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The Great Southwest

III. Irrigation

FOR days we drove over the gray sand and stony mesas of central Arizona—a vast, bare, silent waste ridged with hills and furrowed with great washes, where the water rushes down in flood season from the mountains, but now as dry as ashes. The sun shone white and hot, the heat quivered from the tops of the ridges, and behind us trailed always a cloud of thin white dust. Here and there we saw a squat and thorny cactus, and here and there mesquite, greasewood, yuccas, and gray sage. For miles on miles there was no sign of living creatures; then a lean wild steer or two on the hills, a jackrabbit, a gopher, and a hawk wheeling in the air above and waiting for the desert to do its work. And in all those hundreds of square miles of land not a drop of water anywhere, not a pool, not a spring, save in a few favored spots where some desert pioneer had sunk a well and lived there to guard his treasure and dole out the water sparingly to such travelers as might pass that way. Bones bleached as white as chalk and scattered far and near gave evidence of the consuming thirst of the desert; and everywhere silence, heat, thirst. This was the desert. Who would dream of men bold enough to come here and fight for a home?

Yet here men have come. Suddenly, at sundown, we emerged from a thicket of cactus, and there, stretching away for miles and miles, was the soft green of fields, with rows of rustling cottonwoods, the roofs of homes, and the sound of cattle in the meadows. A wire fence was the dividing line: on this side lay the fruitless desert; on the other green alfalfa, full of blossoms and bees, brimming over the fences. At the roadside a ditch ran full of fresh, cool water; where it had broken through into the roadway—an extravagance that seemed reckless—a pool was wriggling full of polliwogs. Redwing blackbirds whistled in the cottonwoods, and wild pigeons flew up from the fields. Fat cattle stood knee-deep in the adobe waterholes, still and comfortable; the men were coming out whistling to milk. A little brick house stood back from the road, almost hidden with palms and umbrella trees; there were chickens and bees and children about it, and the scent of roses from the porch. Everywhere the landscape was serenely quiet and beautiful; here were homes and happiness. It was something to stir a man's heart, this change from the hard, dry, merciless desert to this sweet green paradise of the irrigated land. And all this change was the result of water—a very little water, too, considering—brought from the river above and spread on the sand. It had made all the difference between desolation and teeming abundance.

If ever men worked miracles, they have worked them here in these Western valleys. If ever something was created from nothing, these men have done it. Thirty-five years ago the Salt River valley, into which we had driven, was all a parched desert, uninhabited save by a few lean Indians and two or three hardy traders, whom the sand and cactus crowded down close to the water of the river. It was a thousand miles from the nearest railroad—an unknown, desolate, forbidding land, a part of the Great American Desert, which travelers said would never support

human life. Today the Salt River valley contains a population of over twenty-five thousand. It has three cities, one, Phoenix, the capital of Arizona, having electric lights, an electric car line, good hotels, churches and other buildings, residences surrounded by trees, lawns, and a wilderness of flowers. More than 125,000 acres of land round about are laid out in farms, highly cultivated, with orchards of oranges, almonds, olives, and figs, and grain and hayfields. Thousands of cattle feed in the rich meadows, and orchards, and fields where cattle feed in rich meadows, and there are bees, chickens, ducks and ostriches unnumbered. Richer soil than this once desert valley does not exist anywhere in the world except in other once desert valleys. Here one may behold the startling spectacle of orange groves in bearing worth \$1000 an acre on one side of a fence, and bare cactus desert on the other, both having the same soil, the same opportunities, but one only having water. Here, when a man builds his fence of cottonwood posts, such is the soil and such the water that the posts take root and grow into trees, so that the wire of many old fences is seen running through the center of large trees. Here a farmer rarely needs to use fertilizer, for the river comes in bearing rich silt and spreads it over his fields; and he may sometimes cut two or three or more crops a year from his alfalfa fields, and then pasture them during the winter—winter which is in reality a continual spring.

This is the paradise which a few determined men have created in the midst of the desert, and all by the building of ditches that divert the water from the river at the upper end of the valley, and divide it so that it will give life to the land below. About 250 miles of main ditches and some 400 miles of laterals have been dug through the valley; they have cost, together with all the necessary dams and embankments and headgates, not more than \$3,000,000. And the property which has been created—and “created” is the only word that will express it—by this expenditure has a money value exceeding \$30,000,000, furnishing a living for twenty-five thousand people, supporting three cities, doing business by two railroads. Is it any wonder that these people of Arizona appreciate the value of water, that they love their valley and their Territory, and that they are ambitious for the wider powers of statehood?

Something of the ancient passion of the bare land for water seems to have burned itself into the blood of these Anglo-Saxons of the West. “On this desert,” says the pioneer of the arid land, “I shall build me a home.” And he stands back to back with his neighbor there in the heat and sand, and they fight and toil and die, but they bring in the water to the land. No man can win the battle for himself: the desert is too strong, too well intrenched, for the feeble effort of a single arm; he must join his neighbor, he must forget his own interests and work for the interests of his valley. And thus he makes the gray places green, he grows rich orchards, and fields where cattle feed comfortably; he builds roads where the sand once blew, and cities where the cactus once stood guard upon the desert. This he has done, but not without the loss of many lives and millions in money.

Moreover, he knows that the battle is never-ending: if for a single season he fails to bring the water to his fields, his crops will wither down, his cattle die, and his green places return to the wilderness of gray. This is no place for fallow land and vacations. The implacable desert is forever silently crowding in along his borders, ready to beat him out the moment his ditches run dry or his strength fails. It is no business for laggards or cowards, this fight; it calls out every resource of human energy, science, and business acumen, and its victories are in exact proportion to the vigor expended.

Once before, some two thousand years ago, this valley of the Salt River was populated by a highly intelligent race of people. The ruins of their towns and of their ditches are scattered everywhere; one may pick up bits of pottery, beads, and bones from the great mounds of their

fallen homes. Frank Cushing, the anthropologist, who made a careful study of these ruins, estimated that the valley must once have supported a population of over two hundred and fifty thousand people. They were expert engineers; the Anglo-Saxons of today can do no better than follow the lines of their ancient canals, and the present settlers find the fields ready leveled for their plows by these ancient workers. Yet the desert wiped them out of existence, closed over them, and they are forgotten. The cause of their disappearance, whether natural cataclysm, wild foes, pestilence, or some mortal waywardness of their river, no one knows positively. But their fate will be the fate of the present settlers if once the water fails. Is it anything surprising that the people of the arid West should possess a sharp consciousness of the impending desert?

I have used the Salt River valley as an example of the conditions that prevail in all parts of the arid West. The system there in use is by no means as old or as perfectly developed as in many other localities, especially in southern California and in Utah, where the Mormons, who are the real irrigation pioneers of the continent, have built a paradise along their western Jordan; but the spirit, the energy, the intense Americanism, the demand for a broader life, are everywhere the same. In southern California, for instance, where a few acres of good orchard are worth a small fortune, the saving and utilization of water may be numbered among the exact sciences. Here the ditches, instead of being roughly dug in the soil as in most parts of the irrigated country, are often substantially lined with cement, so that no water will be lost by seepage; in other cases the water is actually carried in pipes to the farms and distributed from hydrants located at the ends of the furrows. There are regions in southern California where one never escapes the sound of engines, both gasoline and steam, pumping water from wells to irrigate the land. All this seems costly enough to the Eastern farmer, but here it has been made to pay richly, for an acre in an irrigated region can be made to yield from ten to a hundredfold as much as an acre in the rain country. In Utah wheat has yielded from 60 to 80 bushels to the acre, oats from 70 to 100 bushels, potatoes from 500 to 900 bushels, though these are extraordinary records. In California it is not at all unusual for a fruit-grower to clear from \$100 to \$400 an acre, and even more, from his orange orchard. In Arizona alfalfa fields have earned their owners from \$40 to \$100 an acre. These values and conditions, it should be said in passing, are those of the irrigated regions of the Southwest; conditions in the North, the Dakotas, Nebraska, Montana, Wyoming, and Idaho, are different. There the long, cold winters and the cool nights of summer prevent the growing of high-priced, many-cropped products, and the value of the land is much lower—rarely more than \$40 an acre, and often as low as \$12. The products, too, of the North are as different from those of the Southwest as are those of New York and Florida.

It is rare enough for a farmer in the East to make a fortune; but many farmers in the irrigated country who began from fifteen to twenty years ago without anything are now worth their hundreds of thousands of dollars. A farm of fifteen acres will support a large family in more than comfort, so that, region for region, the irrigated districts are destined to become much more densely populated than the Eastern farm country—perhaps, indeed, the most densely populated of any land on the continent, cities, of course, excepted.

Yet one who visits the West is astonished to see how comparatively little the desert has been touched, how much remains of what John Muir calls “wildness.” In passing through New Mexico and Arizona on either of the transcontinental railroad lines, one sees hardly an evidence of irrigation, for the best valleys are hidden away in the interior, and the stranger is impressed with the vast, unbroken stretch of dreary desert and rugged mountains. One finds difficulty, indeed, in realizing the immensity of the arid West. It includes about half the United States. The ninety-eighth parallel of latitude, which cuts down through the Dakotas, Nebraska, Kansas,

Oklahoma, and Texas,—a little east of the center of each State,—is the dividing-line; everything to the west of this line is within the region of scanty rainfall or aridity, except a narrow strip of rich country along the Pacific coastline of Washington, Oregon, and California. In all the remaining vast stretch of arid America no crop of any kind will mature with certainty without regular irrigation. Major J. W. Powell, one of the greatest authorities on irrigation problems, has estimated that there are over 1,000,000,000 acres of arid land in the United States. Of this he thinks that about 120,000,000 acres, or a territory equal to all of New England, with New York, Pennsylvania, and West Virginia thrown in, will ultimately be successfully irrigated by the use of all sources of water. At present about 35,000,000 acres, or a territory equal in size to the State of New York, is actually under ditch, the work of reclamation having cost in the neighborhood of \$200,000,000. These figures show what a vast amount of hard work is yet to be done before the empire of the desert is thoroughly subdued. And even after all the water of the West is utilized and every acre of land reclaimed that can be reclaimed, there will still remain vast areas of mountain and plain which can be left in forest, or used for mining and grazing purposes, or set aside for splendid natural parks like the Yellowstone and the Yosemite. As yet these almost inconceivably great resources of the West have only just been touched; they will all contribute to the prosperity of the irrigated country, and that country will in turn supply the miner, the lumberman, the cattleman, and the pleasure-seeker with food. The West is still the name for opportunity.

The development of irrigation in the arid country is rapidly reaching a great and important climax. All of the lands most easily irrigated have already been taken up, for the most part by little bodies of citizens who formed themselves into cooperative associations, built a ditch, and diverted the water to their land by the work of their own hands. This was the method of the Mormons, this has been the way in which the best farming regions of southern California have for the most part been reclaimed. Never before in America was the spirit of cooperation and communism developed as it has been in the arid West. Now, however, all the water of the smaller streams and much of that of the larger rivers has been diverted and is fully used, except in floodtimes. Indeed, in many localities it is much too fully used, for the attraction of the irrigated valleys, with the opportunities of great profits which they afford, has stimulated the opening of more farms than the water can supply. And who can wonder! Here in the Southwest desert land can be had today for \$1.25 an acre; turn on the water and tomorrow the land is worth from \$10 to \$20 an acre, and in two years it is worth from \$40 to \$60 an acre, and in ten years it may be worth \$1000 or more an acre. Nowhere else in the world can such profits be made by a farmer working with his bare hands and his native grit. I saw some of the magnificent fields of one farmer in the Salt River valley, an old sailor of the Baltic Sea who came to Arizona in 1878, and after working for day-wages in a flourmill for a time, he took up 160 acres of government land. He was compelled to borrow money to buy his first plow, but he was a hard worker and a progressive man. Today he owns a ranch of 1000 acres, all in a high state of cultivation, mostly in alfalfa; he is rated as being worth, clear, more than \$125,000. Well, such instances as these have tempted oversettlement. If there happens to be plenty of rain in the mountains, and the rivers run free, then these new settlers prosper abundantly; but if there comes a dry year or a series of dry years, like that which culminated in 1900, scores of farmers see their green fields wither pitifully before their eyes, and their orchards droop and die, for there is not water enough to go around. In 1900 water shortages caused the loss of millions of dollars to the irrigated country, and a cry has been raised for more water and a steadier supply of water. The result has been a great uplifting of sentiment; the imagination of the men of the arid land has been stirred as

never before, and they are studying some of the most stupendous of enterprises for water-saving. Every year in flood season vast volumes of water go to waste in nearly all the valleys, for there is no way to hold it back and store it up. One may imagine faintly the feelings of the farmers of a valley when they know for a certainty that a few months later their crops will suffer because there is not water enough. Consequently there has arisen a great demand for storage reservoirs for saving the floodwaters of the streams, so that they can be used during the long dry months of the year. Such reservoirs have already been constructed in several important districts. The Sweetwater River has been dammed near San Diego in California, a dam 90 feet high, creating a lake holding 6,000,000,000 gallons of water, a notable engineering feat. Another dam, 300 feet long and 60 feet high, in the Bear valley above Riverside and Redlands in California, furnishes water for a rich irrigated district. Other reservoirs have been constructed in Colorado, notably that on the Poudre River, and in other localities, but the great proportion of the floodwaters of the West is wasted. In the case of the Salt River valley in Arizona, for instance, there are now upward of 125,000 acres in cultivation, raising abundant crops; but that is only a fraction of the land that could be reclaimed and cultivated if all the water now going to waste could be saved and used. It has been estimated that there are over 400,000 acres, a territory equal in size to half the State of Rhode Island, which could be converted into homesteads if there were only water enough, and that the valley could easily support many times its present population.

But the construction of these restraining dams requires vast capital, vaster than these pioneers of the desert, who have so far done most of the work with their hands, can command. In many instances difficult engineering problems must be met, for the violence of these mountain streams in flood-time is not to be lightly dealt with. Several dams in the West, costing large amounts of money, have been carried away with loss of life and property. How, then, shall these dams be built? the arid West asks itself. If private capital comes in and stores the water, as it has already done in some localities, usually to its misfortune, be it said, there will rise up in greater strength than ever the "waterlord," the master of the people's very life, who is already a force and a problem in the new West. In some localities the people advocate bonding the state or county for the necessary money, but even by this means it would be difficult to raise sums large enough, for many of the communities are poor, the wealth being mostly in prospect. So these people are crying out to the federal government to come in and help build the reservoirs in the mountains, advancing the large capital needed with the assurance that in time it will all be repaid, though without interest. They have organized local associations and appointed committees, and last winter the East heard these new powers voicing their demands in Congress. It was not a loud voice, for the men of the arid land are still comparatively few in number, and it fell on unheeding ears; but it will be heard again and again, for it is the voice of a great purpose, and year by year, as other bold men lay out homes where the prophets said homes could never be, the voice will grow louder and louder until the whole country knows that there is a new spirit born to the Anglo-Saxon race.

But the imagination of these Westerners and their passion for development reach even greater heights. Not only do they seek to store up and utilize the water of the smaller streams, but they are preparing for the time when the water of such continental drainage rivers as the Missouri, the Colorado, the Arkansas, and the Rio Grande shall be in perfect control. The water of all these streams is now used to a certain extent, but none of them is absolutely controlled, and the task seems one of too great magnitude to admit of sober discussion. So far, irrigators have ventured to operate on these mighty streams, subject as they are to great floods, only with diversion works; that is, dams which take out a little of the water and divert it into the canals. A

diversion enterprise of magnitude is now in process of development on the Lower Colorado. The water will be taken from the river below Yuma in Arizona, and a canal 50 feet wide and some 50 miles long will be run out into Mexico and around into the State of California, irrigating an area estimated at over 400,000 acres of what is now worthless desert. This canal is now nearly finished.

Those who look forward to the control of the great rivers of America and the use of funds supplied by the government for that purpose point to the fact that England has spent about \$30,000,000 on the new Nile dams and other works for controlling the great Egyptian river and making certain the crops of the valley below, and that she has invested the sum of \$360,000,000 for irrigation purposes in India during the last thirty years. A single canal from the Ganges cost \$15,000,000; it has a total length, including tributaries and drainage cuts, of 3910 miles, and irrigates over 1,000,000 acres of land. These works in India, costly and stupendous as they have been, are regarded by the English as a profitable investment. There are 6,000,000 acres of land under cultivation in the valley of the Nile, supporting a population of over 5,000,000 people. Mr. Elwood Mead, irrigation expert of the United States government, estimates that the Missouri River and its tributaries, if properly controlled, will irrigate five times as much territory, furnishing an opportunity for the expansion of surplus population that will last the American people for a long time to come. No, these Westerners do not believe in the necessity of foreign islands as an outlet for American colonization; they point rather to their own expanses of unclaimed, cheap, rich land in a climate that is nearly perfect. And the proper control of these rivers, especially the Missouri and the Arkansas, will not only enrich their valleys and make them habitable for great numbers of people, but it will benefit the entire Mississippi valley by relieving it of the danger of floods between St. Louis and New Orleans. Progressive engineers assert that if the sums of money now expended for dikes that must always be built higher and higher, and for jetties and wharves and other flood restraining improvements on the Lower Mississippi, could be invested in dams and controlling works on the Upper Missouri, there would be less danger from floods; that with the reduction of sediment now carried down and deposited in the river channel and in the harbors, the river would even burrow a deeper channel and render less necessary the high protecting dikes. And the sediment which now goes to waste—the Missouri is famous as a muddy stream—is a most valuable fertilizer for land. The Nile bottoms have remained rich for ages because of the silt deposited each year by the river. A series of experiments carried on by the University of Arizona have shown that the water of the Colorado River is so rich in sediment that it will deposit fertilizer of a value of \$9.25 to each acre where water to a depth of three feet is used each year—certainly striking evidence of the lasting qualities of these irrigated lands, and furnishing the strongest of arguments for saving so much life-giving plant food.

Great as are these schemes for controlling and utilizing the waters of the largest of American rivers, the imagination of the Westerners goes a step further: water-saving to him has become a veritable passion. He has long been drawing on the underground supplies of water, and during the past year or two this work has come to be of momentous importance in many localities. It is a well-known fact that many rivers of considerable size in the Western deserts flow for long distances aboveground and then suddenly disappear in the sand. One river in Arizona disappears and reappears several times in the course of a hundred miles. In Nevada and other states rivers are lost entirely, and it is supposed that they flow into underground reservoirs or lakes. Some of these reservoirs have been tapped successfully with artesian wells, and one whole valley in California is irrigated with the water which gushes up freely from wells sunk

from 300 to 700 feet deep. In other localities steam and gasoline engines are used to pump the water into the irrigating channels. Indeed, if it were not for these underground sources of water on the ranges in the Southwest, there would be no possibility of maintaining cattle and sheep.

Another scheme of the Westerner for conserving the water supply has borne rich fruit in the last few years. It is a well-known fact that there is no better conservator of water than a forest with thick undergrowing vegetation. The ground is protected, and the vegetation holds back and regulates the water which falls in rain. Nearly all of the high plateaus and mountain ranges of the West, where the rainfall and snowfall are greatest, and where all the great rivers have their source, are covered more or less densely with vegetation, often with magnificent forests, hundreds, even thousands, of years old. If it were not for these forests, all the water that fell would run swiftly into the valleys, the streams would rise to floods, and in a few days' time the channels would be dry again. This is actually what now happens in many valleys of the West—great torrents for two or three weeks in the year, absolute drought all the remainder of the time. It is therefore of vital importance that these forests be preserved. The Westerner, led by wise scientists, has taken up the matter, and by good fortune the government at Washington has been aroused to the necessities of the case, and forest reserves and national parks have been created, which will not only go down to future generations as the most notable places of natural beauty on the continent, but they will preserve life and bring happiness to the valleys below. But the work is yet only half done. More forests must be reserved, and more care be given to protecting them from lawless miners and lumbermen. By the judicious cutting of the older trees and the removal of windfalls and waste, which might give food for fires, they can be made a source of lumber for a thousand years to come, and that without injuring their usefulness as water conservators. But if private greed is allowed to dictate, these splendid forest areas will be left the most desolate of deserts, like those of northern Wisconsin and Michigan—deserts which are far worse than the cactus plains of New Mexico and Arizona.

More than one half of all the world's crops, great and small, are today raised by means of irrigation—in India, Egypt, China, and other old countries. To an American who has seen such development and prosperity arise from the pursuit of ordinary agriculture, such wheat fields as there are in Dakota, such corn as there is in Iowa, such fruit as there is in Michigan, this fact seems at first somewhat startling. But the American has only just begun the practice of irrigation; it is the first time that a republic of free people, having a high conception of the rights of the individual citizen, has developed on a large scale a system of irrigation. Everything is new, strange, unprecedented; customs must be revolutionized, new laws constructed and old ones changed. One of the first teachings of the arid land is that the individual must subserve his interest to that of the community, and that is a hard matter for many an American to do. In the East a farmer may settle on his quarter section, build a home, raise what he pleases or let the weeds grow, keep up his fences or let them fall down, and no one says a word in objection; he is the most independent of men. But in the desert, where the struggle for existence is more intense, men must march in lockstep: if one man wastes water, allows water to run out on another's field, does not keep up his ditches, does not cooperate with his neighbors in the work of cleaning or repairing ditches, he injures the entire community, and the community must force him sternly into the line of duty. Moreover, he must join with his neighbors in the protection of the water supply, in case some other community seeks to divert more than its share from the river above; and in cases of drought and low water he must suffer equally with his neighbor, sharing what little water there is to be had, even though his own orchards are dying. All this serves to build up such a community spirit in the irrigated countries as the Easterner cannot appreciate. There are

human bickerings here as everywhere else, but a man soon learns that the community interest is, after all, greater than that of the individual, and upon every important subject he submits his will to that of the community. From this spirit have arisen those peculiar and powerful cooperative associations of farmers, which all but control the marketing of crops in parts of the West. Instead of trusting to avaricious commission men and engaging in disastrous competition, the orange growers, the raisin growers, the beekeepers, and other classes of farmers, have formed unions and associations which control the whole matter of packing, shipping, and selling the farmers' products. These associations further curtail the rights of the individual, hindering him, for instance, from shipping poor fruit or poorly packed fruit, lest it injure the reputation of the community in the Eastern market; and if there are losses, each man must stand his share. So powerful, indeed, are these associations that they can even venture to fight the railroad companies in the matter of freight rates, as they have done more than once in California. Farming in the East is a sort of guerrilla warfare, every man for himself; in the arid West it is a highly organized and disciplined struggle.

It is interesting to speculate as to the effect which these new conditions of life will have on the American character. Irrigation requires a greater degree of skill than ordinary agriculture; it is more a matter of exact science, less of chance. The Easterner sows his crop and depends on the will of Heaven for his rain; the Westerner goes out to his head gate and lets in the rain, in just such amounts and at just such times as he pleases. He knows how much water he is entitled to, and its distribution is a simple matter of calculation. But he must be a careful student of his crops; he cannot water his strawberries and his sugar beets at the same time and in the same amount, for the strawberries are always thirsty, while the beets require only a few waterings in the season. He must also know his own peculiar climate, for fields require much more water in the desert air of Arizona than in the moister climate of southern California, and he must have a care that the water leaves no alkali in his soil. In other words, he must be an intelligent, reading, scientific farmer if he would outwit the desert and compete with the energy of his neighbors. Men in the irrigated lands live closer together than in the East, and farms are smaller. Some valleys, indeed, seem like villages, each resident of which lives in the midst of handsome grounds; whole districts in southern California are veritable parks for beauty. This brings neighbors closer together, breaks up the deadly isolation of the Middle States farmers, enables a community to have better schools, churches, places of amusement, tempts the mercurial young man to stay on the farm.

The farmer may do all his own work, or keep a steady force of men, for there are no seasons of great pressure as in ordinary farming, no time when hay must be made lest it spoil, or grain cut to save it, with the necessity of great additional outside labor. Of course there are times when the irrigation farmer is busier than at others, but he does not lie virtually idle all winter long, for, especially in the Southwest, he is harvesting crops at all times of the year, and he must irrigate winter and summer alike. In the case of fruit-raising his crop ripens slowly, and he may be harvesting from time to time for months. The first oranges ripen in Arizona in late November, and in southern California the harvest continues from December until the following September.

Then, too, the arid West is without equal in the matter of healthfulness; indeed, it has long been the great health resort of the continent, the tents and homes of invalids dotting the desert everywhere west and southwest from Colorado. Long hours of bright, warm sunshine kill the germs and dispose of decaying matter more surely than the best disinfectants. And there are no swamps and marshes.

An Eastern farmer coming to an irrigated valley finds everything as different from his accustomed life as he can well imagine. He must learn an entirely new language of farming, and a new set of farming rules. His neighbor greets him, not with the remark, "It looks like rain," but, "Have you heard when the water is coming in?" or, "The ditches are low today." He learns to speak of miners' inches and acre-feet of water, and he can soon tell at a glance whether a ditch is carrying fifty or one hundred miners' inches of water; he hears wise discussions of head-gates, weirs, laterals, zanjes; he finds that he is "under" a certain canal, which by and by will come to seem to him like an inexorable fate. He will very promptly make the acquaintance of the king of the irrigated land, the zanjero,—in Arizona called "sankero," in California sometimes shortened to "sanky,"—the water master or ditchrider, a bronzed man in overalls and a sombrero, who drives about in a two-wheeled cart, with a shovel and a long crooked tined fork by his side, and precious keys in his pockets. He is the yea and nay of the arid land, the arbiter of fate, the dispenser of good and evil, to be blessed by turns and cursed by turns, and to receive both with the utter unconcern of a small god. For it is the zanjero who distributes the water. He opens the head-gate of each farmer's canal, and when the water has run the necessary time he shuts it down again, and again locks it securely. If the water is short he sees that it is divided properly between Smith and Jones and Brown, usually with Smith and Jones and Brown watching him like cats. It is a hard place, that of zanjero in the valleys, subject to accusations, temptations, heartburnings; but be it said to the credit of the American, there is many a zanjero who is universally respected in his community as an honest man. The new Easterner will learn the necessity of rubber boots; and he will find that of all known substances water is most perverse, evasive, uncontrollable, and that eternal vigilance is the price of success on the irrigated farm. He will also become familiar with the wonder of midnight farming: he will learn to rouse himself from a warm bed at two o'clock in the morning and go out with his lantern to see that he gets the water that is his due, and that it goes in the right place. And before long he will have a lawsuit with his neighbors, and he will find that there are special irrigation lawyers and irrigation engineers and irrigation experts; and it will cost him so much money that he will never go to law again, but settle his cases, as do his neighbors, by agreement, or submission to a committee of friends. He will learn to harvest in April and sow in October, or sow in July and harvest in January; he will learn that Johnson grass in his ditches is as terrible a weed as purslane or pigweed; and he will acquire a thousand and one other details of strange knowledge. But far and away above all he will learn the great fundamental principle of the arid land, the one commandment that is greater than ten, the law of life: "Water, the greatest thing in the world: save it."

But the life of the irrigator is far from being all sunshine: he, too, has "breaks in his ditches," as they say in the significant slang of the alfalfa valleys. Weighty questions are constantly arising, the decisions of which, obtained at great expense through the courts and legislatures, will furnish the future laws of the arid country. Here is a valley near the mouth of a river; it receives its water from the river, and millions of dollars of wealth has been created by irrigating the lands. Miles above, another community, perhaps in another state, settles in the valley of the same river, and takes out so much water that the old settlers in the valley below cannot get enough water for their fields and begin to suffer loss. Who shall arbitrate between the two communities? The Bear River, for instance, rises in Utah, flows into Wyoming, returns to Utah, returns to Wyoming, flows into Idaho, and then back into Utah, where it empties into the Great Salt Lake. There is irrigated land in all three states representing an investment of upward of \$100,000,000, and there is not enough water to go around. Who shall decide? All over the West these disputes have arisen or will arise. There is great confusion of laws, and in most states

the laws are singularly insufficient. There are great questions to be decided, as to whether there can be private ownership of water, or whether water belongs to the land which it first irrigates, or whether it is the property of the state; whether canal companies are common carriers or dealers in water; and a hundred and one other important points, each of which raises conflicting interests. Then there is the great struggle between cooperation and corporation, the struggle of the community system of canal ownership and the waterlords.

In the dust of all these conflicts which are now being fought out in legislatures and courts the individual settler is often crushed and loses everything; but that is always the accompaniment of such new enterprises. If there were only a wise absolute monarch, a sublimated Kaiser William, who could take hold of these affairs and straighten them out, it would assist materially in the development of the arid West. As it is, they will have to be fought out and settled in the American way, which, while expensive, satisfies the American, and in the end will no doubt produce the best system of control in the world.

There are other perplexing questions of a scientific order, such, for instance, as to the duty of water. What is the amount of water which will irrigate an acre of land in a given climate sowed to a given crop? Many canals supply too much water, and it is wasted; others supply too little: these errors must be righted. Water in ditches loses much by seepage and evaporation, in some instances as high as forty-seven percent, a condition which requires much scientific investigation in order that these sources of waste may be reduced. Some valleys are afflicted with alkali salts, the gradual accumulation of which in a field will certainly ruin its productiveness, so that it returns to the condition of a bare desert. A bureau of the United States Department of Agriculture, known as the Bureau of Soils, occupies much of its time in the study of these grave problems and how to remedy them. Many a poor farmer, attracted by the glittering opportunities of an irrigated valley, has seen his fields whiten with alkali and his crops die because he could not rid himself of the salts which the water contained.

And then, perhaps as disastrous as any other one thing, unscrupulous or mistaken promoters have crept into many a good valley, and by using all the arts of advertising have brought in more settlers than there is water to supply, and the whole enterprise is going to destruction, carrying with it many innocent settlers, and in” most cases, fortunately, the speculator himself.

But this is the darker side of the development of the empire of the arid land, most of the phases of which are unmistakably bright, and they are all difficulties of the sort which the courage, perseverance, and enthusiasm of these desert pioneers will one day surmount, making the arid regions beyond the Mississippi the better half of the country, the most fertile, the most beautiful, the most populous.