DRAINAGE WOULD

Engineer in Charge of Experiments on Nine Mile Ridge Submits Report.

IS CAPABLE OF CULTIVATION

Soil While Heavily Charged With Alkall, Contains Much Plant Food -Cost Comparatively Small.

The report of C. F. Brown, curincer in charge of the drainage experiments covering a large section of the alkali lands in Salt Lake county, has been submitted to the government with the cost of the drainage of the district investigated is given in figures, the conclusion being reached that it would be a profitable investment to expend the land. The investigations have been carried on under the co-operation of the Utah experiment station and the government, and covers the sections known as Nine Mile Ridge. Following

This tract comprises sections 26, 21, and portions of 22, 27, 28 and 29, township 1 north, range 2 west, S. L. base and meridian. It lies about nine miles west of Salt Lake City, and three miles from the lake shore on the west. The soil is classified by Gardner and Stewart in the soil survey of the Salt Lake valley as Jordan sandy loam. It is a virgin soil from four to five feet deep, covered with shadschale, underlaid with sand, and with the water table ranging from three to five feet from the surface. Cereals and alfalfa have been grown successfully on a small area. About 10 acres was planted to alfalfa on section 21 last season and irrigated. This season, nine tons were harvested in two crops without irrigation. A washed out head gate was the cause of the water failure. Potatoes and beets were planted last spring. They grew throughout the season but did not amount to much because not irrigated.

THE FIRST WORK. This tract comprises sections 26, 21,

THE FIRST WORK.

Our first reconnaisance was made July 3, 1907, by Messrs, C. G. Elliott, engineer in charge of dainage investigations, office of experiment stations, U. S. department of agriculture, S. M. Woodward and myseif. We were accompanied by Messrs. Thomas J. Almy and Thomas Jeremy, owners of the tract. The scheme was pronounced feasible if properly handled as a whole and drained with open ditches six feet deep and half a mile apart.

Many attempts have been male in this valley and in other arid states to handle just such lands without drainage. Where the natural drainage has been good, these lands become as valuable as any, but where it is deficient and no artificial drainage has been provided, the attempts have resulted in failure. If the work of these investigations during the last three years had been published, it would be sufficient to call attention to the report to show that such lands have been and are being successfully reclaimed by under drainage. The experiment on the Swan tract near this city by the bureau of soils, and the Utah experiment station, is a fine demonstration of what can be Jone with the heavy low lands of this section when they are in the worst possible stage. This experiment was begun five years also and the whole tract is now growing alfaifa. It is a fair stand and is paylog. Or course it costs considerable to drain alfaifa. It is a fair stand and is paying. Of course it costs considerable to drain

GENERAL DRAINAGE PLAN.

As stated before, a gereral plan for the ridge was outlined at the time of Mr. Elliott's visit, but a level survey was necessary before attempting to plan the drains and irrigation system in detail sufficiently to make a reliable estimate of the cost. A plane table estimate of the cost. A plane table survey carrying elevations was planned but was abandoned for the level because of a poor instrument and conditions of the atmosphere. Levels were run around every 40-acre tract. The elevation was taken from a bench mark established by City Engineer Kelsey in his survey of the sur-

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The Leading Book Concern 6 MAIN STREET plus canal at Cohn's slough, three miles east of the ridge. A line was also run along the North slough to the take shore and the lake water level de-

TWO THOUSAND ACRES.

TWO THOUSAND ACRES.

The project comprises about 2,000 acres of good land. It has an average elevation of 18 feet above the level of the lake. The surface slope is approximately three feet to the mile both north and west, with the highest point 21 feet above the level of the lake at the southeast corner of the southwest quarter of the northeast quarter of section 28. Generally the surface is smooth, but small bumps or knolls from six to eight feet high which are found in small patches will make an allowance for leveling necessary.

The soil survey already referred to, classifies a large portion of this land as having a thin carbonate hard panfrom 18 to 20 laches below the surface. Of 45 test holes 5 feet deep and evenly distributed over the tract, only two showed hard pan. There are several small areas of this formation in the tract, but they are by no means serious. The drainage cutlet shown on the map as the North Slough and Bailey's lake is from 5 to 7 feet below the surface with a fair slope to the lake. The scheme involves the reconstruction of weirs, headsates, and flumes of the North Point Consolidated canal. 3 miles of new canal, and the installation of a pumping plant, the details of which will be treated later and shown on the map.

GOVERNMENT CO-OPERATES.

The U. S. department of agriculture The U. S. department of agriculture, through the irrigation and drainage investigations of the office of experiment stations, in co-operation with the Utah experiment station, has been engaged in drainage studies and the reclamation of alkali lands in this state for the past three years. During this time, experiments have been made in eight different counties. The success attained in most of these has been very marked. Besides this the department has been doing co-operative work along these lines in the states of Washington-Montana, California, Colorado and Texas for five years. Mr. Edilott has had 25 years experience in the drain-age problems of the middle west in ad-dition to five years in the department, which thus has been about equally di-vided between humid and arid drainage

THEORY OF ALKALI RECLAMA-

THEORY OF ALKALI RECLAMATION.

What is commonly known as alkali lands are those lands in and sections in which there is an excess of alkaline salts to the extent that plant production is prevented or seriously interfered with. Nearly all soils in the arid regions have an abundance of these salts, but they are so uniformly distributed that they do not interfere with crop production until after one or more years of irrigation. These salts are very soluble, in lands where the water table is near the surface the anglication of water fills the soil to saturation. The alkaline salts go into solution readily and are carried to the surface with the soil moisture as it rises to the surface by capillary attraction. When the water evaporates the alkali is left behind on the surface. Prof. Hilgard reports the limit to which the water will rise by capillary attraction as 5 feet for clay soils and least for loams. As a result alkali accumulates rapidly at the surface unless excessive evaporation is prevented. Evaporation may be prevented by a reasonable lowering of the water table by drainage and surface muiching or shading of crops.

The prevalent notion that alkali can be washed out by heavy and frequent irrigations without underdrainage is wrong. There is another idea held by some that is equally faulty, and that is, that such lands can be successfully handled by applying just sufficient water to supply the plant needs without any seepage. Of course this will concentrate the alkali at the surface in time. The method of flooding the surface by checks and then sluicing the water taway does not remove much alkali for the reason that the saits go into solution so readily and are carried down into the soil by the first water that reaches them. The only successful and perma-TION.

soil by the first water that reaches them. The only successful and permanent way is by underdrainage, and the use of moderate quantities of water.

SUPPLIED WITH PLANT FOOD.

It is a well known fact that the soils of these sections are well supplied with all of the elements of plant food. The fertility of these soils when the moisture conditions are properly controlled are wonderful. Irrigation water cannot be applied practically without seepage or drainge water. If this water in its downward movement. this water in its downward movement through the soil, passes out through the drains, it carries its load of alkail and the land is improved. If on the other hand it has considerable lateral movement and is allowed to rise near to the surface in other parts of the field, the alkall is accumulated there. This is what usually horsens with the This is what usually happens with the brigation of hillside lands. Nothing can be done beforehand to prevent this can be done beforehand to prevent this but drains should be so placed as to intercept such seepage where it first appears on the surface. This particular tract will not be troubled from the seepage from other lands. If the water table is lowered sufficiently to 5 or 6 feet, the soil will readily care for all ordinary application of water and rains. ordinary application of water and rain-

As stated before, open drains were decided upon by Mr. Elliott and myself as he best method of draining this tract. The sandy loam and sand subsoil which underlies the tract will resoil which underlies the tract will respond to such drainage and keep the water table practically to the depth of the ditches. The following is the section of the drain ditches; bottom width, 6 test, side slopes. I horizontal to 1 vertical; and depth 6 feet. The grades will be from 2 to 3 feet per mile. The bottom width may seem large and be questioned. The first and main reason is that the effective depth of any drain is to the surface of the water. If the dich is marrow, the water which it must carry runs deeper and the depth is lost. The second reason is that 6 feet is about the minimum width in feet is about the minimum width to which a muchine will work. There is a third reason which is also good. It is that such ditches will work effectively with less cleaning and will be less tikewith less cleaning and will be tess likely to become obstructed with very little side, etc. The drains are located with respect to draining the soil and affording outlets or supplementary illelines and surface waste water if necsary. Each drain will require a right of way of 56 feet making a total of 40 acres waste. The waste banks should be left for filling as the land will in time become valuable enough to lay tile in the disches and cover.

COST OF DRAINAGE.

This class of work will require the age of machines. There are two types of ditching machines that might be used successfully on this job. One known as the P. C. Austin Drainage Excavator, which is a scraper cutting Excavator, which is a scraper cutting from side to side and making true side slopes. The other is a drig boat type of steam shovel. The later might offer some difficulty in moving on account of the sand, but it is the simplest machine and the one that has been used the most. The estimae of the cost is made on the basis of 15 cents per

cubic yard. The following table will show the division of the cost: \$ 5,466.20 2,603.25 2,043.80

COVERED DRAINS.

Covered drains will not be needed to any great extent, but to be on the safe side they will be considered and an allowance made. The larger part of the need for drainage in irrigated fields is caused from the seepage from these fields may cause some trouble in the lower portions and awayles. If it does come, it can be prevented and the only course is to irrigate and provide such drainage when and where it develops that it is necessary. The cost of draining irrigated lands with tile in this state where they have become thoroughly water-logged ranges from \$10 to \$15 per acre. When such drainage is provided as soon as the seepage shows, the cost is very materially reduced. A liberal allowance will be \$2.50 per acre. The total may in the end equal \$5.000.

The duty of water or amount required for irrigation on which the sizes of canals, laterals, pumps, etc. are estimated, is one second for cach so crees. This is the standard when

are estimated, is one second foot, or one cubic foot per second for each \$9 acres. This is the standard when properly used. The reason should extend from June 1 to Sept. 39.

ELEVATION OF LAND. The water supply somes from the Jordan river through the Surplus canal and the North Point Consolidated canal. The latter has a low grade and the water flows very slowly. In making the present survey, the clevation was taken from the bottom of the flume on the North Point Consolidated, where it crosses the Cobasilough. The elevation was given at 4,244.7 feet by Kelsey. Running to this land, we found that the elevation was 4,249.6 feet, or more than four feet higher. By the present canal, the distance between these points is over four miles. A glance at the map and the elevations which are given, just in units and tenths, will convince one that the irrigation of this tract can not be accomplished by means of this canal. As the surwill convince one that the irrigation of this tract can not be accomplished by means of this canal. As the surrounding country is low the only solution is to pump. The shortest distance with the least excavation proves to be by way of cutting a new canal from the south quarter corner of Section 22 west, and southwest around Bailey's lake and down the Bond slough a distance of three miles to the pump house. The canal will be six feet wide on the bottom with side slopes of one to one and a depth of three feet. The grade will be 1.32 feet per mile. Leveling and its consequent seepage will be avoided and the water taken directly to the high point of the Isnd. The amount of excavation will be 15,840 cubic yards at 11 cents per yard; this equals \$2,376. This means that the old canal should be filled in where it crosses the tract.

the tract.

For a low lift and a large quantity of water, the centrifugal purt) is best. The following is a summary of the plant:

24-Inch pump and belt	\$1,310.
65-H. P. motor	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Pipe accessors and accessors and accessors	4 × 49101
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Teansformer	3 325
4% mile Trans, line,	- 11,4800
	\$6.095.1

The laterals or ditches for conveying the water to the different parts are shown and named on the maps. These ditches are shallow, being from 1½ to 2 feet in depth an dthe estimate is based on a cost of 10 cents per cubic yard. There are three different sections based on the quantity of water to be carried. The following named ditches have a section of 3 feet bottom width, 1.5 feet deep and 1-1 side slopes. Bond ditch, north and south laterals; and all of the laterals on the Jeremy. Almy-Westman and Crebbin ditches. The Jeremy and Bond ditch mains are 3 feet wide on the bottom and 2 feet deep, with 1-1 side slopes. The Bast ditch is 5 feet wide on the bottom and 2 feet deep. The cost of excavating is \$1,539.21, and 25 per cent for headgates, etc., \$364.86; total, \$1,524.01.

There is no question but th \$t a first

There is no question but that a first class road grading machine would be the most economical for use in making these ditches, as well as for filling the old canal and tearing down the old rail-road grade.

CHARGE FOR MAINTENANCE.

CHARGE FOR MAINTENANCE.

The items of canal reconstruction can not be properly charger to this project, as the capacity of the canal is three or four times the amount that will be used on this tract. It would seem that a liberal charge abnually for maintenance be made on all of the stock and that improvements be made as fast as they could be with the fund thus provided. The Bear river canal system in Boxelder county, Utah, has such an annual charge of \$1 per acre which keeps the system in perfect condition and pays interest on the money invested. To this charge for maintenance there should also be added enough to cover the cost of the pumping and depreciation of pumping plant. On a basis of 2 cents pere K. W. Hr. for power and 4 per cent on money, a maintenance charge of \$1.50 per acre per anum would cover it. The total maintenance charge would then be \$2.50 per acre, which is not excessive. COST SUMMARY.

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removes every trace of the impurity that is causing the trouble. Then as rich, pure blood circulates through the body, the inflamed membranes commence to heal, the mucous discharges grow less and finally cease, and all the disagreeable and disgusting symptoms of Catarrh disappear. S. S. S. has

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