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Irrigation for Profit

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IRRIGATION FOR PROFIT.

THE GREAT AMERICAN DESERT.

THE 97th meridian of longitude, which runs nearly through the centre of the States of Kansas and Nebraska, is usually taken as the eastern boundary of the American Desert. The western boundary is the farthermost Pacific coast range of mountains, coming down almost to the ocean itself. This area comprises nearly two-fifths of the earth's surface included within the limits of the United States, not counting Alaska, and in no considerable part of it is there sufficient rainfall to produce the ordinary crops without artificial irrigation.

There are two principal causes for such aridity :

First—It is so far from the Atlantic that the easterly winds, such as there are, lose their moisture before they reach this portion of the country ; and as to the Pacific, it is walled away from it by this coast range of mountains, which are so high and precipitous that the moisture-laden breezes cannot pass over them.

Second—Much of the region has an excessive drainage which carries off, before it has time to do its beneficent work, even the little rain which does fall. Farmers here in the East are accustomed to underdrain their land with tiles three or four feet below the surface to carry off the surplus water, and this system has been found so effective and beneficial that a very large part of the States of Ohio and Indiana, as well as considerable areas in other States, is now being rapidly reclaimed and improved in this way. But in the process of world-making ditches have been dug by natural forces through this arid region of which we are now

speaking, much larger, longer and deeper than any that man has ever made. The rivers run through deep cañons that so thoroughly drain the country for an immense distance around, and to such a great depth, that moisture cannot remain for any great length of time near enough to the soil to be made available by the roots of plants. The greatest depth of the Grand Cañon of the Colorado is about seven thousand feet, while almost the entire course of the river, except near its mouth, is through a channel not less than two thousand feet below the surface. If a drain four feet deep and a tile two inches in diameter are sufficient to collect and carry off the surplus waters from the overmoist lands of the East, it can easily be imagined what the effect must be of these immense natural ditches furrowing the country several thousand feet in depth, in a region at the best very deficient in its supply of moisture.

THE FIELD FOR IRRIGATION.

It is the great work of our civilization to make the earth more habitable, and compel it to yield to man more of the things that minister to his welfare, comfort and happiness.

There is a story in the Tim Bunker papers, in the old *American Agriculturist*, of a farmer that had drained a swamp, changing it from a noxious morass into the most fertile field of all his farm; whereupon he was solemnly visited by the orthodox but shiftless deacon of the village church who, speaking with all the authority that his high office and his renowned piety gave him, informed the offending farmer that he had committed a most grievous sin against his Maker, and must instantly repent or he would meet some untimely end; that the Almighty, having made that field a swamp, intended that it should remain a swamp, and that he that essayed to make it anything else was guilty of blasphemy in setting himself up as wiser than his Creator. It is not recorded that the divine vengeance was ever wreaked upon this energetic and intelligent tiller of the soil, but it is said, on the contrary, that he prospered and grew rich while his more pious but less pushing neighbors were growing poorer and poorer.

What drainage was to the New England swamp, irrigation is to the Western desert; only the field for it is very much greater.

A distinguished Frenchman, some time ago, said that if he were to land suddenly on a new planet and could get a bird's-eye view of it, he could judge accurately and at once of the state of the civilization of its people by the condition of its isthmuses; if the strips of land which divided one navigable ocean from another were uncut, he would say that this people had advanced but a little way; if, on the other hand, he should find that their ships could travel without interruption over the whole face of the planet, he would conclude that they had reached a very high degree of development.

If the great canal builder were speaking now, in the light of the history of the past ten years, he might well, instead of the *isthmuses*, make the condition of the *deserts* the test of civilization, for there is no more marked feature of our present decade than the great progress which is being made in desert reclamation.

For no other reason than because there is an absence of sufficient moisture for crop cultivation, nearly one-third of the land on the surface of the earth has been, and is, in its present state, incapable of sustaining any considerable population. If you could supply this deficiency wherever it occurs you would enable our planet to sustain an additional population of more than five hundred million people. The *whole* of this arid land cannot probably *ever* be reclaimed, although the limits beyond which it is supposed the line of successful irrigation cannot go are being pushed back every year very rapidly, with the extension of human knowledge; but nothing has been more clearly demonstrated during the last ten years than that a *very large part* of this desert area is practically susceptible of reclamation by engineering devices with which we are already familiar. And when the people of the earth have done what they *can* do in that regard, they will certainly have given the planet on which they live the capacity to sustain an additional population very much larger than that which any single nation of the earth has to-day.

Col. Richard J. Hinton, special agent in charge of the office of Irrigation Inquiry of the Department of Agriculture of the United States, has made a very thorough investigation and careful computation as to the total number of acres susceptible of reclamation in the United States, and he gives the following as the result:

STATES AND TERRITORIES.	No. of Acres reclaimable by Irrigation.
California	25,000,000
Colorado	20,000,000
Dakotas, North and South	33,000,000
Nevada	7,000,000
Arizona	12,000,000
Montana	30,000,000
Idaho	10,000,000
New Mexico	14,000,000
Utah	10,000,000
Wyoming	12,000,000
Public Land Strip (No Man's Land).	2,000,000
Texas, West of 97°	20,000,000
Oregon & Washington, East of Cascade Range	20,000,000
Kansas, Nebraska, Oklahoma and Indian Territory, West of 97°	30,000,000
Total	<u>245,000,000</u>

Other authorities make the reclaimable area even larger than this.

The State of New York comprises, including the large amount of mountain and waste land within its borders, about 30,000,000 acres. According to Mr. Hinton, therefore, the reclaimable area of arid lands in the United States is more than sufficient to make eight states such as New York. In many parts of the world the percentage reclaimable is even greater than in our country, and if Mr. Hinton's calculations are even approximately correct (and there is no man living more competent to make them) it cannot be disputed that I have been confining myself within very conservative bounds in making my estimate of the amount of additional population that the earth will sustain when irrigation has been carried to its farthest practical limit.

I am sure that the Power that made the world as good as it is, will not be jealous of the sons of men that set themselves to work to make it better; and that the pioneers in desert reclamation, who are doing so much to increase the earth's capacity to sustain its people and to minister

to man's welfare and happiness, will go down to future generations more honored, and will win more plaudits here and more rewards hereafter, than the distinguished slaughterers of mankind who in former ages have done so much to depopulate and destroy.

THE SCIENCE OF IRRIGATION.

The logic of all improvement rests upon economy. We learn to so use a little as to make it do the work of much. When we build a house we take a little rock out of the abundance in the quarry, but dispose it so as to make it more useful to man than the whole quarry was in its original condition. When we build a canal in which to float ships, we so construct it that a narrow waterway and a limited amount of water serve all the purposes of a broad river, lake or ocean. Comparatively little iron, properly laid in the form of a railroad track, renders more service to humanity than all the iron ore in the world so long as it lies in its native beds.

The methods of nature are wasteful. She gives unstintingly from her abundance. When it rains, it rains as much upon the ocean as upon the land, upon the barren rock as upon the growing plant; and a thousand drops go to waste where one is made to minister to plant growth or animal welfare. There is water enough in the most arid regions for luxuriant vegetation if we can only save it all, and the effort of the irrigator is to prevent waste, so that the largest possible amount of water that does fall may be properly and effectively utilized. He dams the streams and impounds the waters so that they will not run off to the ocean before they have done their proper work, and then he uses the water thus impounded in such a way that the greatest possible amount of it reaches the roots of the plants which he desires to cultivate, and at the time when they need it most, thus making a little do quite as efficient work as much would do under less economical conditions.

There are three principal requisites for plant-growth: (1) There must be the mineral elements in the soil which go to make up the constitution of the plant; (2) there must be water in sufficient quantity to take up these mineral matters in solution, for it is only in a liquid form that anything can enter the plant-cells; and (3) there must be sun and

heat, for it is by the action of these upon the leaves that the water laden with materials for the plant structure is pumped up through the roots, from the soil.

So far as plant-growth is concerned, rain does no good until it gets below the surface, and if you can get the water there by any other method, it serves just as good a purpose—even better, for the action of the rain upon the exterior surface of the plant is usually detrimental rather than otherwise. If you could hold an umbrella over your tree while it is raining, and remove it when the sun shines, without interfering with the abundance of water at the roots, you would probably facilitate its growth. Irrigation takes the water only where it is needed, and allows it to do no harm elsewhere.

Irrigation is better than rain also for another reason. The combined action of the sun and water is necessary to produce plant-growth. The rain interferes with the action of the sun, and the sun with the fall of the rain, so that the work of each has to be done separately and alternately. But irrigation does not in any way interfere with solar action as the rain does, and the water can be supplied to the roots at the same time that the sun is at work upon the leaves. It is the difference between a two-horse and a one-horse team.

THE HISTORY OF IRRIGATION.

In both the old and the new world irrigation is older than history. In Egypt, India, China and other Oriental countries there are the traces of irrigating systems that precede the dawn of literature, and of which there is no record, except that we find sometimes the ruins of the works themselves. In the earliest history we find accounts of its practice by the ancients, and in recent times Spain, Italy, Sicily and southern France owe a large part of their agricultural prosperity to artificial irrigation. These populous and prosperous countries would have been practically uninhabitable without it. Buckle, in his great work on European civilization, pays much attention to the subject of irrigation, as it was practised in Spain during the fifteenth, sixteenth, seventeenth and eighteenth centuries, and shows that the time of Spain's greatest power and highest

development is coincident with the time of the most extensive and systematic development of her irrigating canals.

In this country also the practice of irrigation is older than history. In the valleys of the Gila, Salt and Colorado rivers in Arizona, on the Rio Grande in New Mexico and Texas, as well as in many parts of old Mexico and Central America, and in the famous Empire of the Incas in old Peru, and in a number of other places on this continent, there are now plainly to be seen the ruins of extensive and magnificent systems of irrigation of which there is not the slightest historical record. We can trace the lines of their canal systems forty or fifty miles, and so perfect was their engineering that some of the best ditches built within the last ten years have followed substantially the old lines.

Under, along and in the vicinity of these old canals, particularly in Arizona and New Mexico, we find the ruins of temples and public buildings, and the traces of works of art in such quantities and of such a character as to furnish conclusive proof that these irrigated valleys must have been the home in prehistoric times of a very large, cultured, intelligent and prosperous population.

In what we call the New World, as well as in the old, there is abundant proof that the early civilization was very closely dependent upon, and connected with, the science and art of irrigation.

When we come to historic times in our country we find that the Pueblo Indians in New Mexico have been cultivating the valley of the Rio Grande by irrigation for at least five hundred years, and that the Pimas in Arizona have used the waters of the Gila and raised abundant crops from the lands which they now occupy for even a longer period. Similar instances might be noted among other tribes in other places.

Some of the early California pioneers practised irrigation with great success, but it was in individual instances only, and there was no concerted movement for its general adoption until the Mormon settlement of San Bernardino, in Southern California, in 1854, and of Salt Lake City, in 1858. But we have to come down to a still later period before we find any important instances of its use in this country by others than the Indians and the Mormons.

Horace Greely may properly be called the father of irrigation in the United States. It was in the memorable year of 1870 that the Union Colony founded that town in Colorado to which the great Editor of the *Tribune*, and the illustrious friend of mankind, gave his name and lent the force of his genius and character, and in the success of which he showed an interest greater perhaps than in any other project of his life.

The Greely Colony had such good fortune that similar movements were soon started in various places, most notably at Riverside and Fresno in California. All these colonies were prosperous beyond expectation, and these early irrigators paved the way for the much larger and more comprehensive efforts in the same direction which are now following them.

During the seventies comparatively little could be done. The best part of the arid region was not open to settlement. Railroad development had not progressed far enough; corporate greed kept the rates of freight and fare too high; and, what was still worse, the hostile Indians still roamed in their fierce and untamed condition over the greater part of this reclaimable country.

Irrigation, as a matter of paramount national importance, may be said to date in this country from 1881. Since that time several thousand miles of irrigating canals have been built, covering and reclaiming millions of acres of land, and the great work may now be said to be fairly under way.

Most of our irrigating enterprises have been financially successful; some of them phenomenally so. There have been no failures except such as have been the result of ignorance, stupidity, or want of ordinary business intelligence. In Southern California, on an average, not less than ten dollars of value has been created by every dollar of expenditure in irrigation. In Arizona the record is not very much, if at all, worse. Farther north the return has not been quite so great, but has still been sufficient to found many handsome fortunes.

To illustrate the progress made during the last ten years I give a table of the irrigating systems in the County of San Bernardino in California, compiled by Richard J. Hinton, on the authority of Mr.

L. M. Holt, editor of the *Orange Belt* of Redlands, Cal., showing the number of acres in cultivation in that county in 1880 and 1890, respectively.

WATER SYSTEMS	ACRES.	
	1880.	1890.
Riverside	5,000	10,000
Gage Canal		15,000
South Riverside		6,000
Pomona	1,000	12,000
Ontario		5,000
Etiwanda		3,200
Cucamonga	2,000	10,000
Lytle Creek	500	15,000
North Fork Ditch	1,000	4,000
South Fork Ditch	1,000	4,000
Mill Creek	3,000	5,000
North Riverside Canal		10,000
Vivienda Pipe Line		5,000
Rincon Ditch	3,000	4,000
Chino Pipe Line		2,500
City Creek		500
Twin Creeks	500	3,000
Banning		4,800
Colton Terrace		1,500
Bear Valley Reservoir		18,000
Glen Ellen	500	2,000
Meeks & Daly Ditch	500	4,250
Total	18,000	144,750

To illustrate still further what irrigation is doing for Southern California I give another table, showing the increase in population during the last ten years of the ten counties of California within which the irrigated area of the State is mostly situated, and which without irrigation could produce little or nothing.

Between 1880 and 1890 the percentage of increase of population in these counties was as follows :

COUNTIES.	PERCENTAGE.
Fresno	228
Kern	79
Los Angeles	234
Orange	244
San Bernardino	227
San Diego	295
San Luis Obispo	77
Santa Barbara	66
Tulare	120
Ventura	98

During these same ten years the increase of the population of the whole state was only 39%, and outside of these ten counties this increase was very largely in the urban population of the City of San Francisco, and its environments.

The increase in the value of real estate and improvements in the four fruit-raising counties of California during these same ten years was as follows :

COUNTIES.	REAL ESTATE.		IMPROVEMENTS.	
	1880.	1890.	1880.	1890.
*Los Angeles	10,477,432	45,454,995	3,033,059	14,453,300
Orange		5,495,015		1,468,337
San Bernardino	1,669,007	12,990,005	586,577	4,198,550
San Diego	1,307,302	20,000,085	341,948	4,450,286
Total	13,453,841	83,940,100	3,961,584	24,560,473

*Los Angeles in 1880 included Orange County.

It should be remembered that these phenomenal results with irrigation are for the same ten years during which, as the Farmers' Alliance tells us, and the census reports seem to show, the farmers in the country generally have been growing poorer rather than richer.

If we may judge from this evidence, it would seem that the irrigating ditch is far ahead of the thunder-shower as the farmers' friend.

A broad and careful study of the subject can lead to no other conclusion than that there has been no other kind of enterprise that for the past ten years has done more for the country or paid better returns upon investment than irrigation; and it is equally clear that irrigation in this country is to-day as much in its infancy as railroading was in 1850. Millions are to be reaped in the future where thousands only have been made in the past.

THE LEGAL ASPECT OF IRRIGATION.

The legal situation in Arizona is particularly favorable to those organizing or investing in irrigating companies for operation there.

Many of the States and Territories of the arid region have passed special statutes upon the subject, but California has gone farther than any of the others. Her legislature has recognized the fact that the prosperity of the State itself is so much involved with the question of irrigation that it has made it a public matter, and by the statute of March 7, 1887, known as the Wright District System Law, it has provided for organizing irrigation districts in the arid portions of the State, and for making each district a quasi-corporation of itself, with the power to purchase irrigating canals already built, to build others, and to issue public or municipal bonds and raise money by taxation in payment therefor; intending that ultimately all the irrigating ditches shall be public works as much as highways are.

Other States and Territories have passed less trenchant statutes, providing generally for police regulations in reference to the use of water, and tribunals for the settlement of disputes relating thereto.

In Arizona, with which we are specially concerned, there is no legislation, and the common law prevails. This is greatly to the advantage of those contemplating investment in irrigating ditches there. The legislation elsewhere, wherever there has been any, has been more or less of the granger kind, for the benefit of the land-owners at the expense of the ditch-owners. It is fortunate for us that there is nothing of the kind in Arizona. Undoubtedly the time will come in the future when there will be some legislation of this sort, but it will be only after our rights have become vested and our titles secured under the Constitution of the

United States; and, really, the conditions which prevail in Arizona are so different from those of most of the other states and territories, that I feel quite sure that we should not have much to fear from hostile legislatures, even though we were not protected as we are by these constitutional provisions. The common law which prevails in Arizona gives an easement or vested right in water to the first appropriators thereof. The right to take and use it becomes then as much property as land itself. Government interference becomes possible only under conditions similar to those which would justify interference with titles to land. Here in the East, where land is limited and water is plenty, we regard the land itself as the principal subject of ownership, and the water only as incident or appurtenant thereto. In this arid region, where there is plenty of land and the water only is limited, the ownership of the water becomes of the chief importance, and the land might more properly be included among the "appurtenances." By the construction of the irrigating ditch we become the owner of the thing of principal value, and whoever has land under it has to pay such tribute to the ditch-owner as the latter may exact in his contract. Our national legislation does not encourage the formation or holding of large bodies of land by individuals or corporate organizations, else we might attempt to take up the land itself under the canal and become the owner of land and water, both. But we accomplish substantially the same results by appropriating and securing firm right to the water, and allowing whoever will to amuse themselves with the ownership of the underlying acres, which are of no more possible value to them than so much area of the blue sky of heaven, unless we choose to furnish them with that which alone can make them valuable.

THE CONDITIONS OF SUCCESS.

The success, which, as I have shown, has attended so many irrigating enterprises during the past ten years, and which I am confident will continue to attend such enterprises for many years to come, cannot, any more than other good things can, be obtained without a due regard to the proper conditions of success, or without an intelligent, energetic and far-sighted business management. It is as possible to fail from ignorance or shiftlessness in irrigation as in any other kind of enterprise, and the

confidence that I express in the financial merit of irrigating undertakings must be understood as being based upon the supposition that the enterprises must be judiciously selected and well managed.

In selecting an enterprise of this nature in which to make an investment, a careful study must be made of five principal natural conditions. They are: (1) the supply of water; (2) the lay of the land; (3) the soil; (4) the climate; and (5) the market.

(1) It was once supposed that a great abundance of water was necessary for successful irrigation. Modern knowledge and improved methods have taught that a little water can be made to go a great ways. Nevertheless a sufficient supply is of the utmost importance.

(2) The lay of the land is very important as determining very largely the original cost of the canals and the subsequent expense of maintenance and distribution of water. The conditions are most favorable where there is a long stretch of very gently sloping bottom or mesa land between the foot hills and the stream, and you can lead the water from high up the river under the foothills and distribute it automatically, by its natural flow over the land itself.

(3) The character of the soil is, of course, of the utmost importance. It is indispensable either that the soil should be naturally fertile or that the water by which it is fed should contain in itself such elements of fertility as the soil lacks. In the Gila and Salt River valleys the soil is a rich, deep loam, and the fertilizing value of the water is a matter of common knowledge.

(4) Climate is also a matter to be taken carefully into consideration. It is much more profitable to irrigate in the southern than in the northern countries. To get the greatest benefit from the water you must have the full sun and an abundance of heat. With plenty of warmth and plenty of water and a fertile soil, you can get, year after year, without cessation, most phenomenal crops. This is the principal reason why irrigation has been financially more successful in Southern California and Arizona than in Colorado and the States and Territories farther North. It would seem that there is scarcely anything which the sun and the waters yoked together and working at the same time, cannot produce from their soils.

(5) A market is also indispensable to success, and it has been the want of such a market hitherto that has prevented the settlement of many of the most fertile lands of the Southwest. Southern California developed early and grew fast because it had, in addition to its other advantages, railroad communication and an easy market. The railroads, for some reason, for a long time, discriminated strongly in her favor and gave her a long pull ahead of her rivals. The Inter-State Commerce Law now prevents discrimination, and wherever access can be had to a railroad, farmers can be assured that they can have their products transported even to distant markets at tolerably fair rates.

Probably no legislation has ever been adopted in this country that has done so much for desert reclamation as this Interstate Commerce Law. I believe it has come to stay.

THE GILA AND SALT RIVER VALLEYS.

We find in these valleys all the conditions for successful irrigation at their very best. If you sail from the Pacific Ocean up the Gulf of California, after a time you find the shores gradually approaching each other; and, imperceptibly, hardly knowing where the one ends and the other begins, you pass from the Gulf into the Colorado River. The first town you reach on the eastern bank, on American soil, is the city of Yuma, Arizona. At this point the Gila River empties into the Colorado. The Gila is the smaller stream of the two, but for the purposes of the irrigator it is much the more important. It has been called the American Nile, and it is certainly true that there is no one stream upon this continent that has played in the past, and, as it would seem, is destined to play in the future, so important a part in the work that has so recently commenced of the reclamation of the American Desert. It drains a vast territory. It and its affluents rise among the lofty snow-covered mountains of New Mexico, Colorado and Arizona. Its upper course is a tortuous and troublesome one. It passes through deep cañons, and, twisting around among the mountains almost all the way, has to fight for its passage to the sea; but near the city of Florence, Arizona, about three hundred miles from its mouth, it emerges into the ever famous Gila valley, and passes along through this valley to its mouth, at Yuma.

The Salt River rises too among the mountains, but not so far to the east as does its twin sister, the Gila. It has a like tortuous and difficult course until it emerges through the rocks, about ten miles below old Fort McDowell, and about thirty miles above Phoenix, and thence it flows through the Salt River valley, past the city of Phoenix, until it is merged into the Gila. The length of the lower Gila valley, from the mouth of the Gila at Yuma to the junction of the Salt and Gila rivers is about one hundred and eighty miles. The length of the upper Gila valley, from the junction to Florence, is about one hundred miles, and of the Salt River valley, from the junction of the Gila to the point where it emerges from the rocks and from which the Arizona Canal starts, is about sixty miles. The valleys and the streams have all the same general characteristics. The Salt River descends more rapidly, and in times of a freshet it is sometimes high water on the Salt opposite Phoenix ten days or two weeks sooner than on the Gila. The character of the climate and soil can be best compared with that of the fruit-growing districts of southern California. It is a little farther inland, and the climate is a little modified by this fact, and the chief distinguishing difference between the soils of these valleys and that of Southern California is, that that of California is somewhat more retentive of moisture, while that of the Arizona valleys has a more abundant natural supply of plant food. It is in the abundance and character of the water supply of these valleys, however, that they have their chief natural advantage over the California region. In Southern California the streams are small; water has to be used with great care and economy, and often they have to resort to artesian wells or to pumping in order to obtain a sufficient quantity. In the Salt and the Gila valleys there is an abundance of water, properly utilized, to reclaim every foot of reclaimable land which by any feat of engineering they can be made to cover; and this water, rising as it does among the snows of the mountains, flowing through rocks and formations which are slowly disintegrating and yielding up the valuable mineral salts which they contain, comes down upon this plain, carrying fertilizing elements quite as rich and valuable as those of the great Egyptian river, and it is in more aspects than one that there is logic in calling the Gila "The American Nile." The Pima Indians have cultivated their lands and raised crops in these

valleys, using the waters of the Gila for irrigation, without employing any other fertilizers whatever, for the last five hundred years or more, and the crops to-day are as good as they ever were. There is no such thing known there as the exhaustion of the soil.

These valleys have a history which must be sought for elsewhere than in books. Near Florence can now be clearly traced the line of a great irrigating system of which there is not the slightest historical record, and which was some forty miles long, and covered at least a hundred thousand acres. So well was it laid out, that in building the present canal system about Florence its engineering has been imitated and followed in many important respects. Near Phoenix, on the Salt River, is found the course of another irrigating ditch some thirty miles long, and the Mesa City canal of the Salt River Valley, recently built, follows its course for a long distance. All along the Gila and the Salt River there are found traces of other works of a similar nature. Everywhere through these valleys are the ruins of an extinct, but highly-advanced, civilization. The ruins of Casa Grande have a world-wide reputation. At Florence there are others quite as interesting. All around Phoenix, and along the whole course of the Gila, and back some distance into the mountains, other ruins occur, which are the delight as well as the puzzle and tribulation of the archæologist. The Casa Grande ruins were visited by the Spanish explorer, Coronado, in the year 1533, and Castanado, the Spanish historian of the expedition, in describing the structure, said :

“ One building is a large edifice, the principal room in the centre being four stories high, as were also those adjoining it on four sides. The walls are two varas thick, or sixty-four inches, and so smooth on the inside that they resemble plain boards. They were also so polished that they shone like Pueblo pottery. The main structure was visible at a distance of two leagues. ”

These and similar ruins all through this country give evidence of the extent of the ancient population, and show that it consisted of a peaceful, agricultural people, highly advanced in many of the arts, and possessed of a very considerable degree of civilization. No trace, however, has been found of a written literature, and if they had any, it has been entirely lost.

These people, with this civilization, have entirely disappeared from the face of the earth. The cause of their disappearance can only be surmised. They may have been conquered and exterminated by some warlike adjacent tribe who had not the ability nor the industry to carry on their work. Some scholars have surmised that it was some religious or superstitious motive which took the people away, and some recent discoveries on the Gila lend a good deal of support to this theory. There is evidence of quite a violent earthquake shock, and some things, it is thought, tend to show that the people left there suddenly, apparently believing that it was the admonition of the Gods that they must at once leave their beautiful country, and seek their home in some less hospitable region. All that we can *know* is that for some cause they did go, and that the valleys are left for us.

The reason for the original selection of these valleys by this prehistoric tribe, the most civilized of any tribe of which there is any trace within the present limits of the United States, is however quite evident. There is no space of the same size on the earth's surface seemingly better adapted to support, and be a home for, a large population engaged in agricultural pursuits. The climate is delightful. Winter, as we know it, is never known there. The heat of the summer, although greater than in our latitude, is, owing to the dryness of the climate, scarcely more oppressive. As a climate to live in, it has few rivals; as the land for the farmer and the fruitgrower, it is a paradise. Wheat, under irrigation, yields forty bushels to the acre; barley, sixty-five; and alfalfa, an excellent kind of clover hay, six or eight tons; and the yield is as regular as the occurrence of the seasons. A failure of a crop has never been known. The farmer has to buy no fertilizer, and the clergyman is never called upon to pray for rain.

Within the last ten years something like 500,000 acres in these two valleys have been covered by about four hundred and fifty miles of irrigating ditches. Irrigation in Southern California and Colorado dates further back than in Arizona, and they have had, until recently, the benefit of better means of transportation to the Eastern markets; but considering how recent it is since the railroads came in and the hostile Indians were driven out, there is no other part of our national

domain which shows the influence of a greater or more well-founded prosperity.

As a fruit-growing country, it is in no respect inferior to California, and in some respects it has very great advantages over it. Marvellous success has been attained in the culture of the grape, fig, orange, lemon, lime, peach, apricot, pear, quince and olive. Raisin graperies have been planted near Phoenix which are among the largest in the world, and have just come into bearing, and experts have pronounced that there is no other place outside of Spain where sherry can be produced with such success, even Southern California seeming to lack some requisite elements of soil or climate. An orchard comes into bearing the third year after it is planted, and becomes profitable at once.

The first time I was in Phoenix, I saw an instance of success in farming such as the Farmers' Alliance does not report to have occurred anywhere this side of the Rocky Mountains. An industrious man, with good reputation, but without money, had bought a piece of land on credit. He set it out to fruit, obtaining credit also for all expenses connected with it, including its cultivation for the next two years. The third year I saw his crop of fruit, and he sold it for enough to pay for his land and all his debts and leave him a good profit besides. I do not say that this could be done now, for he was a pioneer in the business, and was able to obtain fancy local prices; but notwithstanding the enormous quantity of fruits which is now being produced in this country and the distant markets and the many disadvantages under which they have had to labor in years past, but which are now rapidly disappearing, the fruit-growers of Southern California and Arizona are the most successful and prosperous cultivators of the soil in the United States; and far-sighted men who have studied the subject are of the opinion that their prosperity is but just begun, and that they are now only upon the extreme border of the promised land.

In fruit-raising, irrigation is even more important and beneficial than in any other kind of farming. If you are raising wheat and have a drought, it ruins that particular crop of wheat, but next year you can try again, and Providence may be kinder to you; but if you are raising fruit, and just as your trees or your vines are getting into fruit-bearing they die

of thirst, you have to start again away back at the beginning. *With a proper system of irrigation there is never a drought.*

THE COMMERCIAL ASPECT.

It was seen by sagacious and far-sighted men, years before there was any attempt in this country to build irrigating canals on a large scale, that irrigation offered opportunities for very profitable investment. But the continual difficulty was to devise a scheme by which the parties making the investment would be the ones to secure the benefit of it. Our land laws were devised for the settlement of the prairie, and for that they were the embodiments of wisdom. There one eighty or one hundred and sixty acre tract was about as good as another, and an entirely unavailable section was seldom met with, or, if it were unavailable, it was likely to be for some other reason than want of water, of which there was usually too much rather than too little. The survey of the prairie countries was very simple; straight lines and right angles only were used. The location of a quarter section under the Homestead Act was equally simple. A man looked on the map, saw what tracts were still at his command, selected the one nearest to his village or depot and went to work on it. The laws have been designed for the benefit of the poor settler and to prevent the accumulation of large holdings. It was wise and efficient legislation.

But here, in the desert, originally the conditions were entirely different. An ordinary one hundred and sixty acre tract was of no more use to a man settling on it by himself than would be so much of Sahara itself. His land could be made valuable only by the construction of large and expensive irrigating works. To a limited extent, and for a short distance along the streams, the farmers could club together, dig their own ditches, and manage their own water supply, and this was the method of primitive irrigation in this country. But such resources were soon exhausted, and when you came to constructing the large and comprehensive irrigating works that became necessary in order to reclaim the still more valuable lands of the mesa higher up from the stream, co-operation among the farmers was an utterly inadequate method of supplying the wants of the people.

The irrigating ditch increased enormously the value of the land under it, so that, whereas before the ditch was made there was no market for this land, even at the government price of \$1.25 an acre, immediately after it was built the same land became worth twenty, thirty, and in some cases several hundred dollars an acre. A canal that would cost \$500,000 might reclaim a hundred thousand acres of land and add \$25 an acre to its value, thus creating wealth at the rate of \$5 for one expended. This was not at all an unusual or unexpected result. The returns were often very much greater than this; but under the old methods the man who built that \$500,000 canal, while adding more than \$2,000,000 to his neighbors' property and making *them* all rich, would get for *himself* a piece of property which might not even produce him a fair return upon the investment, or if it paid him a profit for his money and time spent in the work, it would pay to some one else who had lifted no finger to accomplish the result a much greater reward. This was not an attractive proposition to present to an outside capitalist, and it was clear that the whole plan and system of building irrigating canals had to be radically changed, at least so far as the conditions in Arizona, with which we are now specially dealing, were concerned.

It was at this point that my services were called into requisition, and I must give you a little of my personal experience.

In 1882 I was at Phoenix, Arizona, on professional business, and obliged to remain there for some weeks waiting for advices from the East. While there the town was visited by a party of prominent gentlemen interested in the territorial welfare. Among them were Hon. Frederick A. Tritle, then Governor of the Territory, and Hon. Clark Churchill, the Attorney General. They came to look over the land and consider the practicability of a more extensive system of irrigation. I was invited to ride over the line of the proposed canal with them, and we spent several days on the route. It was evident to all of us that here was an opportunity for an irrigating enterprise larger and grander than any which had ever been in these valleys, at least since they had been deserted by the prehistoric mound builders. It was clear that such an enterprise would be of the greatest importance to the territory and that it should also yield great profits to its promoters and constructors if it could be properly and

successfully organized and managed. It was equally clear that some plan of organization and management must be adopted, entirely new to that country.

The canal would cost probably half a million dollars. The country was new, and there was not money enough in the valley to build it. The introduction of outside capital for that purpose was absolutely necessary. The problem was to offer inducements such as would attract the capital. I was an Eastern man, and the East was supposed to be the ancestral home of wealth; and I was a lawyer, and presumably knew how to do things that other people could not do. They appealed to me for my opinion, advice and assistance. I yielded to their appeals, and that is how so much of my time and thought since then has been devoted to the subject of irrigation.

Mr. Churchill and myself called to our assistance the ablest lawyers of the country around, and together we devised and formulated a plan for the construction, management and operation of irrigating enterprises on a large scale. Our plan was adopted by the Arizona Canal, which was the enterprise then in immediate contemplation, and it has been substantially followed by all enterprises of like nature that have been carried on in that Territory since that time. We moulded it according to the best models we could find, so far as models were available, and, wherever necessary, we struck out anew.

Its salient features are as follows:

A corporation is organized for the purpose of building, operating and managing the canal for profit. It has no connection with land ownership. The canal organization acquires simply the right to construct the ditch and dispose of the water which flows through it. This water is divided into a given number of water rights. A water right covers eighty acres of land and gives to the owner of such eighty acres the right to buy a definite amount of water from the canal company, for the irrigation of that definite tract of eighty acres, at a definite rate. He must own the water right before he can even buy the water. The price of the water right is fixed at such a rate as will give the owners and builders of the canal an adequate and satisfactory return for their investment, and the price of annual water service is fixed at a rate which will pay a fair divi-

dend upon the capital stock of the canal company. The profit of building the canal is therefore twofold : First, from the sale of water rights, and then afterwards, perpetually, from water rentals.

It has been objected by the people of the locality that this system has yielded very large profits to the canal builder, and it is true that it has ; but the reply is, that it was equally open to any one who desired to locate and build canals, and that if the canal builder did get a very substantial profit for the investment of his money and for his labor, the community and the landowner obtained an equal, if not a greater, benefit without any investment or exertion, and that such a division of profits was certainly not unfair to the men who did nothing.

Of course this, which might be called an abnormal rate of profit, will not always continue. If it did, capital would rush in from every other business, and there would be a surplus of it. Undoubtedly, after the most favorable locations have been taken up (and they are now being very rapidly disposed of) future canal-builders must construct much more expensive works and labor under less advantageous conditions, and the profit in the business of canal-building will eventually find its level with that of every other business. The pioneers have been, and in some favored instances such as ours, still are, able to select most favorable locations, where it is not necessary to use power to lift the water, and where expensive dams are not required, and where a very large area of land can be covered at comparatively small expense, and their profits have been, and will be, commensurate with their advantages; and yet, notwithstanding all this, for every dollar of profit which they have or will put into their own pocket, they have added to their country's wealth many more, and I think they deserve nothing but honor from the people.

It is with canal-building as it was with railroading : the earliest in the field selected the best locations, and reaped the greatest rewards.

THE CASTLE DOME ENTERPRISE.

If the purpose of my paper up to this point has been accomplished, I have succeeded in showing two things :

First : That Irrigation during many years to come, still more than during the few years that have passed since we commenced practising it

on any considerable scale, is to play a very large and important part in the development of our country's material progress and prosperity.

Second: That its development will be attended, not only with great benefit to the whole people as a mass, but with great individual profit to the few who are far-sighted, intelligent and energetic enough to seize the opportunities offered and make the most of them.

It is, of course, of the practical or dividend-paying phase of irrigation, rather than of its scientific or engineering aspects, that I feel from my experience competent to speak, and I do not hesitate to put on record my firm conviction, that the opportunities for profit that Irrigation offers now are even greater than those offered by railroad construction and re-organization in the palmiest days of Commodore Vanderbilt and Samuel J. Tilden.

It has ever been so, and there is some justice in it, that the pioneers in the organization and extension of any industry, rather than the inventor or the student, who was the first to discover the possibility of it and to point out the way to those who were to follow, are the ones who reap the greatest rewards. The world pays them the most, probably because it really owes them the most. The practical man, who actually gives a thing to the world, is perhaps quite as useful as the scholar or the man of genius who first discerned, in his closet, that it might be done; and all the evidence points to the conclusion that now is the time when the practical man, the great executive and organizer, can take hold of irrigation as a business, and when the capitalist and the investor can embark his funds in it, with the expectation of most satisfactory results.

Very many of the present great fortunes of this country have been made in the progress of railroad development; but I hazard the prophecy that thirty years from now more families will owe their wealth and position to irrigation than to railroads.

It was not by any means *every* railroad project that was well-conceived; neither can it be that *every* attempt at irrigation will be successful; but with the exercise of wise judgment in selection and good business management in execution, there need be no lack of profit.

The only question is, do these conditions attend the Castle Dome enterprise?

A.—IS IT WISELY SELECTED?

Mr. Herbert H. Logan selected this project some years ago from a large number of a like nature then open to him, as the one embracing in the highest degree all the most desirable conditions, and he gives it as his judgment that it is one of the best, if not absolutely the best, location for a successful irrigating enterprise in the whole Gila or Salt River valleys.

Mr. Herbert H. Logan has been connected with the building and management of the Arizona Canal, one of the largest irrigating enterprises in this country, from its commencement up to the present time, and he has made the question of irrigation in the Salt River and Gila valleys a subject of most careful and thorough study, and is probably as well qualified to make a selection as any one who could be found. He is my brother, and modesty runs in the family. I therefore forbear to speak further of his virtues.

Among the special advantages of the Castle Dome enterprise are these :

I. ITS ABUNDANCE OF WATER.

It is situated below the junction of the Salt and Gila rivers, so that it takes the full flow of both streams. All previous irrigating enterprises of any considerable magnitude in these valleys are located so far above it that the water they take from the river comes back by seepage through the soil before the head of the Castle Dome Canal is reached. It takes the water out at the point where the Gila River passes through the cañon at the foot of the Eagle Tail mountains. The stream here is confined by rocks underneath and on both sides. All the water has to come to the surface. In most other locations a great deal is lost by waste through the sands. We have, therefore, the waters of both rivers, undiminished either by the prior rights of other canals or by seepage. In this respect our project stands absolutely unique, and the lands under Castle Dome must, as a necessary result of the situation of the canal, have a fuller and more constant supply of water than those under any other ditch, in either valley.

2. THE CHARACTER OF THE LANDS.

These are of the same general character as the famous lands about Phoenix, on the Salt River, and about Florence, on the upper Gila. They are in no respect inferior, and have this very considerable advantage, that the conformation of the country and the general slope is such that there will be less waste or unavailable land under the Castle Dome than under any of the others. These lands have been shown to be especially adapted for fruit-raising. The capacity of Southern California in this line is well known. Her trees and vines have had more time than those of her easterly neighbor to get into bearing, and her fruit has had more opportunity to make its way in the markets of the world; but taking into account the time when fruit-raising was first commenced in the two places and their previous market facilities, Arizona is very well advanced, and it has been practically demonstrated that her soil is, for many kinds of fruit at least, considerably better than that of California.

As a fruit-raising country the Castle Dome region must, in the nature of things, have a future not less bright than that of any other region in the world.

3. THE CLIMATE.

This is so much like the climate of Southern California and like that of Phoenix and of Florence in Arizona, that it is hardly possible to state any difference between them; but whatever difference there is is entirely in favor of Castle Dome. We are a little farther to the South and a little lower in altitude than either Phoenix or Florence, and the tropical fruits which are sometimes endangered by frosts higher up, are entirely safe here. We are not so near the sea as Los Angeles or Riverside, but we are not so far inland as Phoenix or Florence—we are in a position where we have every material advantage of either section, and no special disadvantage whatsoever.

4. ACCESS TO MARKET.

This is the principal cause which gave Southern California its early start and great advantage. It is the one thing which has kept the Phoenix and Florence country back so long.

Our lands lie upon the North side of the Gila river, and extend from the Eagle Tail Mountains on the east as far toward the west as our canal system may be extended. Along our whole line the Southern Pacific follows near the Gila River on the other side, being at no point more than a few miles distant from it. We are, therefore, within easy reach of a railroad the whole length of our line. This is an advantage which no other canal in Arizona has ever had. Florence is still thirty miles from a railroad; Phoenix, until within three years, has been twenty-eight miles from railroad communication; and even now the locomotive comes only to the border of the Salt River country, and some of the lands under the Arizona Canal are as much as twenty-five miles distant from a railroad. And the railroad which Phoenix has is not a trunk line such as ours, but a local road over which they have only local accommodations and must pay local freights. So far as the shipment of produce is concerned, therefore, the lands under the Castle Dome will have a very considerable advantage over those under any other canal in Arizona, and we are fully five hundred miles nearer the Eastern market than Southern California. We have, as yet, but one railroad, the Southern Pacific; but the Inter-State Commerce Law protects us from unjust discrimination, and it is not likely to be long after the canal is built before we shall have at least one other line in our immediate vicinity.

There are some irrigating communities in the United States which *now* have railroad facilities as good as ours. But there has never been one of any considerable importance in any part of the country, which *at its commencement*, had the same market advantages that we have.

5. THE AREA THAT CAN BE COVERED BY THE CANAL.

The proposition is to build at first a canal sixty miles long which will cover 65,000 acres. There are not many canals in the United States which covered at the completion of their system more than we shall at the commencement of ours, and the possibilities for extension are almost indefinite. As I have already shown, we have an abundance of water, and the extension of the canal to the West, which this makes possible, will of itself bring more land under our canal than is now covered by any irrigating ditch in the world. By damming also we can raise the

water to such a height that it will cover a very considerable amount of additional lands, the very best in the world, under the foot-hills to the North, and we can also go on the other side of the river and cover a country extending way down to the borders of Mexico.

Altogether, the Castle Dome Canal system, when fully completed, must cover not less than 300,000 acres, and will have few rivals either in the extent or in the value of its lands.

6. ITS COST.

The course of the river is such at this point that we can take all the water out without a dam. No other canal of the size of ours has ever been able to do this, and it saves us at least a hundred thousand dollars in the cost of construction and a large amount in the way of annual maintenance, besides the constant danger of having the dam carried away by a freshet. The Arizona Canal lost its dam twice by floods before it was completed, and the smaller canals lose their head-works very frequently.

The conformation of the country is peculiarly well adapted for the building of a canal, and for its size it can be built as cheaply as any in the Territory. The experience of those who have gone before us and the work of modern inventors will also help us much. Canal-building has become a science, and machinery which has been invented in recent years materially diminishes its cost. So rapid has been this progress of invention, and this improvement in methods of construction, that the sixty miles of our canal can be built at least \$200,000 cheaper now than the forty miles of the Arizona Canal were built six years ago.

In California, in many places, they have irrigated at a cost averaging fifty dollars an acre for the lands covered. At Florence the cost was about twenty. On the Arizona canal it was a little more than ten. We can contract the remainder of our work to-day with responsible parties, if we choose to do so, at such rates as will insure us that the first cost of irrigating our 65,000 acres will not be much if any more than five dollars an acre.

The plans have been carefully examined by competent engineers, and experienced irrigators, and they report that no irrigating enterprise ever started under more favorable conditions.

B.—THE BUSINESS MANAGEMENT.

Confidence in business management has a very large personal element in it, and it always must be so.

We believe in the joining of power and responsibility. A majority of the stock of the Castle Dome Canal Company has been placed in my hands, in trust, to remain until the canal is completed and placed upon a practical working basis.

This has been done so that we might be able to give our personal and unqualified assurance, as we do, that the rights of every person investing in any of the securities of this company shall be fully protected in every contingency, and that no advantage whatever shall be had or taken by one stockholder over another, whatever may be the amount of their respective holdings. For this purpose I consider myself to be acting as attorney for each individual stockholder.

Our friends, who have so kindly expressed their confidence in us and their appreciation of our management of similar enterprises and trusts heretofore, will be satisfied with this. If any who do not know us contemplate joining the enterprise, they will naturally satisfy themselves upon this subject before making the investment.

The books of the company will be at all times open to every one interested in the enterprise, and every stockholder will be kept fully advised and informed upon all matters relating to it. The securities in this, as in our previous enterprises, will be offered at rates which will give every investor a fair proportion of the generous profits reasonably expected. Those of our friends and clients to whom we offered Santa Juliana at \$3.50, and who three years later were glad to buy it at \$25.00, and think it very cheap at that, will appreciate what this means.

Mr. Herbert H. Logan, than whom it is believed there is no one more competent, is the business manager in Arizona, and Mr. Samuel A. Davidson, an engineer of great capacity and experience, is in charge of the engineering work. The trustees and officers of the company are selected for their special qualifications and experience in the management of a work of this nature; and we think that their names will command general confidence.

The present official roll is as follows :

President and Treasurer—Walter S. Logan.

Secretary—Arthur E. Walradt.

General Manager—Herbert H. Logan.

Engineer—Samuel A. Davidson.

Attorneys and Financial Agents—Deming & Logan, 58 William Street, New York.

Trustees—Walter S. Logan, Horace E. Deming, Lindley Vinton, Salter S. Clark, Arthur E. Walradt and George A. Treadwell, of New York; Governor John N. Irwin, Herbert H. Logan, Col. William Christy and Thomas W. Hine, of Arizona; J. De Barth Shorb, of California.

New names will be added to the list of trustees from time to time from among the stockholders, so as always to keep the enterprise in close touch with those whose money is invested in it, and to give us the benefit of all the special knowledge and talent which it is possible to command.

We shall be pleased to answer any special inquiries in relation to the enterprise or any matters connected with it.

If our ambition is realized and our efforts are not abortive, the Castle Dome organization will accomplish two things :

(1) It will prove a very profitable investment for its security holders.

(2) It will do its part, and an important part, in the great work of desert reclamation in this country, and so merit well of mankind.

WALTER S. LOGAN.

