

Under the Sweetwater system, in San Diego County, 1402 acre-feet of water served 3800 acres of citrus fruits from May to November, 1899, during a drought. Deducting for domestic consumption of water, this leaves .28 foot in depth applied. The trees survived and a crop was gathered, but this is regarded as an extreme case.

The importance of the fruit industry to Southern California may be judged from the statement that in 1899 the shipments of oranges aggregated nearly 10,000 car loads, valued at \$7,000,000. The assessors report for the seven southern counties over 2,000,000 bearing trees, and over half as many non-bearing. The principal orange-growing locality is Riverside, which produced a third of all these oranges, and next Redlands and the Azusa Valley, each producing about 10 per cent of the entire output. The orange crop in the seven counties was produced from about 48,000 acres, or 75 square miles, of which about 40 square miles contained bearing trees. The first cost of the land, including the planting and care of orchards, has been estimated to be \$25,000,000. The profits of the grower have been found to be 12 per cent. The orange land with water, but without trees, is estimated to be worth from \$250 to \$300 per acre, while with bearing trees the price ranges from a thousand dollars per acre up to double that amount for groves with fine location, navel trees, and first-class water rights.

COLORADO.

Among the irrigating states Colorado stands next to California in the amount of land watered. The crops raised are decidedly different, in both character and value, owing to the colder climate, which prevents raising the citrus or semi-tropical fruits for which Arizona and California have become celebrated. Large quantities of forage and the coarser staples are produced. Various portions of the state have acquired a more than local reputation for the production of excellent vegetables and deciduous fruits. For example, Rocky Ford, on the Arkansas River, is known throughout the country for its watermelons, and especially for cantaloupes. Greeley and vicinity have set a standard for potatoes, while Grand Junction has attracted attention by its peaches. Although equally good results are claimed for other rural communities, the reputation acquired by these localities testifies to the excellence attained.

Colorado has 103,645 square miles of land surface, a little less than the combined area of the six New England states and New York. Its population in 1900 was 539,700, or less than a twentieth of the population of these seven states, but its natural resources are in many respects incomparably greater. The state includes a considerable part of the Rocky Mountain region, noted for the valuable

deposits of precious metals and minerals. It extends on the east out over a portion of the high plains which rise from an altitude of about 3000 to 5000 feet or more at the foothills. These broad plains furnish excellent grazing in ordinary years, and occasionally a crop of cereals can be produced by careful cultivation, if favored by the occurrence of fortunate rains. Dry farming has been attempted at various points along the eastern boundary, and is carried on with a fair degree of success on the high divide which lies north and northeast of Colorado Springs. As a rule, however, it may be stated that irrigation is essential for success throughout the state.

The plains are traversed by two rivers, which receive their main supply from the Rocky Mountains: the South Platte, flowing toward the northeastern corner of the state, and the Arkansas, farther south and flowing easterly. Large canals and many ditches divert water upon the valley lands and adjacent plains, so that, during the summer at least, the beds of both rivers are dry long before reaching the state line.

The high plains, rising gradually toward the west, are suddenly intercepted, nearly half of the distance across the state, by the foothills of the Rocky Mountains and by the main ranges, which rise to lofty snow-covered peaks 13,000 feet and more in height. From the front range westward the entire state consists of mountains and broad

plateaus with relatively few valleys. Among the mountains, at elevations of 7000 feet, are a number of basinlike areas dotted with trees and known as parks. Here natural grasses abound, and by distributing water from the small streams over the surface large quantities of forage can be had.

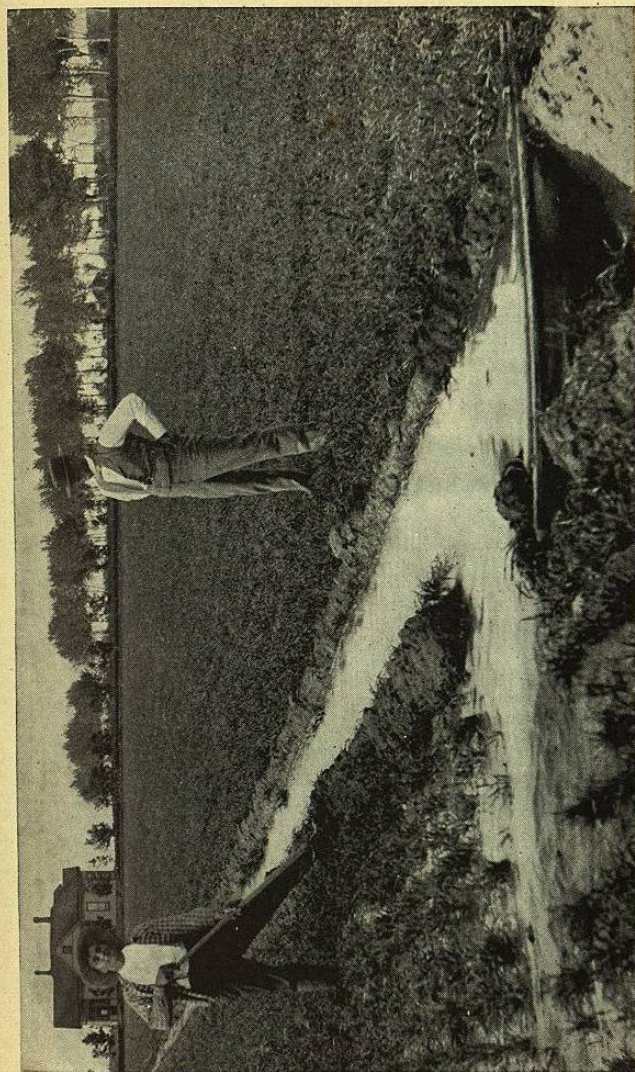
The streams which flow westward from the main divide unite finally to form the Grand River or empty into Green River. These join to make the Colorado River of the West. The water supply is large, but the valleys are narrow, and as a rule there is more water than is needed for the agricultural land, so that storage here is of secondary importance. The principal problem is to lift the water to the benches or mesas along the streams, or to divert it by means of canals heading in the canyons, or by tunnels cut through intercepting rocky spurs.

In the southern part of the state, at an altitude of over 7000 feet, is the broad San Luis Valley, through which flows the Rio Grande on its way south into New Mexico. In spite of the altitude, and consequent cool climate, agriculture by irrigation is successfully practised for the production of cereals and for the growing of alfalfa and other forage plants.

The largest irrigated areas in Colorado are along the Platte and Arkansas rivers, and here the principal problem is that of increasing the summer supply by a thorough system of water storage.

The canals and ditches already built, taking water to land partly under cultivation, could probably utilize to advantage all of the water which can be conserved. The owners of these irrigation works have been gradually enlarging them, building private reservoirs, and adjusting among themselves a system of apportioning the water, so that the scanty supply may be divided in accordance with priorities and with various equities.

One of the principal tributaries of the South Platte is Cache la Poudre River, which supplies the farms in the vicinity of Greeley, a view of one of which is shown on Pl. LI. The summer flow of this stream has been increased by the diversion of the waters of Laramie River (p. 178), and also by the building of a number of reservoirs, both in the mountains and out on the plains. A complicated system of transfers of water has been inaugurated, by which the claims of one set of men are temporarily transferred to another, the natural flow of the stream being traded for an equivalent amount of stored water, and the reverse, so as to utilize reservoirs which lie at different altitudes and to enable the storage of water which otherwise could not be economically handled. Out of these apparent complications there is being gradually evolved a system of local water control, embracing the entire stream, and tending to do away with the rigid observance of priorities of right in favor of the largest and best use of the water.



IRRIGATING A WHEAT FIELD IN COLORADO.

The gradual evolution and adjustment of water rights on the Cache la Poudre and along the Arkansas is to a certain extent typical of the progress in other localities, where some of the lower canals have prior rights over those higher upstream. The latter are located in such a position that they can more readily take the water as it comes from the mountains, and it has been exceedingly difficult to keep the head gates of these upper canals closed in times of scarcity in order to force down the proper amount to ditches below. To assist in adjusting the various difficulties, associations have been formed and various agreements entered into. One of the chief obstacles to full development of the water resources lies in the fact that water storage has been begun on the head waters, not for the benefit of all concerned, but for one or two canals, thus introducing irritating complications, and uncertainty as to which portion of the water is stored and which is the natural flow. The importance of public ownership and control of natural reservoir sites has been mentioned on page 177.

IDAHO.

This state has a land area of 84,290 square miles, being slightly larger than the state of Kansas and a third greater than the whole of New England. The population in 1890 was 161,772, thus averaging about two to the square mile, as compared with a density of from 20 to 50 persons to

the square mile in the Eastern states. The greater part of this population is in the valleys along Boise, Payette, and Weiser rivers and on the head waters of Snake River, and also in the mining towns scattered through the mountains.

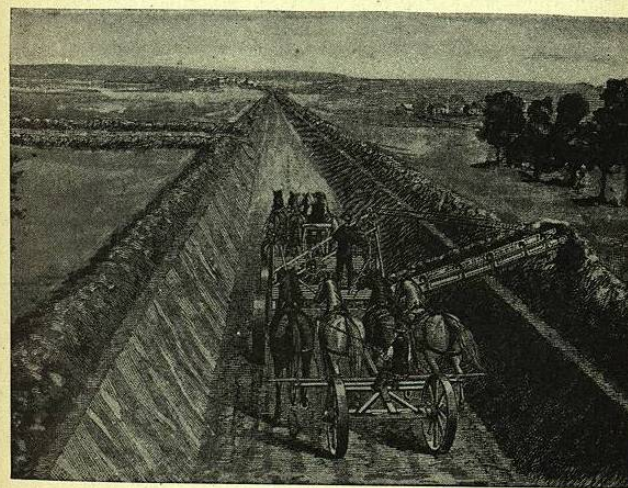
The form of Idaho is peculiar. Toward the north is a narrow prolongation, including the mountainous area between the states of Montana and Washington. The broad southern end includes the greater part of the valley of Snake River and the tributary country. This is mainly a broad, lava-covered plain, dry, dusty, and barren, except for a dense growth of sage brush and similar woody shrubs. The lava frequently appears on the surface, the rough, angular blocks giving a forbidding appearance to the landscape. A thin soil, often sandy, covers some of the lava, but where watered this, like most of the soil of the arid regions, has been found to be highly productive.

The head waters of Snake River are in the vicinity of the Yellowstone National Park. They flow in a general southwesterly course, out upon the lava-covered plains, bringing vast quantities of sand and gravel. Over the deposits thus formed the streams meander, rendering it possible to easily divert the water for agricultural purposes.

Soon after leaving the mountains Snake River begins to cut into the rocky surface, and with successive rapids and falls, as shown on Pl. LII, A,



A. TWIN FALLS. SNAKE RIVER, IDAHO.



B. CONSTRUCTING A CANAL BY MEANS OF A GRADER.

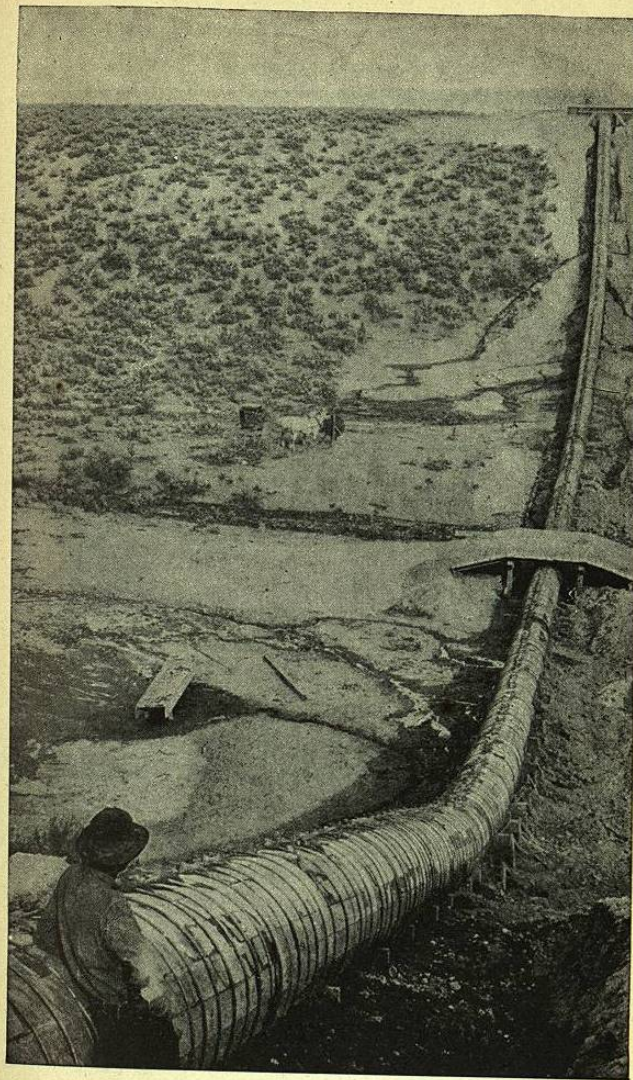
it works its way downward until it flows at a depth of 1000 to 2000 feet or more beneath the general level. Continuing in deep canyons, the river crosses the southern end of Idaho and then swings toward the north, the canyon walls giving place to broad, undulating valleys where the Boise, Payette, and Weiser rivers enter from Idaho and the Owyhee and Malheur rivers come in from Oregon. Here agriculture has been developed to a larger extent than elsewhere in the state. Leaving this open land, the river keeps northward, having cut for itself deep, gloomy canyons separating the Blue Mountains of Oregon from the characteristically named Seven Devils region of Idaho.

North of the Snake River plain are the Salmon River and other rugged mountains of the central portion of the state. From these a number of streams flow southerly toward Snake River, their waters disappearing in the pervious lava, and probably reappearing as springs in Snake River Canyon. These springs are almost innumerable and some of them have a volume of several hundred cubic feet per second. Within the mountains the valleys are narrow, and agriculture is practised to a limited extent, mainly in the vicinity of the mining camps of this rich mineral region.

In the eastern end of the state, on the head waters of Snake River, where the altitude ranges from 4000 to 5000 feet, the settlers, mostly Mormons,

have brought large tracts of land under cultivation. The altitude here is such that greatest success is had with alfalfa and similar forage crops and with small grain. Fruits are being raised only to a limited extent. Farther down the river, and especially in the western part of the state, in the vicinity of Boise, the capital city, and extending out along Snake River, fruits are of considerable importance, orchards of large size being devoted to the production of prunes, plums, apples, and pears, these being in addition to the ordinary farm crops. The altitude here is from 2000 to 3000 feet, and the almost continuous sunshine of summer is highly favorable to the production of fine fruits. Large and expensive irrigation works have been built below Boise, one of these being illustrated in Pl. LIII.

The flow of Snake River near the central portion of its course in the state averages in summer about 5000 second-feet, and ranges from a low-water flow of a little less than 2000 second-feet to ordinary floods of 50,000 second-feet. This volume of water, tumbling over cliffs such as those at Twin Falls, shown on Pl. LII, *A*, and Shoshone Falls, and shooting down the long rapids, not only adds to the picturesque attractions of the country, but at once suggests possibilities of the development of enormous water-power. Part of this has been made of use at American Falls near Pocatello, and at a point southwesterly from Boise,



WOODEN PIPE LINE ON PHYLLIS CANAL, IDAHO.

By devoting this power to its full capacity at points where it can be utilized without interference with irrigation, it will be possible to create many industries and to pump water to elevations which cannot be covered by gravity canals. It is of the utmost importance, however, to the future development of the state that these power plants be located above the irrigable areas and not below. It has been found by recent observations that there will not be more than enough water passing American Falls under ordinary conditions to irrigate the lands between it and Twin Falls or Shoshone Falls. The development of power at these latter places, although apparently so attractive, would in reality be an injury to the state, if by so doing it should be necessary to force water to flow down to these falls at times when it is needed for irrigation.

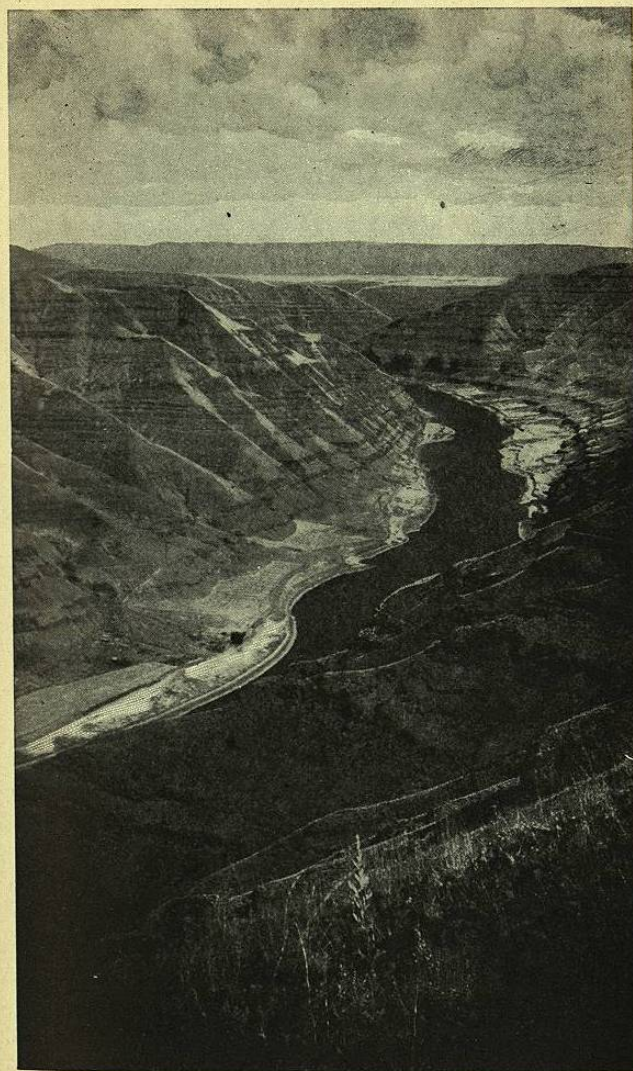
The notable developments in this part of the state, brought about under the terms of the so-called Carey Act above Twin Falls, and under the National Reclamation Act at the Minidoka project (see p. 411), have reached an extent such that the ordinary low-water flow of Snake River must be supplemented by storage at the head waters, principally in Jacksons Lake in Wyoming. Even before these large tracts were brought under irrigation there was during the late summer a shortage of water in ditches and canals heading in Snake River and its tributaries in eastern Idaho, the main river being dry at times in the vicinity of Blackfoot.

The principal town in the northern part of the state is Lewiston, situated at the point where Clearwater River enters Snake River. Here the valleys are very narrow, as shown on Pl. LIV, and are bounded in places by benches upon which some water can be taken from tributary streams, or to which a small quantity may be lifted by pumping. Fruits are successfully raised in these narrow valleys and on the higher lands wherever water can be had. Dry farming is practised on the rolling uplands (Pl. LVI), wheat being the principal crop.

MONTANA.

Montana is the third state in area, being exceeded in size only by Texas and California. Its land surface of 145,310 square miles is nearly as great as that of New England, New York, and Pennsylvania combined. The population in 1900 was 243,329, or less than two per square mile. This state is the most northerly of those lying wholly within the arid region. In spite of the general lack of moisture, there are a few areas among the mountains where crops have been raised by dry farming, but as a rule irrigation is essential to successful agriculture.

The Great Plains, which extend across Kansas and Nebraska and into eastern Colorado, sweep northerly and westerly around the Black Hills and Bighorn Mountains. Contrary to popular concep-



CANYON OF SNAKE RIVER ABOVE LEWISTON, IDAHO.