than to all other crops combined. It has proved to be well adapted to local conditions.

Prior to 1925 large quantities of alfalfa hay were shipped to California markets. This outlet was closed in 1924 owing to the discovery of alfalfa weevil on the project, which was followed by quarantine regulations by the State of California.

For a few years following the closing of these California markets for alfalfa there was a surplus of hay and a decline in both price and acreage. However, as more farmers turned to dairying and to feeding sheep and cattle, it was found that the greater portion of the hay crop could be consumed locally with prospects of fair returns. The surplus remaining was ground and marketed as alfalfa meal.

In point of acreage the next most important crops on the project are wheat and barley. While the yields of these cereals and their sale value have not justified their being featured extensively in the planting program as cash crops, yet they have served a useful purpose, in the interests of diversification, as a source of feed for livestock and at times in reconditioning old alfalfa land. Also, grain is often advantageously used as a nurse crop for alfalfa.

There are certain areas on the south and east sides of the project where wheat is grown to the exclusion of other crops. This is due to a peculiar character of the soil. The physical properties are such that difficulty is encountered in obtaining adequate water penetration to a depth sufficient to make alfalfa production profitable. Such areas as these are handled largely with motorized machinery to reduce the cost of production. The production on this area has averaged about 1,300 pounds, or 22 bushels, to the acre.

Such grain crops as oats and corn have never been grown extensively on the project. The acreage in oats reached its maximum during 1914 and 1915. It was at this time that many horses were being used in freighting supplies from Fallon to the nearby mining camps. Many of these mines have since ceased to operate, and the remaining freighting is done by motor trucks.

The maximum acreage in corn was reached in 1927. At this time the reclamation census reported slightly more than 400 acres. Most of this acreage was utilized to produce silage for dairy stock. The justification for supplementing alfalfa hay with corn silage in feeding practices, under local conditions, is still a debatable question with many dairymen. Until it can be definitely shown that corn silage can be profitably fed or that it has some beneficial effect on the constitution of the dairy cow, little increase in the acreage of this crop on the Newlands project can be expected.

Potatoes reached their largest area in 1922, when nearly 900 acres were grown. The acreage has fluctuated greatly from year to year, as the majority of farmers have tried to anticipate the probable demand, restricting their acreage when they believed prices would be low and increasing their production when price prospects appeared to them to be favorable.

Several attempts to grow sugar beets were made during the period from 1911 to 1928. The first attempt was made in 1911 and 1912, when a local factory was established. This attempt proved a failure owing to the prevalence of the curly-top disease during 1911 and a shortage in tonnage in 1912. A further trial was made in 1917 which was a disappointment to the growers. Another attempt was made in 1921, which failed because of a further appearance of the curly-top disease. The last attempt of importance was made in 1927. The factory again operated at a loss because of insufficient tonnage.

A relatively small acreage is devoted to garden crops and orchards. Owing to the sparse population of the area in close proximity to the project, the local demand for such products is limited. The few farmers engaged in this type of agriculture realize a fair return for their endeavor as long as the local market or short distance shipments consume all they produce. The frequent occurrence of late spring frosts is a limiting factor in connection with the successful production of fruit on the lower lands of the project. As a result the small area in orchards is chiefly found on the bench lands.

Cantaloups have been reported separately from the garden crops since 1921, when there were 129 acres. The peak of production was reached in 1924 and 1925, when over 500 acres were devoted to this crop. Cantaloups mature rather late in the season and are shipped largely to eastern markets.

The chief cause of the increased acreage for 1930, 1931, and 1932, reported under the heading "Miscellaneous crops", is the realization by some dairymen that pasture crops should be included in their feeding operations. The Newlands Field Station has conducted experiments for a number of years with pasture grasses and clovers. Certain mixtures have proved to be well adapted to local conditions. The results of these tests have been made available to those interested and have had some influence on the kinds of pasture crops used as well as on the increase in acreage. During 1932 there were 1,157 acres listed as seeded to grass or clover pastures. The greater portion of this acreage was sweetclover, either the white or yellow varieties. It has been found that an acre in grass pasture produces approximately as much feed as a similar area devoted to alfalfa production. Likewise, sweetclover pasture was found to produce nearly as much feed as the grass mixtures.

### LIVESTOCK CONDITIONS

Inasmuch as alfalfa, native grass pasture, and grain make up the bulk of the crops grown on the irrigated acreage of the project, it naturally follows that the system of farming should be one in which livestock plays an important part. The cropping system, together with the distance from large consuming centers, early encouraged dairying and the production of beef cattle and sheep. Some of the beef cattle and sheep utilize pasture land and hay produced on the project. Some are fed in this manner the year around, while others are fed only during the winter and are kept during the spring and summer months on mountain ranges. The project continues to be an important adjunct to range operations, but in recent years dairying and poultry raising have become increasingly important. Table 5 gives the number of livestock and of hives of bees on the project for the years 1914 to 1932, as recorded by the Bureau of Reclamation.

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TABLE 5.—*Number of livestock and hives of bees on Newlands project farms during the 19-year period, 1914–32*

| Year | Horses and mules | Beef cattle[1] | Dairy cattle | Sheep[1] | Hogs | Poultry | | Hives of bees | Rabbits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Turkeys | Other poultry | | |
| 1914 | 3,483 | 4,540 | 1,503 | 1,081 | 3,815 | 6,972 | 27,309 | 1,621 | ..... |
| 1915 | 3,780 | 5,957 | 2,433 | 4,710 | 4,836 | 12,006 | 22,912 | 3,500 | ..... |
| 1916 | 3,911 | 7,802 | 2,537 | 5,452 | 6,092 | 15,239 | 20,270 | 2,958 | ..... |
| 1917 | 3,467 | 7,581 | 2,044 | 3,346 | 3,170 | 9,042 | 24,056 | 1,633 | ..... |
| 1918 | 3,734 | 8,839 | 1,895 | 3,560 | 3,343 | 4,746 | 20,229 | 1,589 | ..... |
| 1919 | 3,592 | 6,778 | 1,850 | 3,347 | 3,048 | 3,442 | 25,032 | 2,821 | ..... |
| 1920 | 3,875 | 7,428 | 2,072 | 4,611 | 2,211 | 3,624 | 28,780 | 2,083 | ..... |
| 1921 | 4,038 | 6,732 | 3,597 | 7,707 | 1,795 | 4,834 | 28,582 | 2,983 | ..... |
| 1922 | 3,730 | 4,601 | 5,088 | 7,051 | 3,214 | 12,130 | 44,131 | 1,267 | ..... |
| 1923 | 3,822 | 4,260 | 6,738 | 7,280 | 2,975 | 27,254 | 45,246 | 2,302 | ..... |
| 1924 | 3,818 | 4,880 | 7,306 | 4,624 | 2,206 | 22,415 | 49,805 | 2,249 | ..... |
| 1925 | 3,222 | 4,663 | 7,706 | 12,807 | 1,972 | 20,429 | 54,833 | 2,913 | ..... |
| 1926 | 3,314 | 6,052 | 8,523 | 7,930 | 2,265 | 30,613 | 70,632 | 2,697 | ..... |
| 1927 | 3,374 | 2,802 | 9,357 | 7,230 | 3,446 | 47,898 | 94,031 | 2,722 | 6,188 |
| 1928 | 3,164 | 3,148 | 8,551 | 9,481 | 2,598 | 57,594 | 75,000 | 2,898 | 9,701 |
| 1929 | 2,757 | 2,009 | 8,664 | 12,109 | 2,502 | 47,691 | 81,284 | 2,148 | 17,594 |
| 1930 | 2,762 | 4,964 | 8,955 | 7,899 | 1,774 | 35,365 | 89,151 | 3,421 | 16,864 |
| 1931 | 2,573 | 5,420 | 8,336 | 6,127 | 2,559 | 39,634 | 77,098 | 3,924 | 12,323 |
| 1932 | 2,444 | 4,087 | 7,788 | 5,430 | 2,275 | 37,725 | 59,771 | 3,099 | 3,516 |
| Mean | 3,411 | 5,402 | 5,486 | 6,505 | 2,957 | 22,583 | 49,949 | 2,591 | 10,546 |

[1] The number of sheep and beef cattle does not include those brought in from summer range to be fed during the winter months.

## LAND RECLAMATION

Since the establishment of the Newlands station, extensive investigations have been conducted in the effort to determine the possibilities of various methods of reclaiming the more refractory soils (*5, 6, 7, 9, 10*).[2] Adoption of improved irrigation practices and the effect of applying various chemicals to the soil have been investigated. The effectiveness of other less expensive treatments has been tested. These tests have been made chiefly to determine the value of stable manure and chemicals, various cropping methods, and improved cultural practices as aids in reclaiming saline soils.

In many instances the quantity of soluble salts that occur in these unproductive areas, together with the character of the soil, makes reclamation difficult and costly. However, it has been found that many tracts have adequate drainage, and the soil is of such a character that it is possible to reclaim the land at an expense within the means of many landowners. Generally these areas range from a compact adobe to a sandy loam. Usually they are impregnated with substantial quantities of salts. The adobe soils have such a physical texture that water will not penetrate more than 2 or 3 inches during the process of an ordinary irrigation. The sandy loam type takes water quite readily but upon drying the surface becomes very hard. As a result of this cementing quality seeds do not germinate readily, and those that do emerge are in such a weakened condition that the mortality is high.

An essential to land reclamation is adequate drainage. Drainage, in the sense it is used here, is not confined solely to the removal of underground water, although this is recognized as fundamentally essential, but also, surface drainage of surplus water remaining

[2] Italic numbers in parentheses refer to Literature Cited, p. 35.

after irrigating, coupled with the engineering means of removing underground water where the water table is too close to the surface. There must be adopted also such cultural practices—including the addition of soil amendments where required—together with such irrigation practices that there is a movement of the irrigation water applied downward through the soil so that the soluble salts may be removed. Often the quantity of water required to leach the land is underestimated, consequently the reclamation endeavors are often ineffectual because of the inadequate penetration of the irrigation water.

The amount of the water used and the uniformity with which it is applied to the surface are factors directly under the control of the farmer who must operate efficiently if his reclamation endeavors are to be successful. Consideration should also be given to the character of the soil in planning the system of distribution. If the border method is adopted, the most satisfactory degree of slope

FIGURE 1.—Field basin irrigation at the Newlands Field Station. If adequate water penetration cannot otherwise be attained, this system of applying water may be resorted to advantageously.

will be influenced materially by the character of the soil. In the case of a sandy soil, which takes water readily, the grade may be as much as 3 or 4 inches to the hundred feet. For the heavier, more refractory soils the gradient must be reduced, and at times basin irrigation may be required. This latter method has been used on areas of extremely impervious soil in order to hold the water on the surface for long periods and thus facilitate penetration (fig. 1). However, such methods of irrigating cannot be practiced after the area is in crop. The intense heat of the summer sun tends to scald the plants; hence the principal use of basin irrigation is as a preliminary step in reclamation prior to seeding.

The method of applying water that has proved the most satisfactory at the Newlands station as a means of reclamation is one which utilizes little slope and large plots (fig. 2). The most satisfactory gradient has proved to be about 1.5 inches per hundred feet for a plot 62 by 680 feet. Heads of water not in excess of 4 second-feet are used. Such a flow will irrigate a plot of this area in from 40 to 60

minutes, the time required depending largely on the state of crop growth and the need of water, as well as on the character of the soil and the crop.

There are times when the use of a specified head of water is somewhat modified. If there exists definite surface indication of soluble salts a larger head of water may be used advantageously, in order that the water may flow over the plot rapidly to wash off the surface accumulations of salt, thus avoiding penetration as much as possible. Obviously such flushing action requires adequate surface drains in order to remove the surplus water.

The foregoing discussion of land preparation and irrigation applies regardless of the system or systems of land reclamation adopted. In the following paragraphs is included a discussion of the methods adopted and the success attained in reclaiming the more refractory

FIGURE 2.—A virgin field properly prepared for reclamation with barley that had been seeded in the spring. Photographed July 25, indicating the productivity of such areas prior to intensive treatments. Compare with figure 3, which shows an unproductive area of the adobe type.

types of soil by (1) chemical treatments and (2) by the use of special cultural methods. In the latter investigations special consideration has been given to the development of improved cultural practices as an aid to more adequate water penetration.

### RECLAMATION BY CHEMICAL TREATMENTS

The aims in reclamation practices by use of chemical treatments have been two: (1) The changing of the more toxic alkaline salt into one of the less toxic forms, e.g., sodium carbonate to sodium sulphate by the use of gypsum; (2) the improvement of the physical properties of the soil by improving its perviousness to irrigation water. The treatments with certain chemicals have proved relatively effective but rather costly. The process involves applying these chemicals either alone or in combination with each other or with other treatments. The usual procedure has been to apply the chemicals directly to the area to be reclaimed after it has been leveled and prepared for

irrigation. If gypsum, sulphur, or alum are the reclaiming agents being used, the practice has been in some cases to apply them either by broadcasting by hand or using them in a manure spreader in combination with manure. In this latter case the gypsum, sulphur, or alum, or combinations of one or more, are added on top of the load of manure. A few loads with the manure spreader will soon determine the rate of application desired. In the investigations as much as 2 tons of sulphur and 10 tons or more of gypsum have been applied. If used in combination with farm manure or a green-manure crop, it has been found that the amounts used may be materially decreased. Some results have been obtained from using 1,000 pounds of sulphur in combination with 18 tons of manure to the acre. However, sulphur has not proved as effective in the Fallon area as some other treatments. Some benefits have resulted from the application of 4 or 5 tons of gypsum per acre in combination with heavy applications of manure. In comparing the merits of alum and gypsum the former has proved to be the more effective as an aid in obtaining more adequate water penetration on the more impervious soil types. Sulphuric acid has been tried as a reclaiming agent, the liquid having been poured into the irrigation water as it entered the plot to be treated. The use of this acid proved to be effective but relatively expensive.

The chief drawback to the use of gypsum alone, other than that of expense, has been the time required to effect the reclamation. The low solubility of gypsum requires a large number of applications of irrigation water to dissolve all the material when applied to the soil in the usual manner. In order to hasten this reclamation procedure a machine has been developed which dissolves and distributes the gypsum in the irrigation water (*11*). This is accomplished by causing the flow of irrigation water to furnish the power to turn a paddle wheel. This in turn drives an agitator partly immersed in the stream. Finely ground gypsum feeds down from a storage bin through an adjustable feed opening. The agitator consists of four paddles enclosed in a perforated cylinder. The revolving paddles mix the inflowing gypsum with the water flowing through the perforated cylinder. By thus agitating the water and gypsum together it was found possible to apply gypsum-saturated water to the area being reclaimed. This method reduces the time necessary for reclaiming and increases the efficiency of the application of this chemical. During the 2 years of trial it was found that an average of 210 pounds of gypsum was applied to each acre of land during each irrigation; hence it is possible to apply about 1 ton of dissolved gypsum per season under local irrigation practices.

The use of alum as an agent of reclamation has shown a rapid improvement in small areas in productive fields, but the treatment is expensive. It is doubtful if present land values will justify such an expenditure on an extensive scale. The greatest benefit to be derived from the use of this chemical lies in its ability to alter the physical property of a soil quickly. Areas that were impervious to water were greatly improved within a few days after application of the alum ore. The process employed was to spread the alum over the area to be treated and then flood with water, keeping the entire area under water for about 24 hours. Three half-acre plots of highly impervious soil at the Newlands Field Station were treated in this manner with several tons of alum ore. The treatment was applied during the

spring of 1922, before the present drainage system was instituted, and resulted in a material improvement in the perviousness of the soil making it possible to obtain a fairly uniform stand of alfalfa.

These investigations of chemical treatments for reclaiming lands on the Newlands reclamation project have disclosed that such treatments will result in definite improvement, particularly if alum and gypsum are used, but the cost of such treatments does not justify attempts to reclaim extensive areas under present conditions. Chemical applications may be justified if only small areas in a field are involved or if it is desired to reclaim a small tract of valuable land.

### RECLAMATION BY CULTURAL METHODS

While investigations were being conducted on the reclamation of the more refractory soil types by chemical treatments, consideration

FIGURE 3.—Typical adobe area on the Newlands Field Station. Highly impervious to water, but possible to reclaim. Photographed in May 1908, soon after the station was established.

was being given to the development of other methods that might prove to be less expensive and therefore have a somewhat more general application. Efforts were made to determine the effectiveness of such measures as treating the soil with stable manure and the intensive application of certain improved irrigation and cultural practices. In the following paragraphs methods of procedure are outlined that have given satisfactory results in land reclamation and are materially less costly than the chemical treatments.

After leveling the land very carefully, manure is applied at the rate of 20 tons or more per acre, with seasonal applications as high as 40 tons per acre on some of the more refractory soils. The manure is thoroughly disked into the surface rather than plowed under. The reason for this is obvious. The first requisite for the establishment of a crop is a good seed bed. Manure worked into the topsoil facilitates the penetration of water and consequently the leaching out of harmful salts. It also aids in preventing the soil from crusting. After the

application of manure and the disking operation the land is again smoothed for irrigation.

During the first season the land is not necessarily cropped. Irrigations are given about every 2 weeks. Each irrigation is followed by a shallow cultivation. The entire area is treated as if it were in some cultivated crop. The object of such treatments is to aerate the soil and facilitate water penetration and the decomposition of the manure. During this period the application of water should be copious, as the removal of the harmful salts depends on the leaching effect of the water.

After the first year the land should receive another application of manure, but this may be somewhat lighter than the first. This is again worked into the soil by disking or harrowing, and the land is again smoothed for irrigation. Under favorable conditions it is

FIGURE 4.—View of an alfalfa field on the Newlands Field Station on reclaimed land that was formerly like that shown in figure 3.

possible to seed at this stage. However, if the condition of the soil does not warrant seeding, the procedure followed the first year should be repeated. The crop planted should be one not highly susceptible to salt, nor easily injured by frequent irrigations. Sweetclover has proved satisfactory in these respects. It is planted with barley or rye as a nurse crop. The resulting growth may be cut for hay, but it has been found that where pasturing is possible this is preferable. If the crop cannot be pastured it should be cut the first year and left on the ground to be disked into the soil the following spring. The land should then be ready to seed either to a grass pasture for further pasturing or to alfalfa. In planting grasses for pasturing, following 2 years of pasturing sweetclover, the grass seed is broadcast into the sweetclover stubble without previous disking. The area is lightly

harrowed to cover the seed and then irrigated. It may be found advisable to apply a light coating of manure and straw to prevent the soil from drying out and destroying the small grass seedlings.

If the sweetclover is disked under before seeding alfalfa, the alfalfa is planted with a nurse crop. The same procedure is used in planting as is used in planting any area to alfalfa, except that greater care is exercised in smoothing the land for irrigation.

The method of broadcasting the grass seed in the sweetclover stubble has proved to be the best way of obtaining a stand of pasture grasses (fig. 5). After 2 or more years of irrigating a sweetclover pasture crop, the 2 or 3 inches of surface soil is generally washed fairly free of harmful salts. Likewise this surface area will contain some humus from the cultural practices involved. An inch or so of surface soil free of injurious salts and containing humus to aid in retaining moisture makes an ideal seed bed for grass and clover.

Very satisfactory results have been obtained by this process of reclamation, which has the distinct advantage of being less expensive than chemical treatments. Many farmers have access to fairly large supplies of manure and some available time during the winter months to work on such a project. If advantage is taken of this condition in leveling the land and applying manure, it will result in turning otherwise worthless land into an asset and at relatively low cost (figs. 3 and 4).

Another method of establishing a seed bed and of aiding water penetration is to cover the land with a coating of coarse sand. An application of 3 or 4 inches will provide a relatively satisfactory seed bed and maintain moisture in the underlying soil. This method of reclamation has given satisfactory results on certain types of adobe soil, but it is expensive unless sand is conveniently available. However, in many instances sand hills are close by, and for small areas particularly such treatment has definite possibilities.

## FIELD CROPS

### ALFALFA

Since the inception of the Newlands project, alfalfa has been the chief crop grown. It was early determined that for the first few years at least the lands could be most advantageously devoted to this crop. The relative importance of alfalfa is evidenced by the fact that for the 21-year period 1912 to 1932, 62 percent of the total irrigated area has been devoted to alfalfa, and for the 10-year period 1923 to 1932 this percentage has increased to 67 percent. The variety most commonly grown is known as Western Common. It is probably a strain of Chilean.

#### CULTURAL PRACTICES

In the preparation of the land for alfalfa, special attention should be given to leveling. It is essential that this operation be properly performed if satisfactory results are to be obtained. A few extra hours spent in preparing the land for seeding will be found to have been well spent. Properly leveled land greatly reduces the labor involved in irrigating and increases the yields.

It has been found advisable to level the land roughly at first, giving it the desired slope. The degree of slope depends upon the type of soil

and the head of water that will be used for irrigation. Following this operation the roughly leveled area is smoothed over. Usually this feature of the preparation of the land is most effectively performed by using what is known locally as a "tailboard scraper." This piece of farm machinery is made in various sizes. Usually the one fitted for use with eight horses is used at this stage of the leveling. The object of this leveling operation should be to eliminate all high or low spots and maintain a constant degree of slope, without side fall, in the direction of the flow of the water.

After this phase of the leveling operations has been completed, parallel levees are thrown up to give the desired width to the plots. These are generally wide and low in order that they will subirrigate. In this manner it is possible to obtain an alfalfa stand over the levees as well as between them. This greatly increases the yield of the field and prevents the growth of weeds on the borders.

The general practice at this stage of the leveling operations is to put in the irrigation boxes and flood the plots before planting. This method gives a further check on the leveling and also causes newly filled areas to settle before planting. As soon as the surface has dried sufficiently to permit working the land, the entire area is resurfaced to remove all high spots and to fill depressions. Often there is moisture sufficient to germinate the seed without reirrigating; if not, the land should again be irrigated. Sometimes this second irrigation seems advisable regardless of the state of moisture. This is especially important if any large fills have been made during the leveling operations. These areas will continue to settle for some time, and any settling can be more easily remedied before seeding than after.

Sometimes these final leveling operations leave a crust over the surface area leveled. Such a condition should be remedied before seeding. A light harrowing at this stage of the land preparation is advisable. After it is assured that there is enough moisture and a proper surface mulch, the seeding is undertaken.

If alfalfa is planted with a cereal as a nurse crop, the grain is first seeded and after sufficient time has elapsed for it to sprout, alfalfa is sown, using from 15 to 18 pounds of seed to the acre. While the alfalfa is young rather frequent irrigations are necessary. The interval between irrigations depends on the type of soil, the sandier soils requiring more frequent irrigations. As the alfalfa develops, the irrigations may be less frequent. As a general rule, during the hottest part of the summer mature alfalfa will need an irrigation about every 2 weeks. Less frequent irrigations are required during the spring and autumn. In all, about 8 to 10 irrigations should be given during the growing season.

It is advisable to seed alfalfa in the spring with grain as a nurse crop. The grain is an aid in protecting the young alfalfa seedlings from the heat and spring winds. Usually the grain crop is harvested in July and helps to defray a part of the expense of seeding alfalfa. There is generally one light crop of alfalfa the first year. Thereafter three crops are usually cut each year. The first is cut about the middle of June, the second the last of July, and the third the latter part of September. Observations have shown that about 36 percent of the total yield of hay is obtained from the first cutting, 35 percent from the second, and 29 percent from the third.

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There are two methods of irrigating alfalfa on the project. The method used in the Fernley district is furrow irrigating and on the rest of the project flooding or border irrigating. The greater area of the project is irrigated by this latter method. Numerous experiments have shown the advisability of allowing the water to flow slowly over the heavier soils to produce adequate penetration. The rapidity of the flow is determined by the degree of slope given the area to be irrigated.

With the exception of irrigating during the growing season, little labor other than harvesting is involved in producing alfalfa hay. Some farmers renovate their fields with a spring-tooth harrow in the spring. This is recognized as a desirable practice, for it eradicates many weeds and tends to keep in check some of the insect pests.

As the yields harvested have a marked effect upon the production costs per ton, it is important that high yields be maintained. Where soil conditions are favorable and good farming practices followed, yields of 5 tons or more per acre are not unusual. Under such conditions alfalfa production has proved to be the most promising farm enterprise on the Newlands project (4).

### CEREALS

It is doubtful if extensive acreages of the cereals should be advocated for the more productive lands of the Newlands project or adjoining irrigated areas. However, the value of these crops in certain respects should not be ignored. Settlers who keep livestock usually find it advantageous to produce sufficient grain for their requirements. Even where little or no livestock is kept on the farm it is advisable to include certain of the cereals because they are good nurse crops for alfalfa or sweetclover.

The cereals grown on the project are chiefly barley and wheat. Most of the wheat produced is of the hard winter varieties, being planted in the early fall, although some soft wheats are spring planted, frequently as a nurse crop for alfalfa. Most of the wheat is either fed to poultry or sold locally.

Several years of experiments were completed in 1929 showing the effect of fertilizers on spring wheat (7). In these tests manure and superphosphate were used. The tests were in a 2-year rotation of corn and wheat. The year the corn was planted manure was applied at the rate of 15 tons to the acre. At the time of planting wheat 250 pounds of superphosphate to the acre was added. The results of the use of the manure alone increased the wheat yield nearly 40 percent. The use of the superphosphate and manure in later experiments increased the yield over 100 percent. Project yields have been recorded from certain more productive areas where no increases were obtained by using either manure or superphosphate. The project areas on which these tests were made were producing well over a ton of spring wheat to the acre. The areas at the Newlands station on which these fertilizer tests were made produced less than the average of the project. The soil was of a light, sandy nature, containing very little humus and some soluble salts.

The acreage devoted to barley is small. Relatively satisfactory yields have been harvested, yet the local prices have not thus far justified an extensive planting of this cereal. However, the crop serves a useful purpose in supplying feed for dairy cattle and certain

other classes of livestock on farms and often may be included in the cropping program to advantage.

The chief purposes served by barley, as well as other cereals, in the cropping program have been (1) supplying at least partially the needs of the livestock on the farms, (2) acting as a nurse crop for alfalfa, and (3) where production costs are low, for planting lands not yet well adapted to alfalfa.

### VARIETAL TESTS WITH WHEAT

A number of varietal tests have been conducted with both wheat and barley to select those varieties likely to be best adapted to the local conditions. Eight different varieties of wheat were grown on private farms during a 5-year period, under conditions somewhat more favorable than those existing at the Newlands station; this was done to ascertain the yield to be expected from the more productive areas. The results covering this 5-year test given in table 6 indicate that relatively satisfactory yields may be expected where soil conditions are favorable.

TABLE 6.—*Varietal tests of wheat on several Newlands project farms for a 5-year period*

| Variety | Average yield per acre | | Variety | Average yield per acre | |
|---|---|---|---|---|---|
| | *Pounds* | *Bushels* | | *Pounds* | *Bushels* |
| Little Club | 2,468 | 41.1 | Bluestem | 2,095 | 34.9 |
| Rieti | 2,226 | 37.1 | Marquis | 2,008 | 33.5 |
| Sonora | 2,129 | 35.5 | Defiance | 1,992 | 33.2 |
| Dicklow | 2,027 | 33.8 | Early Baart [1] | 1,530 | 25.5 |

[1] 2-year test only.

More recent tests with spring wheats were made at the station in 1931 and 1932, including four varieties of spring wheat, namely, Arizona No. 24, Little Club, Spring Federation, and Early Baart. The results are recorded in table 7.

TABLE 7.—*Varietal tests of wheat at the Newlands Field Station in 1931 and 1932*

| Variety | Average yield per acre | | Variety | Average yield per acre | |
|---|---|---|---|---|---|
| | *Pounds* | *Bushels* | | *Pounds* | *Bushels* |
| Arizona No. 24 [1] | 1,916 | 31.8 | Early Baart | 1,627 | 27.1 |
| Little Club | 2,127 | 35.5 | Jenkins Club [1] | 2,143 | 35.7 |
| Spring Federation | 1,602 | 26.7 | | | |

[1] 1-year test only.

### VARIETAL TESTS WITH BARLEY

The average yield of barley on the project is about the same as wheat, or about 1,300 pounds, approximately 27 bushels per acre. Varietal tests of this cereal have been conducted on private farms. The varieties used in these tests were Coast, Trebi, Hannchen, Svanhals, Chevalier, Nepal (hull-less), and an unknown variety purchased locally from seed grown on the project. The average yields from these different varieties over a 5-year period are given in table 8. In comparing the results with wheat and barley, as given in tables 6, 7, and 8, larger yields in bushels as well as in tonnage per acre may be expected from wheat than from barley when grown on the more productive soils.

TABLE 8.—*Average acre yields of barley varieties on several Newlands project farms for a 6-year period*

| Variety | Average yield per acre | | Variety | Average yield per acre | |
|---|---|---|---|---|---|
| | *Pounds* | *Bushels* | | *Pounds* | *Bushels* |
| Coast | 1,057 | 34.5 | Svanhals | 1,232 | 25.7 |
| Local [1] | 1,474 | 39.7 | Chevalier | 1,227 | 25.6 |
| Trebi [1] | 1,323 | 27.6 | Nepal (hull-less) | 1,010 | 21.0 |
| Hannchen | 1,298 | 27.0 | | | |

[1] 4-year test only.

[1] 3-year test only.

RYE

Rye has never been grown at the Newlands station as a grain crop. The few times it has been planted it was fall-sown, to be used during the winter months and the following spring as a pasture crop. Generally it has been grown on the more refractory soils where poor stands of other cereals would be obtained. A planting of fall rye has often served as a nurse crop the following spring for sweetclover. In this case both the rye and sweetclover serve later as a pasture crop.

The results obtained with wheat, barley, oats, and rye indicate that the largest tonnage per acre may be expected from wheat with barley second. Neither oats nor rye is extensively grown and furthermore, except for specialized use, the planting of these two cereals is not recommended.

CORN

The relatively short growing season of 125 frost-free days characteristic of this locality, together with the wide daily range in temperature which results in rather cool nights, makes it necessary to select early-maturing varieties if a corn crop is to be assured. Several of the so-called "90-day varieties" usually will mature. Tests of varieties have been conducted which indicate that several are adapted to the local conditions (7).

These experiments have shown that most of the early-maturing corn planted about May 10 matured before the fall frosts occurred. The varieties producing over a ton of shelled corn to the acre for 2 of the 3 years of this test were Early Murdock, De Wolfs Prolific, Wisconsin No. 7, and Wimples Yellow Dent. The yields of several varieties are recorded in table 9.

Silage corn has been grown at the station every season during the years 1917–32 with the exception of 1931, a year of water shortage. The corn is drilled about May 10, rather closely in rows 3 feet apart, and harvested during the first or second week of September. Yields as high as 14 tons per acre have been made. Several varieties are used including Minnesota No. 13 and Reid Yellow Dent. The variety being adopted at the Newlands station for the dairy-feeding investigations is sold under the trade name of Red Cob Ensilage and has proved to be quite satisfactory.

TABLE 9.—*Acre yields of corn varieties grown at the Newlands Field Station, 1924–26*

| Variety | 1924 | 1925 | 1926 | 3-year average | |
|---|---|---|---|---|---|
| | *Pounds* | *Pounds* | *Pounds* | *Pounds* | *Bushels* |
| Early Murdock | 2,595 | 2,381 | 1,881 | 2,286 | 40.8 |
| Gurneys Rainbow | 2,768 | 2,098 | 2,500 | 2,455 | 43.8 |
| Wimples Yellow Dent | 2,318 | 2,248 | 1,930 | 2,165 | 38.7 |
| Northwestern Dent | ---------- | 2,082 | 1,881 | 1,981 | 35.4 |
| Wisconsin No. 7 | 2,388 | 2,160 | 1,979 | 2,176 | 38.9 |
| De Wolfs Prolific | 2,803 | 2,262 | 1,652 | 2,239 | 40.0 |
| Champion White Pearl | ---------- | 2,796 | 1,870 | 2,333 | 41.7 |

## POTATOES

Several of the soil types of the Fallon project are not adapted to potato culture. The most satisfactory results have been obtained in the Carson River bottom lands which have been subjected to overflowing in years past and to which the commercial acreages are largely confined. The soil in these areas is a silt loam easy to work and very permeable.

To produce smooth marketable potatoes good seed free from disease should be selected, the land should be well cultivated, proper crop rotation should be practiced, and favorable soil-moisture conditions should be maintained. The soil should never be allowed to become too dry. Enough moisture should be maintained to cause the particles of soil to cling together readily when squeezed in the hand. If the moisture falls below this point, trouble may be expected to develop in the form of a second growth. If such a condition occurs during the growth of the tubers, a rough unmarketable product results.

The best time to plant potatoes to obtain maximum yields has proved to be between April 20 and the middle of May. Plantings made after the later date have yielded less, whereas plantings made much earlier than April 20 are in danger of frost injury.

Tests to determine the best type of seed to use have shown that medium-sized potatoes free from disease should be selected. Such seed has produced heavier crops when planted whole than when the potatoes have been cut. However, when too large potatoes have been selected the increased quantity of seed required has more than offset any additional increase in production. The use of culls has caused a decided decrease in yields (*6*).

Investigations conducted to determine the comparative merits of 9 different varieties showed that 3 varieties were the heaviest producers. These are Portland Netted Gem, Pride of Multnomah, and Burbank. Each of these varieties produced over 200 bushels to the acre on the light sandy station soil. It was found that less difficulty was experienced in producing a smooth, more marketable potato from the Portland Netted Gem and Multnomah varieties than from the Burbank (*7*).

The chief pest injury with which local growers of this crop must contend is a nematode infection. The years in which this trouble was most evident on the Newlands Field Station were those in which potatoes were planted on soil that had been in alfalfa the previous year. The most promising method of control yet developed is to grow potatoes in a well-planned rotation, particularly to have them follow a crop that is not susceptible to injury from the pest (*8*).

### CANTALOUPS

Most of the cantaloups raised for car-lot shipments to eastern markets are produced on the bench lands by a few farmers. The seed is planted in hills 6 feet apart each way on the edge of a furrow to facilitate irrigation. Frequently water is run in the furrows before planting in order to be certain that the seed is moistened.

The seeding is done as early in May as weather conditions will permit. Two methods are practiced to insure against loss by frost. One is to protect each hill with paraffined paper caps. The other method is to make two plantings about 10 days apart without waiting to see whether the first planting survives damage by frost. By the latter method, if the first planting is partially or wholly destroyed it will be replaced with the second planting a few days later. If this first stand does not suffer damage, the later planting is removed. In the case of light frosts some protection is afforded by night irrigation during the period of low temperature. The first melons or "crown set" are generally ready to pick about August 20. The picking continues daily until the first frosts occur.

During the period 1922 to 1927 it was believed that a cantaloup industry might be established in the Fallon area, with the result that much encouragement was given the project by local and State organizations. However, it was soon found that the short season, combined with the late ripening, worked to the disadvantage of the growers. Local melons ripened at the peak of the season from many other localities having similar climatic conditions. The distance from large consuming centers was also a handicap. As a result the acreage planted each year has dwindled to a small area that furnishes the local demand and fills the market requirements that can be served by express or parcel-post shipments.

The varieties that have proved the most satisfactory, based on investigations conducted at the Newlands Station, are Hearts of Gold and Hales Best. As a result of fertilizer tests it was found that superphosphate was the most beneficial, nitrates slightly so, and potash not at all.

### PASTURE GRASSES

Investigations to determine the possibilities of establishing permanent grass pastures have been part of the dairy activities on the Newlands Station for a number of years. Various mixtures of grasses and clovers have been tried with three primary objects in view: (1) Grasses or clovers that are adapted to local climatic conditions as a source of green feed for dairy cows; (2) the carrying capacity of pastures as compared with alfalfa hay; (3) the effect of pasturing as a possible aid in land reclamation.

The results of growing various grasses and clovers to determine their adaptability have shown that the following varieties are adapted: *Bromus inermis*, tall oatgrass, orchard grass, English or perennial ryegrass, Australian ryegrass, Kentucky bluegrass, redtop, meadow fescue, white Dutch clover, alsike clover, Ladino clover, and sweetclover. The mixture recommended consists of the following: Bromegrass, tall oatgrass, orchard grass, English ryegrass, Kentucky bluegrass, redtop, meadow fescue, white Dutch clover, and alsike clover; or Australian ryegrass and Ladino clover. By planting the first mixture the coarser grasses furnish early feed during the time the finer

stemmed grasses and clovers are establishing themselves. Also, it was found that one grass adapts itself more readily to certain types of soil or withstands a little more salt than others. By taking advantage of such a combination a stand is usually assured on the soil conditions characteristic of this locality.

The problem of obtaining a satisfactory stand is often rather complex. The grass and clover seed are small and consequently must be lightly covered if the plants are to emerge. The following method

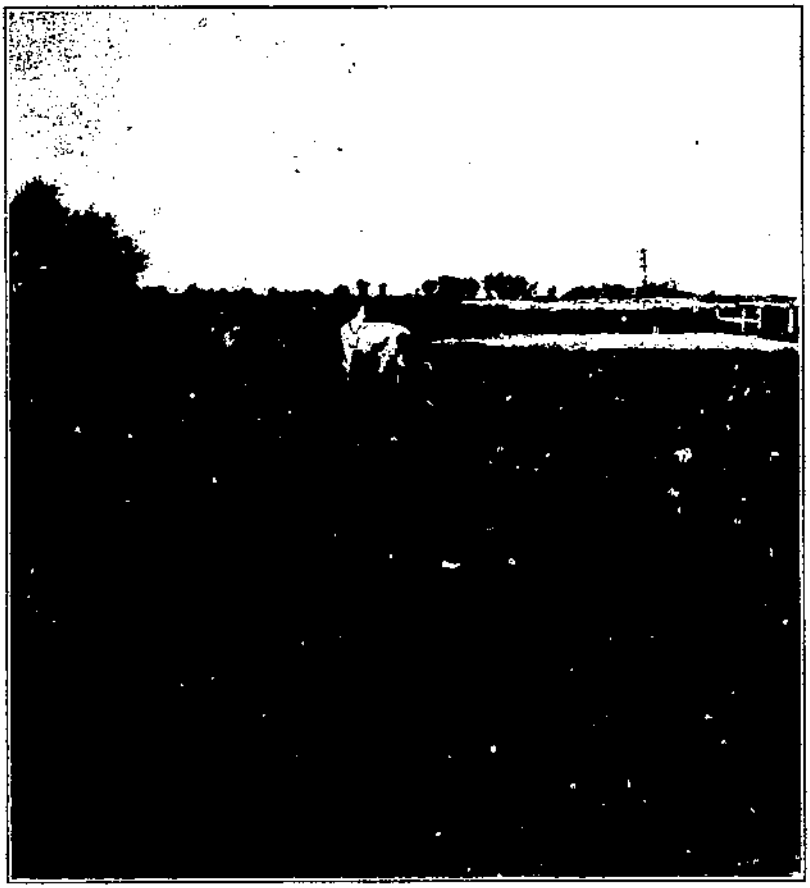

FIGURE 5.—Ladino clover and Australian ryegrass pasture at the Newlands Field Station. This is a very satisfactory pasture combination and is useful in connection with land reclamation.

has been used successfully at the station. The area to be seeded is first very carefully leveled and then flooded. After the land has dried sufficiently the seed is broadcast and lightly harrowed in. This is followed by a light application of manure into which grain straw has been worked by using it as a bedding in the cow barn. From this stage on it is a question of maintaining the proper surface moisture conditions, never allowing the surface to dry out. This procedure necessitates frequent irrigations. After a good stand is obtained the irrigations may be less frequent. However, it has been found advisable to irrigate about once a week during the pasturing season.

Sweetclover, either the white or yellow variety, is often used as a pasture crop. The cows seem to maintain their flesh and production just as well on this pasture as on grass pasture. However, investigations have disclosed that the carrying capacity of sweetclover is less than that of the grass mixtures. It has been found that sweetclover has a seasonal carrying capacity of 196 cow-days to the acre as compared to 230 cow-days on grass pasture. These records were obtained with cows subsisting entirely on the pasture. More recent tests indicate that the Ladino clover and Australian ryegrass pasture mixture will equal or exceed all former carrying capacities of pasture mixtures. Pasturing data obtained during the past season (1932) on a 1-year-old

FIGURE 6.—Variety test of cabbages and melons at the Newlands Field Station. These two vegetables, as well as a relatively large number of other vegetable crops, are well adapted to the Newlands project conditions.

pasture of this mixture showed a carrying capacity at the rate of 236 cow-days to the acre (fig. 5).

## VEGETABLES

As far as yield and quality are concerned a number of vegetables may be produced successfully in the Fallon area, although the problem of marketing at remunerative prices has restricted extensive plantings. However, the growing of vegetables has been extensively practiced and undoubtedly in many instances could be expanded advantageously in order to supply the local requirements and to aid in reducing the cost of living on the farm (fig. 6). In this respect the extent to which the home garden may be developed into a substantial asset is often underestimated. A large part of the living expenses

of the home may be met by a well-planned garden. The area involved is not large, usually from one-half acre to an acre in size, depending on the number in the family. Where irrigation water is available and the drought hazard eliminated, conditions are particularly favorable for a garden consisting of a wide range of vegetables and small fruits to supply the family throughout the summer, and even extending into winter months if a surplus is provided of the more hardy sorts of a character adaptable to cellar storage. Numerous variety tests have been conducted for the purpose of determining those best suited to the local conditions. In considering the desirability of the different varieties their adaptability to local conditions as well as their quality has been emphasized.

### TOMATOES

The length of the growing season on the Newlands project is rather short for tomatoes; therefore, it is essential that early-maturing varieties be selected. If home-grown plants are to be used, the seed should be planted the latter part of March in the greenhouse or hotbed and transplanted to the field about May 20 or as soon as danger of frost has passed. As a rule the first tomatoes are ready to pick about August 20.

A number of variety tests have been conducted. The results of 8 years' tests, previous to 1925, placed the seven varieties in the order of production as given in table 10.

TABLE 10.—*Acre yields of tomato varieties at the Newlands Field Station in stated years*

| Variety | Number of years grown | Acre yield (tons) in— | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1914 | 1915 | 1916 | 1917 | 1921 | 1922 | 1923 | 1924 | Average |
| Earliana | 6 | ..... | 3.5 | 5.7 | 3.7 | 7.6 | 18.5 | ..... | 26.0 | 10.8 |
| Perfection | 7 | 6.3 | 5.4 | 3.9 | 4.4 | ..... | 19.5 | 4.4 | 18.9 | 9.0 |
| Ponderosa | 6 | 6.0 | 1.0 | ..... | 1.1 | ..... | ..... | 10.5 | 15.5 | 6.8 |
| Globe | 6 | 5.0 | 1.9 | .4 | 1.0 | ..... | 10.1 | ..... | 11.4 | 5.0 |
| Stone | 6 | 4.5 | 1.9 | .1 | 1.6 | 3.1 | 12.9 | ..... | ..... | 4.0 |
| Golden Queen | 5 | 3.7 | 1.2 | ..... | ..... | ..... | 7.5 | 4.5 | ..... | 4.2 |
| Dwarf Champion | 7 | 3.7 | 1.6 | .3 | 1.8 | 2.2 | 6.5 | 4.3 | ..... | 2.9 |

Following these tests another variety, the June Pink, was included. Its flesh is deep pink and quite firm, having little juice. It is doubtful whether this variety will prove to be a good canning tomato commercially. Many produce houses prefer a red tomato, as this type sells more readily than those of lighter shades. However, as far as the farm garden is concerned the June Pink variety has proved to be particularly satisfactory because of its superior yielding qualities and the fine texture and flavor of the fruit.

### PEAS

The local conditions have not proved to be particularly satisfactory for the commercial production of garden peas, although they may be advantageously included in the farm garden. The hot dry atmosphere tends to develop a rather small, somewhat off-flavored pea. The varieties tested were Early Alaska, Early Market, and Potlatch. Seeding may be made as early as April 20, and if planted at this time

the first picking should be available about the middle of June. In the tests conducted Early Alaska matured on June 19, followed by Early Market on June 24 and by Potlatch on July 7. Potlatch yielded heavier than either of the other two varieties, but it has a much coarser texture and is not as pleasing to the taste as the other two. Potlatch yielded 16 pounds to the 100-foot row, Early Market 13 pounds, and Early Alaska 12 pounds. As far as palatability is concerned there is little choice between the Early Alaska and the Early Market.

### BEANS

Satisfactory results have been obtained with beans, and this vegetable is to be recommended for the home garden. Two varieties were tested and found to be reliable bearers and of good quality. The pole variety known as the Kentucky Wonder and the bush type called Sure Crop have been grown a number of years with success. Spring frosts, which occur in this locality on an average as late as May 19, necessitate relatively late planting. However, the warm weather of late May, June, and July rapidly matures the vines. In the tests conducted the average planting date fell on May 23, and the first picking date on July 29 for the Sure Crop variety and on August 5 for the Kentucky Wonder. The Sure Crop produced 49 pounds to the 100-foot row and Kentucky Wonder 41 pounds.

### CUCUMBERS

This crop does exceptionally well under local conditions, and a few vines will supply the needs of the family. The vines mature rapidly and are very prolific. It is customary to plant in single rows 4 feet apart.

The varieties tested were Evergreen Pickling and Davis Perfect. The planting date averaged May 11 and the first picking may be expected between the middle and latter part of July, or about 70 days after planting. There did not seem to be an appreciable difference between the two varieties in the length of time elapsing from planting to first picking date. The yields recorded favored the Davis Perfect, which produced 375 pounds to the 100-foot row as compared with 282 pounds for the Evergreen Pickling variety.

### ONIONS

Various tests have been made with this crop from time to time. The climatic and soil conditions of the Newlands project have proved well adapted to this vegetable. The chief drawback to raising onions for an outside market is the wide range of prices paid from year to year. Onion production other than to supply the local markets has proved to be a hazardous enterprise.

In the test plantings the usual double-row system was adopted, each double row occupying 3 feet of space. The plantings were made on the average date of April 23 and harvested about the middle of October. Six varieties were chosen as best from the results obtained in former tests. They were Yellow Globe Danvers, Mammoth Yellow Prizetaker, Ohio Yellow Globe, Red Wethersfield, Mountain Danvers, and Riverside Sweet Spanish. The latter is a new variety grown for the first time at the Newlands station in 1928. It yielded well and was exceptionally large, well formed, and mild. The yields per 100-foot row are given in table 11.

### CABBAGE

Each year cabbage seed is planted under glass in coldframes and the plants are later transplanted to the garden. The average date of this transplanting was May 24. The mature cabbages have been harvested about mid-October and stored for winter use. Generally the method of storing was to bury the cabbage in a dry sandy soil with the head down.

They were planted in single rows 3 feet apart. The yields recorded per 100-foot row are given in table 11.

### SWEET CORN

This crop does well on old alfalfa land, but usually does not produce well on new land. The greatest difficulty connected with growing corn is the corn earworm. Thorough dusting of the silk with sodium fluosilicate or pyrethrum preparations will prevent serious injury of the ear by this pest. Early-maturing varieties should be planted. Golden Bantam is a particularly sweet and well-flavored variety and is a satisfactory producer.

### PUMPKINS AND SQUASHES

Most varieties of pumpkin and squash do well under local conditions, and a few vines of each should be included in the farm garden. A few vines of the White Bush Scallop, Summer Crookneck, and Hubbard squashes will guarantee an ample supply of these vegetables for the summer and fall, and for winter storage. The most desirable pumpkins for winter storage are the smaller varieties like Small Sugar and pie pumpkins.

### ASPARAGUS

As asparagus is a perennial crop it should be located where it will not conflict with the operations incident to caring for annual plantings. Usually 1- or 2-year old roots are planted in well-manured trenches about 8 inches deep and 18 inches apart in the row, the rows being about 2 feet apart. Usually the crop is not harvested the first year and only rather sparingly the second. Commencing with the third year the early sprouts are cut below the ground surface as they appear. Toward the end of June harvesting is stopped, and the plants are allowed to produce their normal growth of tops. These are cut off during the fall. One essential to maximum yield of asparagus in this section is heavy fertilization, which may be advantageously accomplished by heavy applications of well-rotted manure.

### BEETS

Garden beets as a general rule are well adapted to the local conditions. They withstand some salt and therefore may be grown in some areas that might not be adapted for other more sensitive crops. However, some years the curly-top disorder causes an almost complete loss of the beet crop. The variety usually grown is one of the globular-shaped types, such as Crosby Improved Egyptian.

### CARROTS

Carrots thrive in this section, although some gardeners occasionally experience some trouble in obtaining a stand. The difficulty is generally due to crusting or baking of the surface of the soil. Carrot seeds are small and slow in germinating; therefore it is necessary to maintain moisture in the surface soil by frequent light applications of water. Carrots dug in the fall may be buried in dry sand and stored for winter use. The varieties commonly planted are the small short varieties like Improved Chantenay.

### OTHER VEGETABLE CROPS

Other vegetables which may well be included are lettuce and turnips. The former should be planted early in the spring or late in August in order to avoid the maximum summer temperatures. The same practice should be followed with turnips, the earlier planting for midsummer use and the later for winter storage. Limited plantings of celery have been made with success, but extensive plantings are not to be recommended.

A summary of the results obtained with certain of the more important vegetables discussed in the foregoing paragraphs are recorded in table 11.

TABLE 11.—*Summary of the 4-year average results with certain of the more important vegetables tested at the Newlands Field Station*

| Crop | Width of row | Average yield per 100-foot row | Average date of planting | Average date of first picking |
|---|---|---|---|---|
| Peas: | *Feet* | *Pounds* | | |
| Early Alaska | 3 | 12 | Apr. 23 | June 19. |
| Early Market | 3 | 13 | do | June 24. |
| Potlatch | 3 | 16 | do | July 7. |
| Beans: | | | | |
| Sure Crop | 3 | 49 | May 23 | July 29. |
| Kentucky Wonder | 3 | 41 | do | Aug. 5. |
| Cucumbers: | | | | |
| Evergreen Pickling | 4 | 282 | May 11 | July 19. |
| Davis Perfect | 4 | 375 | | |
| Onions: | | | | |
| Yellow Globe Danvers | 3 | 58 | Apr. 23 | Oct. 16. |
| Ohio Yellow Globe | 3 | 41 | | |
| Mammoth Yellow Prizetaker | 3 | 76 | | |
| Red Wethersfield | 3 | 31 | | |
| Mountain Danvers | 3 | 45 | | |
| Riverside Sweet Spanish | 3 | 62 | | |
| Cabbage: | | | | |
| Ideal Winter | 3 | 122 | May 24 | Oct. 18. |
| Sure Head | 3 | 126 | | |
| Jersey Wakefield | 3 | 80 | | |
| Flat Dutch | 3 | 134 | | |

## FRUIT CROPS

It is doubtful whether fruit production on a commercial scale is a promising industry on the Newlands project because the section is subject to late spring frosts. Furthermore, the soil characteristic of much of the area is not favorable for a satisfactory tree growth. A relatively high water table is encountered on many farms, and where such a condition exists the life of the trees is of short duration. The higher elevations where better air and underground water drainage exist have been found better adapted to fruit production.

Since the establishment of the Newlands station extensive tests have been made of various fruits and varieties. Among the list of those indicating the greatest promise are apples. Of the summer and early fall varieties, those that have proved the most satisfactory are the following: Yellow Transparent, Red June, Maiden Blush, and Red Astrachan. Those that may be included for fall and early winter use are Wagener, McIntosh, Wealthy, Northwestern Greening, and Rhode Island Greening. Satisfactory winter varieties are Jonathan, White Pearmain, Rome Beauty, Northern Spy, Delicious, and Golden Delicious. Other winter varieties that have been under observation but which have proved less desirable are Arkansas Black, Baldwin, Stayman Winesap, Winter Banana, Yellow Bellflower, Esopus Spitzenburg, and Gano. Of the crab apples the Transcendent variety has given good results.

The next most promising fruit crops have proved to be plums and grapes. The most satisfactory varieties of the plums tested are Burbank, Omaha, Red June, Blue Damson, Opata, Wachampa, and Compass Cherry (hybrid sand cherry). Varieties that have proved less reliable are the Bradshaw, Sapa, and Wild Goose. On the better types of soils, including the higher lands and the more open river-bottom soils, good results may be obtained from the Concord variety of grapes. Fairly good results may be expected from the Niagara, Diamond, Brighton, and Worden varieties.

At least for the farm home, a few pear trees may be added advantageously to the list of fruit trees. Included in the varieties tested are Kieffer, Winter Nelis, Rossney, Seckel, Anjou, Bartlett, Flemish Beauty, Barry, and Duchesse d'Angouleme. Of this list the first four have proved to be the most desirable when adaptability to the local conditions, disease resistance, and reliability of bearing are considered.

Five varieties of peaches have been under observation, and while usually some fruit is matured every year, a heavy crop is produced only rarely. The best results have been obtained from the J. H. Hale, Late Crawford, and Elberta varieties. The Illinois and Phillips Cling have proved to be less reliable bearers.

For extensive plantings cherries are not recommended for the Newlands project, although on the better soil types which are well drained some success may be expected from the Early Richmond, Late Duke, Montmorency, and Ostheim.

Owing to their early-flowering habits, apricots are not adapted to the conditions existing in western Nevada characterized by the Newlands project.

If soil conditions are favorable, such small fruits as blackberries, raspberries, and strawberries may be added to the fruit plantings for home consumption. If success is to be expected, a well-drained soil free from salt is essential, as these small fruits are highly susceptible even to very low concentrations of salt in the soil solution.

## DAIRYING

During the World War the high prices paid for hay caused many farmers to dispose of their cows, but the growth of the dairy-cow population of the Newlands project has been consistent and substantial from 1919 to 1927. The downward trend of hay prices following the war caused farmers to seek more profitable outlets for their feed through utilizing the dairy cow. The quarantine against the shipment

of alfalfa hay was still another factor which contributed to the increase in dairy cows. The number of dairy stock reached its peak during 1927, and since then there has been a slight decrease.

Relatively small amounts of whole milk, cream, and butter are consumed locally. The surplus milk is separated on the farm and the cream sold on a butterfat basis. The greater portion of the cream is shipped to California creameries; about one-third is purchased by a local creamery. Most of the butter produced by the local creamery is shipped to Los Angeles. During 1929 over 1,000,000 pounds of butterfat was marketed from the project.

The greater proportion of the milk cows on the project are grade cows of the Holstein-Friesian breed. The method of feeding and the lack of demand for whole milk are perhaps the important factors in determining the breed selected. Alfalfa hay is extensively fed. As a result heavy animals with large capacities are in greater demand than individuals of smaller breeds. The relatively low cost of alfalfa hay

FIGURE 7.—Dairy scene showing alfalfa hay stacked out of doors and feeding racks in the corral.

has militated against the feeding of high-priced concentrates. A few attempts have been made to feed some grain, but most of the feeding has been alfalfa hay exclusively (fig. 7).

In order that some light might be thrown on the relation of feeds to the cost of production and the effect of feeds on the cow's body functions, a dairy-feeding experiment was inaugurated in cooperation with the Nevada Agricultural Experiment Station in the fall of 1925. Different rations of hay, grain, pasture, silage, etc., were fed during the subsequent 7 years. The hay used was alfalfa, as it was readily obtainable, being practically the only roughage grown. Barley and bran, the latter being obtained as a byproduct from the local flour-mill operations, and some corn were used as concentrates. Grade Holstein cows were used throughout this experiment.

One of the chief objects of the experiment was to determine whether cows on a straight hay ration would maintain a satisfactory level of productivity without encountering difficulties due to lack of some

vital element of nutrition. The results of this experiment, covering a 7-year period, indicate that cows fed on a ration of alfalfa hay maintained their production at a satisfactory high standard and maintained good body flesh. The feeding of grain increased production, but in most cases the cost of the added grain exceeded the value of the increased product. However, other factors must be considered than efficiency of production. There is the question of body health and of sterility. This latter disorder has resulted in rather heavy losses in certain herds. It is encountered not only in the individuals of the milking herd, but in heifers. From this investigation it has been found that the continuous feeding of alfalfa hay without any supplementary grain feed has had no detrimental effect on the cow's health or ability to breed. As little sickness occurred in those groups receiving an all-hay ration as in those groups receiving grain as well as hay. The number of breedings required per calf was not of sufficient difference between the grain and all-hay groups to warrant any conclusions as to the breeding efficiency of the two groups.

The feeding of corn silage has not proved to be profitable on the basis of net returns. It was possible to maintain the milk flow of the individual cow at a higher level with silage, but the cost of producing that feed was too great. Under local conditions it would at least be necessary to produce 3 tons of silage at the cost required to produce 1 ton of alfalfa hay. It is rather doubtful whether this can be accomplished. Here again the question of improved bodily functions might enter. The same conclusion may be drawn from silage feeding as from grain, that is, the cows receiving silage did not show better health conditions nor was their breeding efficiency greater than that of hay-fed cows.

The question of pastures is an entirely different matter. The feed obtained from an acre of pasture, when credit is given the cows for harvesting the crop, has compared favorably with the feed obtained from an acre of harvested hay. The results of the first 5 years of the investigations with dairy cows are summarized in a recent bulletin (*3*).

## HOGS

The production of pork has never been extensively featured as a farm enterprise in the Fallon area. The three feeds most suitable for pig raising that are produced on the project are alfalfa, grain, and skim milk.

The number of hogs on the project has fluctuated within wide limits. The peak in numbers was reached in 1916. In recent years there has been an average yearly number of about 2,500 head. Until recently it was thought that the production of pork under local conditions could be advantageously expanded. Investigations conducted at the Newlands Field Station, as well as on private farms, on the cost of producing pork have left some doubt whether the prices which have been paid locally for finished pork warrant much encouragement for expansion of this enterprise. Generally the production of pork is a natural adjunct to dairying when skim milk is available. However, in recent years the turkey-growing enterprises of the project have consumed more of the skim milk produced than formerly, as it has been found difficult to produce healthy growth in young turkeys unless some skim milk or mashes containing dried milk are fed. Moreover,

the returns, per gallon of milk fed, from turkeys have been in excess of those from hogs. There have been 2 or 3 months of the year, following the holiday sales, when some unused skim milk has remained, but as a rule poultry, calves, and the few hogs on the project have consumed all the skim milk produced. However, it seems logical that farmers should keep a few hogs as a source of pork to supply, at least partially, their own as well as the local requirements.

In the investigations conducted at the Newlands station of methods of feeding hogs, alfalfa has been used as roughage, fed both as hay or pasture. The balance of the ration has been skim milk and barley. Usually the hogs were allowed all the roughage they would eat, but several methods of feeding the skim milk and barley have been tested (*2*). The cost of the alfalfa hay or the pasture has always been one of the lesser items of expense in feeding hogs under local conditions, as hay has rarely had a value of over $8 or $9 per ton in the stack.

### SHEEP

Large flocks of sheep are brought in from the mountain ranges annually to be winter-fed on the project. The number fed each year has varied with the price of mutton and the cost of the hay. Generally there is available a few thousand tons of alfalfa hay not used by the local farmers in their year-round feeding practices. Much of this hay is purchased locally, ground into meal, and shipped out of the State. Surpluses that remain have been utilized for feeding range stock during the winter months. Sometimes the hay is purchased outright on stack measurements, or deals are made whereby the purchaser pays so much per head of stock fed. In either case the farmer generally provides feeding facilities such as corrals, feed racks, and water.

Sheep are generally accompanied by their herdsmen from the ranges. These caretakers see that the sheep are properly fed and cared for throughout the winter. As a general rule the late fall months are spent pasturing alfalfa stubble. Later the sheep are placed in corrals and fed alfalfa hay for the rest of the winter. Sometimes the hay ration is supplemented with grain or cottonseed cake.

### BEEF CATTLE

Conditions on the project for beef cattle are similar to those for sheep. Some farmers maintain small herds that graze on nearby waste land during the summer and are fed hay during the winter months. These herds are known as farm herds. Census figures indicate that during the period from 1914 to 1932 the number of animals in such herds have shown a yearly average of about 5,500 head. The peak was reached in 1918, when 8,800 head were reported in farm herds.

The Newlands reclamation project and adjoining irrigated areas in western Nevada are distinct assets to the range operations of cattlemen as well as sheepmen. At times substantial purchases of alfalfa hay are made by these beef growers to supplement the range feed during the winter months and to avoid severe losses which otherwise would be experienced when periods of extreme drought occur. It is also a customary practice for beef cattle to be brought in from the ranges and finished for the market. Where such a procedure has

been followed the cattle are confined in feed lots for 3 or 4 months and fed alfalfa hay and generally some grain or cottonseed cake. The same method of purchasing hay is practiced for cattle feeding as for sheep feeding. It is bought either in the stack or on the basis of the number of head fed. Generally the deal calls for the actual feeding to be done by the owner of the hay.

## POULTRY

### CHICKENS

The climatic conditions on the Newlands project, together with the small capital requirements and quick returns on the investment, have been factors in stimulating poultry production. Since 1920 poultry other than turkeys have more than doubled in numbers. During 1920 there were over 28,000 and in 1930 there were 89,000. In 1932,

FIGURE 8.—Flock of turkeys on a Newlands project farm.

13,000 cases of eggs were sold, aside from the eggs consumed by the farm families.

Of the poultry diseases, some coccidiosis and white diarrhea occur among the baby chicks. As a rule it has been possible for the poultrymen to take precautionary measures in time to prevent serious outbreaks. Chicken pox is the most serious disease affecting the laying flocks. This has been effectively controlled by vaccination.

### TURKEYS

Because of favorable climatic conditions, western Nevada has proved to be well adapted to the production of turkeys. The light rainfall and arid atmospheric conditions prevailing during the growing season are an aid in avoiding excessive losses. The success that was

being realized by farmers during the period 1920 to 1928 is evidenced by the increase in the number of turkeys kept during those years (fig. 8). In 1920, 3,600 turkeys were raised on the project. This number had increased to a maximum of nearly 58,000 in 1928. The decline in prices paid the growers subsequent to 1928 discouraged growers, with the result that the agricultural census reported only about 38,000 turkeys on the project in 1932.

Definite progress has been made in solving some of the more acute problems that have confronted turkey growers[3] (*1*, *12*).

Investigations have disclosed that the most important items in growing turkeys successfully are sanitation and proper feed. Sanitation will prevent the entrance of disease, the naturally dry atmosphere and sunshine being the greatest allies of the grower. Ample feed of the right kind will maintain vitality and rapid, healthy growth. Coccidiosis sometimes occurs among the turkey poults when they are 3 or 4 weeks old. Blackhead has at times been a limiting factor in successful turkey production and some losses have occurred as a result of chicken pox and roup. Methods of combating these diseases successfully have been devised, with the result that the losses which formerly were a serious factor are now materially reduced.

## SUMMARY

This bulletin discusses the agricultural conditions on the Newlands reclamation project, which is located in western Nevada. The results from some of the more outstanding and useful investigations conducted at the Newlands Field Station, located on the project, are included.

The soils of the Newlands project are extremely spotted, ranging from a coarse sand to a compact adobe. In their virgin state the heavier soil types, particularly, contain appreciable quantities of soluble salts.

The weather conditions characteristic of the region are summarized for the 22-year period, 1906 to 1927, and are given in detail for the years 1928 to 1932.

The agricultural conditions on the project for the 21-year period, 1912 to 1932, are recorded, showing the trends in acreage of the different crops. Alfalfa has been the chief crop grown from the standpoint of acreage as well as from that of total value. A summary of the livestock population maintained on the project from 1912 to 1932 is included.

The results of land-reclamation investigations conducted at the Newlands station are reported. The importance of careful land preparation is stressed in order that adequate penetration may be attained when irrigation water is applied. The effectiveness and practicability of land reclamation by chemical treatments are considered. Relatively satisfactory results have been obtained, but the costs have been excessive.

The results obtained by the adoption of improved cultural practices are discussed. By adding humus to the soil, together with the intensive application of certain improved irrigation and cultural practices, tracts of land have been successfully reclaimed at an expense materially less than they could have been with chemical treatments.

[3] SCOTT, V. E., and SCHULZ, O. RESULTS OF TURKEY EFFICIENCY STUDY IN WESTERN NEVADA. Nev. Agr. Expt. Sta. News Bull. v. 6; no. 7. 1932. [Mimeographed.]

As alfalfa is the chief crop grown on the Newlands reclamation project, the cultural practices involved in the successful production of this crop are discussed.

The results of experiments with other crops, including variety tests, are recorded, among the crops being cereals, corn, potatoes, cantaloups, and pasture grasses.

The value of the home garden is stressed, numerous variety tests of vegetable crops having been made with different cultural practices.

The extent to which fruit crops may be advantageously included in the farm program is discussed. The evidence thus far accumulated indicates that fruit production on a commercial scale is not promising although the value of small plantings for producing fruit for home consumption should not be ignored.

Various phases of the livestock developments on the project are considered. Dairying is the one most extensively engaged in. The production of poultry, particularly the raising of turkeys, has proved to be second in importance.

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