

THE OPEN RANGE AND THE IRRIGATION FARMER.*

BY PROFESSOR R. H. FORBES,

Director of Arizona Agricultural Experiment Station.

PART I.

AMONG the great public works, which look towards the upbuilding of the great West, especially important because of its immediate effects upon irrigation, is that of forest preservation and administration. "Save the forests" is the watchword of a great corps of scientific workers and their sympathizers, both public and private, and their efforts have resulted, throughout the West, in the safeguarding of great areas of forested watersheds, and of the interests immediately dependent upon them.

The popular idea of a forest, however, is that it is composed of great trees, with their attendant and dependent forms of life. But it must be considered and remembered that, throughout the great West, including the Great Basin, the Rocky Mountains, and the Great Plains regions, the areas which concern these workers and their abettors are but a minor fraction of the whole. The watersheds of many of our great irrigating streams throughout the West, are covered to but an insignificant extent with forests of the greater trees.

It is my purpose, however, to call your attention to-day to the fact that, especially in the Southwest, great watershed areas are forested with "little trees"—thousands of them to the square rod—which, making up by numbers what they lack in individual size, are no less potent than their greater brethren in governing the flow and behavior of the adjacent rivers.

* One of the papers read at the summer meeting of the American Forestry Association, held at Denver, Col., August 27-29. We regret the necessity of having to publish this paper in two parts, but owing to its length and the many demands on our limited space we are compelled to present it in that way.—EDITOR.

I refer to the numerous grasses, so characteristic of vast areas of western country.

I will speak more in detail of that region best known to me, the Great Southwest, within whose vague boundaries are included a large part of western Texas, New Mexico, Arizona, southern Nevada, and a portion of southern California. This empire of deserts, mountain chains, and grassy valleys, industrially the youngest portion of the United States, and scientifically the least known, is at present undergoing botanical changes, and consequent industrial ones, of the greatest consequence to that region, and of instructive interest to other districts. Though speaking more particularly of the Southwest, the principles which there obtain may be in part applied to the various great grazing regions of the West.

As to its natural features the Southwest is characterized by few, though often torrential, rains, mild winters, and long, hot summers—conditions which render the country essentially semi-arid. In such a region, where the water supply is originally so scant, and where evaporation and the rapidly-draining soils lead to its rapid loss, the adjustment of plants to their surroundings is a very delicate and precarious one, and vegetation pursues various ingenious methods of self-maintenance. Some classes of plants hardly take Nature at her worst, and inure themselves to the severest conditions of heat and drouth that can be inflicted upon them. The *cacti*, for instance, contracting their surfaces to the least extent consistent with a certain bulk, and charging their juices with hygroscopic substances which resist evaporation, ask no mercy of sandy deserts and of blazing sun.

Pursuing another method, the *ocateilla*,

in equally arid situations, puts forth its leaves during the brief rainy season, makes its gains, and then sheds its foliage when the hungry air again seeks to snatch away its moisture.

Many forms of vegetation contract their leaf-surfaces, or cover them with hairs or varnish, which restrict evaporation to the utmost. Other classes of plants, however, less harsh in nature, exert their ingenuity to supply themselves with a comparative abundance of water. Some develop extraordinary root-systems which penetrate deeply to underground supplies. The mesquite tree has been known to send its roots at least sixty feet below the surface in its eager search for water.

Other forms of vegetation start quickly and mature during the brief rainy seasons of summer and winter. The six-weeks grasses are so called because they start into activity and mature their seed in, approximately, that short period of time.

Still other forms avail themselves of the occasionally flooded valleys to construct and maintain storage reservoirs of their own, and live luxuriantly on the fruits of their wisdom. These last-mentioned, tendered forms of vegetation, including the grasses and other forage plants of the plains, constitute the great forests of "little trees" to which I have alluded, and more especially concern stockmen and, consequently, the irrigation farmer.

In explanation of this statement, I will present the case for a single grassy, typical, southwestern watershed—that of the Gila with which I am more familiar, in detail. The slopes tributary to the Gila River above the great bend and including that of the confluent Salt, have an area of about 45,000 square miles. For the most part this great area consists of originally grassy plains, now too often bare deserts, intersected by numerous mountain ranges clothed with forests on their upper slopes. Probably from eighty to ninety per cent. of this watershed is grass country.

It may, in consequence, be stated that the interests of irrigation in southern Arizona, and other regions of like character, are more concerned with the grassy and open range than with forested districts.

The history, present condition, and possible future of this country, and of the vast western and southwestern areas resembling it, should, therefore, be of immense interest to us.

Considered as a stock-raising country, New Mexico and Arizona are industrially young. Shortly after the Civil War, the establishment of military posts, and the issuance of treaty relations to the Apache Indians, created a heavy demand for beef. Large herds were driven from Texas into the lovely wild pastures of southern New Mexico and Arizona.

In their original condition, these grassy plains are said by those who first came to Arizona, to have been rarely beautiful to the eye, and even yet, in remote districts, comparatively unchanged by the operations of cattlemen, evidence of the truth of these statements is to be found. In the swales and valleys of this country, and wherever water was more abundant, the great bunch grasses grew luxuriantly. *Savatas* and the *galleta* covered the ground thickly, affording an abundance of native hay in the dry season and quickly freshening up into green forage after a rain. In the same situation, also, was to be found a bewildering variety of quick-growing water grasses which afforded most nutritious feed while they remained green. On the knolls and in the drier places, the crowfoot grama and the six-weeks grasses, so called, supplemented, in the rainy season, the more abundant forage of the lower levels. When it rained upon these grass-covered plains, the water, being obstructed in its downward courses by the abundant vegetation, sank largely into the ground and very slowly made its way into the underflow of the great valleys, finally re-appearing in the Gila River. In so doing, much of it was utilized by growing vegetation, while the residue, gradually joining the main watercourses, insured a constant flow. When severe storms occurred, with their resulting floods, the abundant bunch grasses at the lower levels obstructed the flow to such an extent that the water in its downward course, was spread laterally over great areas and its force dissipated. At the same time, the silt brought down

from the higher levels, including quantities of fertilizing material, was deposited in those places, with the result that the bottoms of the valleys were kept level and were enriched and made the scene of an ever-perpetuated growth of beautiful and luxuriant grasses.

But, after the completion of the Southern Pacific Railroad, in 1881, numerous small owners shipped in their herds from worn-out districts in Texas and elsewhere, while still others, driving their cattle overland to California, and deterred by the terrors of the Colorado desert, stopped by the way.

The multiplication of small herds, with their natural increase, together with restricted sales due to the low price of cattle at times during the eighties, soon caused the range to be stocked to its utmost capacity, even in favorable years. In seasons of scarcity, when feed was short, the cattle began to perish from starvation, devouring in their desperate struggle for existence, almost every vestige of growth upon the plains. Being compelled in their wanderings back and forth between the higher and lower grounds, to take twenty steps for a mouthful of food where formerly but one was necessary, they deepened their paths from place to place; the prevailing winds blew the dust from these paths until they lay inches below the general surface, and then, upon a country prepared for destruction, came the rains. The water, collecting in the trails from the bared and devastated surface of the country, fell swiftly to lower levels, gully-ing the trails as it ran, and gathering in destructive freshets in the larger valleys. The bunch grasses, having been depleted by the starving cattle, were no longer able to withstand the rush of the floods, and the gullying process began on a large scale through the very heart of what were formerly the most luxuriantly grassy regions of the country. When these channels are once established through a given district, the water is thereafter destined to flow through them, no longer spreading out over the level bottoms and no longer being available for the growth of the bunch grasses which formerly thrived in these

situations. In this way, when a valley has once been so gullied as to carry the water in streams, instead of spreading it out in broad floods, the very existence of the richest grazing districts is rendered impossible.

A striking instance of this process of ruin is offered by the San Simon Valley. This once beautiful district has been despoiled and hopelessly ruined within the short space of some fifteen years. At Solomonville, the great barranca which has cut its way up the valley is about fifty feet across and from ten to twelve feet in depth. From this point it extends southward for sixty to seventy miles, with tributary washes and barrancas branching out to a yearly increasing distance on either side.

In the midst of this ruined district, I once talked with a lone and aged rancher, too old and too poor to move away, the personification of the ruined country about him, who had witnessed, and who had helped to bring about the destruction of this valley from the very beginning. He said that, fifteen years before, the first night that he camped there he tied his four horses to his four wagon wheels, where they grazed in plenty during the night. At the time of our conversation, although it had been raining for just a month past, and although the San Simon Creek contained a stream of running water, the country was as bare of grass as a floor. Here and there was to be found a patch of rank cockle burrs, and on the adjacent flats the few remaining cattle were filling themselves with pusley and red-root. Such is the scene of ruin which now replaces what were the former beauties of a favored country.

Let us consider this typical instance in its various industrial bearings: In the first place, the stock industry itself has suffered, in some localities almost to the point of extermination. The ruinous methods which seem inevitable upon a public range, which, being everybody's property, is nobody's care, have so destroyed its value, and have so changed the original condition of the country that in many cases, in spite of the present high

prices of cattle, the ranges now carry but a tithe of what they once did. It is impossible to procure definite figures; but rough judgment, based upon observation and conversation, with the stockmen of this depleted range, shows it to have been almost commercially destroyed. In the San Simon valley alone, it is judged, on these grounds, that within the past decade the number of cattle has fallen off from 75 to 90 per cent. In the Sulphur Spring valley, adjacent, it is stated that during the season of 1900, which was a very severe one, the losses of cattle by starvation were from 15 to 50 per cent., averaging about 25 per cent.

These instances represent the condition of the cattle industry in scores of great valleys, and from the stockman's point of view, indicates the urgent need of administrative measures planned for the salvation of this great industry.

But the hardship merely begins with the stockman; far below him, on the land adjacent to the rivers, is the irrigating farmer, who depends for by far the most part upon the range watersheds for his water supply. As previously stated, the vegetation on the range, especially the bunch grass in the lower swales, at one time so obstructed the flow of water that the rainfall found its way but gradually over the surface of the ground to the main water-courses. I well remember once being overtaken by a flood in country of this character. A heavy storm in the mountains, some fifteen miles away, gave rise to a great volume of water, which slowly and almost noiselessly found its way through the abundant grass to lower levels, and the first intimation of the presence of the flood, which was several miles broad, was the splashing of my horse's hoofs in the quietly moving sheet of water.

A large portion of such a flood also sinks into the ground, joins the underflow, so characteristic of the great valleys of the Southwest, and finds its way to lower levels yet more slowly. At one point with which I am familiar, the water comes a distance of ten miles in about three months in just this way.

The result of these agencies was a constant and not excessively muddy flow of water whose fluctuations were not extreme, thus yielding to the irrigation farmer a comparatively regular and cleanly supply of irrigating water.

When a range has been bared by cattle, however, and its surface ground to powder by their hoofs, and especially when the gullying process has begun in the larger valleys, the rains quickly collect into sudden and destructive floods of extremely muddy water, which pass away as quickly as they come. The water supply is thus made much less constant in character, overwhelming the farmer with excess one week, and threatening him with drouth the next. The excess of mud contained also embarrasses the irrigator, increases the expenses of maintaining his ditches in good order, and often causes severe loss in coating the leaves of tender vegetation with mud. The quantity of mud which may result under these conditions may be judged when I state that in my laboratory I have several composite samples of water, each representing one week's flow of the Gila River at Florence, which, after 12 months settling, show 6 to 18 per cent. by volume of mud. This enormous quantity of sedimentary matter for such considerable periods of time shows not only the magnitude of the erosion which is being accomplished by these rivers, but indicates the difficulties which they impose upon the farmers using the water.