Irrigation Canals and Reservoirs.

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The all important question to the modern farmer is that of water supply. In the eastern and southern States the annual rainfall is sufficient for all agricultural purposes and sometimes necessitates drainage, but in the arid and regions of the west the rainfall is not sufficient and the farmer must help nature in the struggle with drought. By skillful use of the rainfall, the arid desert of Utah have become luxuriant gardens, the valleys of Colorado have become as productive as her mines, the endless stretch of buffalo grass in Southwestern Nevada has changed to a green sea of alfalfa, and throughout the whole arid west the course of the canal is marked by prosperous homes.

The subject of irrigation is too extensive for a person to thoroughly put forth in so limited an article, so only one phase of it will be discussed, irrigation canals and reservoirs.
The water supply comes from several distinct sources, namely: natural lakes and reservoirs, rivers, artesian wells and underground waters, and surface waters. Of these, the surface waters are most commonly stored in reservoirs.

The irrigator who has a reservoir has the equivalent to a gold mine. He has a supply of water always on hand and need not be in fear of drought. The water in a wet year can be stored for a dry one. A very small percent of the annual rainfall, if properly stored, would be sufficient to water all arid America.

Reservoirs by storing the storm waters, considerably lessen the danger of floods which every year do so much damage. If a sufficient number of large reservoirs should be built the country would receive a twofold benefit; floods would be decreased and thousands of square miles of land, now useless, would become productive. The also increase
The moisture of the atmosphere making a cooler climate and increasing the rainfall.

In building a reservoir the first step is in selecting the site. This must be chosen in consideration of the area and character of the land to be irrigated, distance from the land area of the watershed from which the water is to be obtained, the drainage which will fill the reservoir, and the maximum and minimum rainfall of the water shed. It is always advisable to build it with a capacity as to hold more than the minimum rainfall to provide in a wet year for a dry one. It is always best to select as economic a basin as possible. After it is possible to make a good reservoir with very little work by impounding a small lake or pond.

Reservoirs should always be in a position out of danger of floods. If in a place where water will flow in several directions, so much the better, as more land can be irrigated.
At less expense.

After clearing the site, covering with earth and constructing, the bottom of the reservoir should not be more than three feet below the surface of the ground, for all below is useless.

Much care should be taken in calculating the pressure and in the shape of the dam. The pressure on the dam is not greater when the flow of water is large than when it is small. It is the height of the body of water that counts. High dams are deemed dangerous and should be avoided.

In building an earth embankment, first make arrangements for removing water. For this purpose iron pipes are most useful though wooden culverts are often used. The pipes should have a good safe bearing beneath and should be packed in cement or clay to prevent leaks.

The surface upon which these tests should be placed and feed well with water. Water should be used freely in the construction, the material being well sprinkled when put in. Another important thing is the sorting of materials. The fine superior material should be placed next to the water and the coarser outside. The inner slope of the
The dam should be gentler than the一种 and should be riprapped to prevent erosion. The base of the embankment should be three times its height.

The cost of a typical earth reservoir is about twenty cents a cubic yard. Taking it to be 1200 ft. long, 640 ft. wide and 20 ft. high, holding 23, 000,000 cubic feet of water, which is an average reservoir, the cost would be $37,617. This would irrigate two hundred and thirty-five acres at $1.25 per acre to come.

Earth reservoirs often reach an enormous size. The one known as Lake Josephine, in Madera County, Cal. is very large. It is fed by the Madera River. As the lower reservoir is situated in a gap in the foot-hills, nine miles away and is connected with the river by a canal, the hundred feet wide and ten feet deep. The embankment is four thousand feet long, two hundred fifty feet wide at the base and twenty at the top and is sixty feet high. The inner slope is riprapped to prevent erosion.

For masonry reservoirs no definite rule can be given. The chief failure is in the construction of dams. A masonry dam should...
have a foundation core, concrete laid on solid rock over piles driven close together. The stones should be cemented together by a very strong cement. At the top should be a waste channel to carry off flood waters. The ends of the dam should be carried up as high as possible to prevent the water from cutting out around. In construction of a very large dam, safety should be secured in every direction regardless of expense. The best way to show the construction of masonry reservoirs would perhaps be by giving a few examples.

The Bear Valley Dam in Southern California is a typical masonry reservoir. It is built into the solid rocks of the gorge. It rises from an arch curving inward forming the area of a circle 333 ft. in diameter. The face is 17 ft. thick and the top 3 ft. thick, the highest point is 65 ft. above the creek bed. The dam is built plunger blocks of granite and portland cement. It took 5304 cubic yards of rock and 13,750 barrels of cement. At the bottom is a stone culvert 21 x 24 inches which discharges 2000 inches of water into a drain which measures the discharge. There is a spill-
way on one side, four feet from the top, to remove overflow water.

The Sweetwater Reservoir is another example. It is the largest piece of engineering work yet carried out in the world. It is built of granite and Portland cement. It is 93 feet high, 76 feet long at base and 346 feet at top, 46 feet thick at base and 12 feet at top. The reservoir covers 100 acres and stores six billion gallons of water. It gathers water from 186 sq. miles of territory and holds two years supply for ten thousand acres of canals.

The constructor making a canal meets many difficulties. The principal question is to get the most water at the least expense. The source of the water for a canal is a river, lake or artificial reservoir. In choosing the route must select as direct a route as possible. Curves should be avoided as much as possible and when necessary should be as gentle as possible. A sharp curve checks the flow of water and erodes easily.

To get the greatest velocity, the canal should be in the shape of a half-pipe. Grades are important. For short distances...
the grade should be steep. In main ditches the grade is from 1/2 to 2 1/2 ft per mile. Where the grade becomes too steep it is lowered by means of a drop reduction box. It is useful where the supply of water is lessened by customers up the line. By keeping up the grade a larger area can be covered.

The construction of flumes should be avoided if possible as they are very expensive and apt to leak. Felt is an important factor. If it settles in the bottom of the canal and causes much expense in removing. By proper construction if head works the water may be made comparatively free. A dam causes the silt to settle to the bottom where it can be let out at waste gates.

In the construction of a canal the best effort should be on the head works. The head gate should be a few hundred feet from the intake at the river, with a bay of moderate grade intervening. It should be at a point convenient to discharge
water back into the river through the waste and sand gates. Ving plantin a masonry should extend for fifty feet on each side to protect against floods. Sand gates are also important. By means of them, silt and sand is caught and drawn off with dirt entering the canal. Waste gates are the safest Salinian canal. By them the flood waters, which would otherwise damage the canal are caught and carried up.

The outlets into the laterals should be set before the canal is built. Planting is governed by the amount of water delivered. The gate should be at the inner end of the outlet. The construction is simple, a tight slide over the end of the outlet box being all that is necessary. The tanks of the laterals should be made so that the bottom is above the surface to be irrigated. Ditches may be constructed in loose soil and remade every time the water is applied, thus preventing the ground from taking. The best thing for making laterals are a common plow and scraper. Ditches
Cotton should be as wide as a scraper and the plowing about three times as wide to break up the ground.

The loss of water by seepage and evaporation is great. The loss by evaporation in the summer is from 3-4 inches per day at 40°F and a year. The loss by seepage will depend on the character of the soil and the care in building the tanks. In a canal 15 miles long with grade good, the loss will be 38% before the point of delivery is reached. It may be prevented by cementing the sides and bottom with a layer of cement 3" thick. When the soil is sandy this becomes absolutely necessary. It may be done cheapest and best by putting on the thin coat without using stone.

The average cost of main canal less than 5 ft wide is $487 per mile, 6 to 10 ft wide $629, over ten ft wide $603 per mile. This includes headworks, flumes, etc. Some canals have been constructed on an immense scale.
Canal in South Dakota starts from the Cheyenne River, fourteen miles from Edgemont. It is twenty-six feet wide and four feet deep. At Edgemont it falls thirty feet and runs several large factories. After this, ten thousand acres can be irrigated from it.

The Sonora Canal in Mexico is 35 ft wide, 30 miles long and will irrigate 350,000 acres of land.

The End