Network Of Canals Carry Life Giving Water To Waiting Acres

Valley Is Seamed With Main Canals Leading From Roosevelt Dam

(By ERNEST DOUGLAS.)
From Information Furnished by the U. S. Reclamation Service.

Before Cheops built the pyramids the Salt River Valley was a center of prehistoric civilization. It was here that the mysterious race which held sway before the Aztecs came brought the art of irrigation to a perfection never before attained and not attained again for many centuries. And it is here, in modern times, that the United States reclamation service and a few thousand of the most wideawake, progressive farmers in the world have advanced the art of irrigation to a point of perfection that is the envy and wonder of all mankind, which far eclipses anything accomplished by the ancients. Persistence and ingenuity, combined with unparalleled natural advantages, have made this possible.

Eleven great canals, with a combined length of 135 miles, watered this valley in pre-Aztec days. Now the valley is seamed by seventeen main canals, with a combined length of 193 miles, and by scores of laterals which, if placed end to end, would extend 577 miles. Both canals and laterals are models of scientific construction.

But it is the great Roosevelt dam which most clearly demonstrates the superiority of the moderns over the ancients. At the expense of infinite time and labor, and without the aid of even domestic animals, the first dwellers in the land were able to dig broad, deep canals and completed a marvelous irrigation system. Without the machinery of modern man the construction of the Roosevelt dam would have been impossible.

Owing to the Roosevelt dam, the Salt River valley farmer today cares little whether it rains. Rain is useful to lay the dust upon the roads but otherwise it is oftimes more inconvenient than welcome. Irrigation is depended on to mature the crops of alfalfa, sugar-cane, cotton, oranges and grain, which flourish in tropical profusion.

Modern irrigation in the Salt River Valley dates back only to 1867. Between that year and 1892 several canals were built by private enterprise. All of them were only partially successful, owing to the difficulty and expense of maintaining diversion dams. In time of high water the brush and sand dams would be washed away; by the time they could be replenished there would not be water enough in Salt River to irrigate the land under cultivation.

An equalizer, something to impound the flood waters and release them when needed, was required. And so, today, the Salt River valley has the Roosevelt dam.

Valley farmers was at last in a fair way to come true.

Numerous unforseen difficulties delayed the construction of the dam. It was not until September 20, 1906, that the first stone was laid. The last one was laid on the parapet, extending from end to end of the crest, February 5, 1911, and the official dedication was held March 18 of that year. Ex-president Theodore Roosevelt delivered the dedicatory address.

Long after the dam was finished there were scoffers who said that the reservoir would never be filled to its greatest capacity. On April 14 of this year water splashed over the spillway at the south end of the monumental structure. The reservoir was full; not another drop could be impounded. At no time since April 20 has the stream flowing over the spillway been less than two feet in depth. With the reservoir full, more water is being furnished by the Salt and Verde rivers than the farmers can use and a great stream is flowing away to the sea.

It cost $3,190,000 to build the Roosevelt dam. No less than $551,000 was expended on permanent roads for the damsite, though in a place of great natural beauty, was almost inaccessible. In order to freight in supplies it was necessary to construct a sixty mile highway from Mesa. This is the far-famed Roosevelt road, that is known throughout the world for the magnificence, beauty and charm of its scenery. It is part of a transcontinental highway across the United States.

Not all the material used in the construction of the dam was freighted from outside. The rock, of course, was quarried right out of the mountains buttressing the site. A cement mill and sawmill were constructed nearby, and it is estimated that the saving effected thereby was $644,000.

Mere figures give on only a faint idea of the Roosevelt dam and lake. They are so stupendous that they cannot be comprehended by the human mind.

The dam towers 284 feet from its lowest foundation and 244 feet above the bed of the river. The total length at the bottom is 210 feet and the top 1125 feet. A roadway runs along the crest, connecting the sections of the town of Roosevelt which are on opposite sides of the river.

When full, as it is today, the lake created by this titanic structure is 28 miles long, covers 26.3 square miles and contains 1,367,000 acre feet of water. The average depth is 81 feet.

An acre foot of water is enough to cover an acre to a depth of one foot. The area of land in the Salt River valley regularly entitled to receive this dam is as important as the Roosevelt dam. It cannot be washed out by any flood, but is always there ready to divert water into great canals on the two sides of the river. It is the Salt River Valley's last protection against drought, for it insures that the water stored at Roosevelt, and also the normal flow of the two rivers, will at all times be available for use.

At each end of the dam is a great headgate, operated by electric motors. On the north side the gate admits water into the Arizona and on the east side into the consolidated. These big canals are feeders for all the others, and for many laterals and small ditches.

There are eight main canals on the north side, having a total length of 97 miles. On the south side are nine canals, 96 miles long. Most of these canals were purchased by the reclamation service from private companies. Practically all of them have been enlarged and straightened; the old wooden gates and bridges have been replaced with concrete structures.

About two miles west of Tempe is the Joint Head dam, also of concrete. It is much smaller that the one at Granite Reef and serves the purpose of diverting seepage. In ordinary times little water goes by the joint head.

Not all the irrigation water used in the Salt River valley comes from the rivers. On the south side are nine pumping units, operated by electricity. During the irrigation year of 1913-1914 these pumps furnished 30,481 acre feet of water. They are marvelous machines, requiring little attention. Ultimately many more will be installed around the edges of the irrigation project.

Water is sold to the landholders at fifty cents an acre foot, up to three acre feet. If more is used the charge is slightly higher. This plan of selling water on the acre foot basis was inaugurated in October, 1912. Prior to that water was delivered on a flat acreage basis. As the water users did not have to pay for the exact amount delivered, they naturally gave little thought to the conservation of water and as a result there was much waste. Under the new system the "duty" of water has increased from 3.25 feet per acre per year to 2.8 feet per acre. This is spoken of as an increase because a given amount of water now irrigates more land than formerly. Further reductions are hoped for, as farmers and reclamation service officials are co-operating in the effort to cut down consumption.

The hydrographic work carried on inestimable importance. These investigations have shown that 45 per cent of the water diverted into the canals is lost through seepage and irrigation. They have shown that in 1914, 222,647 acre feet of Verde water went to waste. And plans are now under consideration for the saving of much of this seepage by cementing the canal. Hydrographic data on the Salt River project is available as far back as 1899.

Drainage work is carried on in connection with the hydrographic investigations. In February, 1915, the engineer in charge of drainage segregated two districts, which are to be investigated carefully. One district, 27,000 acres, lies west of Phoenix; the other, 26,000 acres is between Tempe and Chandler. Over these districts test boring have been made at quarter-mile intervals, affording accurate data regarding underground water and soil strata. In all other irrigated districts, the underground flow is slowly rising.

It is estimated that the lining of the canals, laterals and ditches with concrete would save ninety per cent of the water now lost through evaporation and seepage. This would admit the addition of a large area to the irrigated area. Concreting the laterals alone would save enough water for over 30,000 acres. Another plan the valley has for increasing its water supply is to build a storage dam on Verde river, a few miles above the mouth. An excellent damsite exists and enough water for 31,000 acres can be stored there.

It is not visionary to predict that the time will come when the Verde dam will be constructed and the canals and ditches will be lined from end to end with concrete, thus greatly increasing the irrigated area. It is certain that as time goes on the farmers will learn how to produce abundant crops with much less water than they are now using, thereby making available water for the irrigation of many thousands of additional acres.

Evaporation and seepage are not the only problems connected with the maintenance of the irrigation system, but investigations and experiments by the reclamation service have kept the cost of maintenance down to a minimum. In some canals, where the velocity of the water is slow, moss growth sometimes seriously impeds the flow. The most satisfactory method of removing moss, it has been found, is by means of a spring-tooth harrow, pulled by horses. Silt is removed from the canals with fresno scrapers.

The removal of weeds from the banks of the canals is effected in two ways. The first way is by the use of mowers, scythes and shovels. The most satisfactory method is to let sheep and goats graze off the weeds. This plan was first tried in 1914 and the cost of maintaining the canals dropped $114.95 a mile that year. In addition to a profit of $3,199.47 was realized from the flocks.

Now, what is being accomplished in the world's most favored farming district, under the "show" project of the reclamation service?

According to statistics collected by the United States government, the average value of the crops produced in the Salt River Valley during the year extending from October 1, 1913, to September 30, 1914, was $23.80 an acre. The returns were from 169,719 acres.

Alfalfa was planted on 30,733 acres of the total. The average yield was three tons to the acre and the average price was $6 a ton. Anyone who knows anything at all about farming in the Salt River Valley will concede that both of these figures are extremely conservative.

Some of the most profitable crops: small fruits, $140 an acre; deciduous fruits, $100; watermelons, $110; sugar cane, $48; long staple Egyptian cotton, $70; cantaloupes, $70; broom corn, $37.50. Other crops figuring prominently on the report were barley, beans, corn, garden truck, oats, olives, potatoes and wheat.

The climate of the Salt River Valley is semi-tropical. It is healthful to man and causes to flourish every product of tropical or temperate zone. There is never a crop failure. All danger of drought is eliminated by the Roosevelt dam and the magnificent irrigation system which supplements it. Pests which devastate less favored agricultural regions have never made their appearance here.

No crop failure! No drought! Unequaled climate! Assurance that ultimately every rural home will be electrically lighted and that much of the farm labor will be accomplished by electricity!

What more can man desire?

Power System.

The people of the Salt River Valley are to be congratulated that in the development of a reliable irrigation system there was incidentally made possible the development of a comprehensive power generation and transmission system which will become a source of very satisfactory revenue, as well as the means of promoting local industry and greater comfort throughout the valley. The power system got its start from the need of power in the construction of the dam. Fuel, when transported to the site of the Roosevelt dam is very expensive, hence a power canal was built above the high water line of the reservoir of sufficient capacity to carry the low flow of the river. A power plant for construction purposes was located in a cave that has since become the switchboard gallery of the permanent power plant.

This power system has been nearly completed to a total installed capacity of 17,000 kw. distributed in four plants. There is connected with the system a total of 173 miles of 54,000-volt transmission line and 32 miles of 10,000-volt transmission line, acting as a distributing system. These lines supply nine sub-stations and twenty pumping plants used for irrigation.

The Roosevelt power plant, having a capacity of 9,500 kw., is located at the toe of the dam. Five units have already been installed and the installation of the sixth unit, capacity 4,000 kw., will be completed within the next few months. There are two striking innovations at the Roosevelt plant. The first one is the installation of the electrical generator on the top of the water wheel case; the second is the use of a single runner turbine for a range of head operating from 90 feet to 226 feet with a good power output and high efficiency throughout the range. The plant is built on a shelf cut from the edge of the canyon wall, and the type of unit installed was developed to fit the small amount of space available for the plant, on account of this condition. The plant generates at 2300 volts, and this current is transformed in the transformer and switching house 600 feet away to 45,000 volts which is the voltage of the transmission line.

The South Consolidated plant is located about one and a half miles below Granite Reef dam on the South and Consolidated canals. It has a demonstrated capacity of 2000 kw. with a fall of 32 feet. The plant is a standard low-head type of plant of reinforced concrete construction, and is so designed that it can be operated with only one man on shift. The overall efficiency is unusually high while the operating cost is low on account of its simple and substantial design.

The Crosscut plant is installed on the Crosscut canal, which is used to transfer water from the high to the low lands of the valley. This plant stands out as one of the most unique hydro-electric developments in existence. Due to the great variation in the flow of water in the Crosscut canal and the silty character of the water, a new type of plant was necessary. Water is supplied to the wheels of this plant through force mains and passages composed entirely of reinforced concrete. The water wheels are of the impulse type, supplied with six nozzles under individual control. This makes possible the control of the water through the plant to equal the supply of the Crosscut canal by varying the number of nozzles in use. It also brings about a very high average efficiency, for the plant will sustain its maximum water wheel efficiency down to 1-30 of full plant load. The output of the waterwheels has exceeded all expectations and the efficiency will undoubtedly be above the guarantees. The water wheels are connected to alternating current generators, delivering 11,000 volts both to transformers for connection to the 45,000-volt transmission line and directly into the 10,000-volt distributing system. The result of this layout is a plant of moderate cost and great flexibility. The cost of maintenance will be very low, as there will be practically no repairs to the concrete structures and very small repairs to this type of wheel in spite of the silt. The plant can be operated with one man on shift, so that the cost of operating is also a minimum. This plant has also been made the switching sta-

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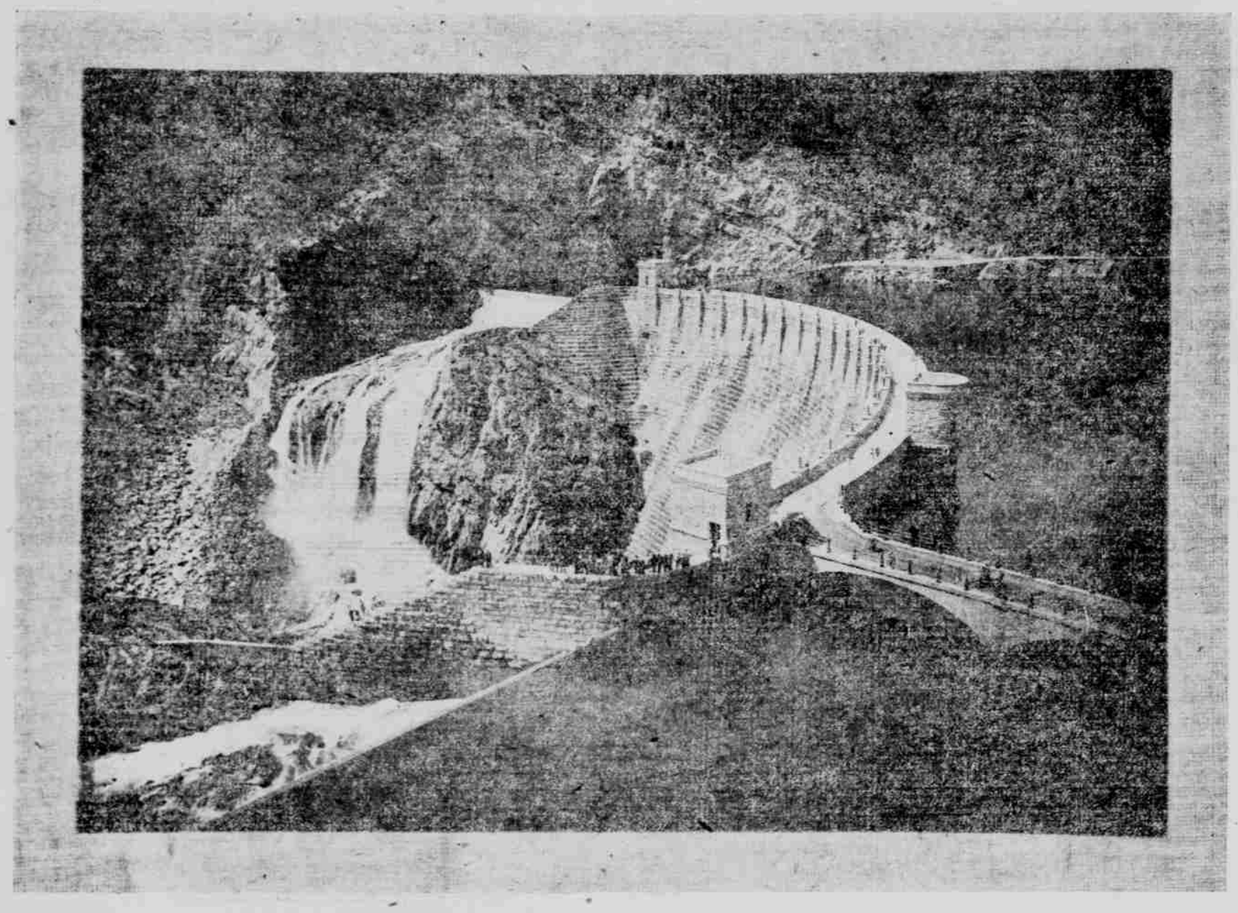
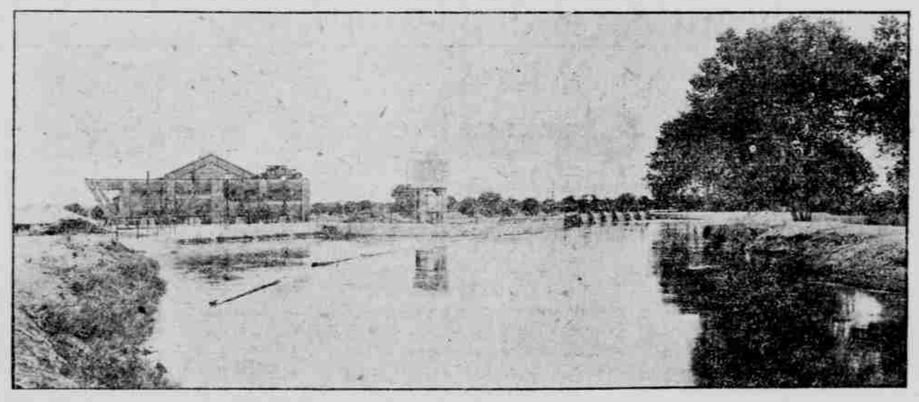


Cut by Phoenix Engraving Company.— WATER ENOUGH—AND TO SPARE. —Photograph, Courtesy Romaine Fielding.

The Roosevelt Dam is today, May 23rd, impounding over 1,400,000 acre feet of water—enough to insure maximum crops in the Salt River Valley for three years to come. In gallons the contents are 4,573,806,000,000. Today the water going over the spillways, one of which is 220 feet wide, the other 207, is over two feet deep, and on its way to the bed of the river, 227 feet below, forms most beautiful waterfalls.

SOME PHOENIX RESIDENCES

Miles of well-kept lawns and thousands of evergreen trees make Phoenix attractive the year round.



FOREBAY AT ARIZONA FALLS POWER HOUSE

Located northeast of Phoenix on the Arizona Canal near Ingleside. This power house is one of the four hydro-electric plants in the Salt River Project.

Cut by Phoenix Engraving Co. ANOTHER VIEW OF THE RESERVOIR AT ROOSEVELT —Photo by Farquhar.