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EXPERIMENTAL WORK

AT WILLCOX, ARIZONA.

BY F. A. GULLEY.

In the winter of 1892–3, several of the citizens of Willcox organized a company under the name of the Willcox Agricultural and Improvement Co., to make a careful test of the soil and the under ground water of the Sulphur Spring Valley, with reference to determining the actual supply of available water, its quality, and cost of raising it to the surface for irrigation.

The Experiment Station was requested to render such assistance as could be given to the work, which has been done, although to the present time the expense of equipment, and labor has been borne by the company.

Sulphur Spring Valley is in the southeastern part of the territory, extending north and a little west 90 to 100 miles running north from the Mexican line. It varies in width from ten to thirty miles, and Willcox is a town on the Southern Pacific railroad which crosses the valley a short distance north of the center.

SOIL OF THE VALLEY.

Just south of the town of Willcox is an alkali flat which is bare of vegetation, and the soil on which the town is built contains more or less alkali, but getting away from the town in either direction, for miles up and down the valley, the surface soil varies from a light to a heavy sandy loam, and is covered more or less with mesquite and other growth.

Practically the entire valley, with the exception of the alkali flat referred to, produces a luxuriant growth of grass and has always been known as one of the best cattle ranges in Arizona.

Generally speaking the surface of the valley is smooth and apparently level, but it has a quite uniform fall of from four to six feet to the mile to the south and southeast.

At Willcox water is found at a depth of from eight to ten feet below the surface, where a clay stratum is found, below which in sand, water is encountered again, and below this clay again, lying on sand which likewise carries water.

Wells sunk to the first water are readily exhausted. The second water is more abundant, but it can be removed without difficulty, while the lower body of water comes in too freely to be removed or even lowered by any pumping done to the present time. The three water carrying strata do not seem to be connected, as samples taken from each at different places show distinct qualities by chemical analysis.

The water from the upper vein or strata contains a considerable quantity of soluble salts not desirable in irrigation waters, the second less, while the lower and most abundant flow of water is shown by analysis to be of such quality that it is good for irrigation, domestic purposes or other use.

The lower flow of water is apparently one of the peculiar underground streams not uncommon in Arizona, for it seems to be inexhaustible through the center of the valley by pumping, while near the lower end of the valley, forty miles south of Willcox it breaks out at the surface of the ground in a number of constantly flowing springs.

A place two miles west of the town of Willcox was selected for the experimental farm, and a well eight by sixteen feet sunk for supply of water. The surface soil of sandy loam was found to be six feet deep, below which is six feet of a coarser sand, then clay and sand for three feet, where water was encountered in a sand stratum of three feet. Below this clay again, then sand also carrying water, then clay again at a depth of twenty-four feet.

The first water was easily removed with buckets, and the second flow would only keep the pump, which was set up, supplied for fifteen minutes at a time. To learn the depth of the

third clay stratum a six inch hole was sunk with an auger eighteen feet before reaching sand again, when water poured up through the auger hole, filling the well to within twelve feet of the surface of the ground.

If the No. 3 centrifugal pump is worked up to its full capacity for some time, the water is lowered to twenty-six feet below the ground level but no farther, showing that the water below has sufficient head to rise sixteen feet through a six inch opening at the rate of 300 gallons per minute.

During last May and June, after two years with the least rainfall winter and summer, known to the oldest resident, with the pump at work night and day, the head of water was not lowered below twenty-six feet from the ground level. This would indicate that the supply of water is sufficient to supply pumps of large capacity, and irrigate a considerable part of the valley, if raised to the surface.

QUALITY OF THE SOIL.

During last spring and summer some twenty acres of land was cleared off, partially graded and planted to alfalfa, beans, corn, sorghum, melons and other crops, all of which made a good growth. The work was done in a rough way, but the result is more than satisfactory for the first crop on newly and rather indifferently prepared ground.

One-half mile west of the farm is a small truck garden, irrigated from a windmill pump, where for several years a variety of vegetables have been grown very successfully. At several places in the valley where wells have been sunk to supply stock water, small gardens have been planted and fruit trees set out, all of which have made luxuriant growth when supplied with water.

There seems no question as to the fertility of the soil, or of its adaptability to the production of farm and garden crops, and fruits for which the climate is suited. It would appear therefore to be a question of water supply, to reclaim the valley.

The indications from this test so far, are, that there is sufficient available water in the underground flow to irrigate the greater part, if not the entire valley, and the main point at issue, is the cost of raising the water to the surface by pumping. Can it be made profitable?

Pumping water for irrigation is becoming a matter of much interest, as there are many tracts of most excellent land too distant from flowing streams, or lying too high to be reached from gravity canals, yet having abundant water from fifteen to fifty feet below the surface of the ground.

A number of irrigating pumps are in use in this territory, and many in California and other states, but accurate data as to the cost of water supplied in this way has not been collected to any great extent.

The cost of raising a certain quantity of water to a given height for supply of cities, and for draining mines has been determined in numerous instances, but the capacity of these pumps and the height to which the water is raised does not give us a basis for comparison. In most cases where pumping has been tried with sufficient water supply, satisfactory results are reported, and in some places the water is delivered at less cost than the prices paid to canal companies.

Pumps and engines designed specially for this class of work have not until recently received the attention of manufacturers, but with the demand that is springing up, machinery of the highest efficiency will no doubt be built and placed on the market.

The perfection of the gasoline and kerosine engine will do much towards encouraging irrigation by pumping where fuel is scarce and expensive. If we may accept the guarantees as to quantity of water that will be raised with a certain fuel consumption, and to the durability of the pump and engine that manufacturers are willing to give, pumping for irrigation promises to be practicable in many places.

At the Willcox farm a No. 3 centrifugal pump made by Byron Jackson of San Francisco, and a ten horse power engine and boiler has been used during the past summer. The capacity of the pump is 300 gallons of water per minute, 180,000 gallons in ten hours, or two thirds of a cubic foot per second.

Running up to its capacity, this pump, with boiler consuming one cord of wood in twenty-four hours, covers one acre of land one and one-third feet deep, or five and one-third acres with three inches of water, about the quantity used at this place at one irrigation.

With the average winter and summer rains at Willcox, it is believed that five to six such irrigations will be sufficient for the

year, for alfalfa, four for fruit trees and two for corn, sorghum and beans, with good cultivation.

On this basis, and with this small pump and engine, one cord of wood will pump water to irrigate one acre of alfalfa, one and one-half acres of fruit trees, or three acres of the last named crops.

Estimates furnished on the latest improved engines and pumps of ten times the capacity of this one, show that one cord of wood or its equivalent may be made to pump water to supply four or five times as much ground.*

In estimating the cost of pumping water for irrigation, pay of engineer, cost of oil, waste, repairs, wear on machinery and interest on capital invested must be added to cost of fuel, but with these included the total expense of supplying water by pumping from fifteen to forty feet will not exceed the cost of water rights and water rentals in many places in the irrigated belt.

The company has just purchased a gasoline engine, guaranteed to develop thirty-five actual horse power with a consumption of three and one half gallons of gasoline per hour.

A centrifugal pump warranted to lift 2,600 gallons of water per minute, thirty-five feet, with thirty-five horse power engine, has also been ordered.

If this pump and engine work up to the specifications, the pump will supply 3,744,000 gallons of water per twenty-four hours, or nearly eleven and one half acre feet, equivalent to five and three fourths cubic feet per second, or 287 "miners inches." The engine will consume eighty-four gallons of gasoline per twenty-four hours, which costs, with present freight rates, about twenty cents per gallon. As gasoline sells at five cents per gallon in the eastern cities, and at eleven cents on the Pacific

*The Yuma Water and Light Company at Yuma is pumping water to irrigate a high mesa near that city. They have a special form of double acting plunger pump, and automatic cut-off, condensing engine of 165 horse power. The pump has a capacity of 5,550 gallons of water per minute, (equal to 600 "miners inches") and it raises two and one-half acre feet of water eighty-five feet, and forces it through two and one half miles of 26-inch pipe, for each cord of wood burned under the boilers. The economy in using pumping machinery of large capacity is shown in comparing results obtained, and it is evident that to raise water at the lowest cost it will be necessary to procure machinery of the highest efficiency, and of large capacity. The cost of supervision is nearly the same with a small as with a large pump, while the consumption of fuel with the small engine and pump is much greater in proportion to the quantity of water raised to the surface.

coast, cheaper rates to inland points will no doubt be made as soon as any considerable quantity is used.

The gasoline engine as now made does not require constant attention, as after it is started it will work automatically for several hours, or for all day, and the man in charge may attend to other matters, while having charge of the machinery.

With an assured supply of water at not too great depth, pumping water for irrigation has some advantages over a canal system fed from a stream or from a reservoir. The supply is not subject to the risk from floods in washing out dams or reservoirs, and thus shutting off the water for a considerable time before they can be repaired, to the great injury of crops, which sometimes occurs.

Again full advantage may be taken of occasional rainstorms, and the pump only kept at work when water is actually needed. The supply is regular and not cut down to less than the crops should have during long dry periods when rivers at times become dry, or nearly so. Skill is required to keep machinery in order and working, but without good management a canal system is very unsatisfactory.

CROPS AT WILLCOX.

The elevation of Sulphur Spring Valley at Willcox is 4,160 feet above sea level, which gives this place a cooler climate than in the lower Salt and Gila Valleys. There is also a greater rain fall, the summer season is shorter, and the atmosphere contains more moisture. For these reasons less water will be required for irrigation than in the western and southern part of the territory and the climate will no doubt be found better suited to certain productions, such as apples, cherries, some of the small fruits and some farm and garden crops.

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