

IDAHO.

Total population (average per square mile 1.00)	84, 385
Number of owners of farms (7.82 per cent of population)	6, 603
Number of irrigators (65.47 per cent of farm owners, 5.12 per cent of population)	4, 323
Area of state, land surface (84,290 square miles)..... acres	53, 945, 600
Area irrigated in census year	217, 005
Area of all farms, 46.56 per cent improved	1, 302, 256
Cereals raised in census year, including 16 acres in buckwheat and 1,092 acres in rye	98, 175
Barley, average production, 23.64 bushels per acre	10, 004
Corn, average production, 18.13 bushels per acre	1, 362
Oats, average production, 26.70 bushels per acre.....	21, 997
Wheat, average production, 18.47 bushels per acre	63, 704
Alfalfa	31, 895
Total value of all farms, including land, fences, and buildings.....	\$17, 431, 580
Estimated total value of the farms irrigated in whole or in part	\$10, 091, 000
Estimated value of all farm productions (sold, consumed, or on hand) for 1889	\$3, 848, 930
Estimated value of productions, as above, from farms irrigated in whole or in part	\$2, 806, 000
Average size of irrigated farms..... acres	50
Average size of irrigated farms of 160 acres and upward..... do.	270
Per cent of acreage of irrigated farms of 160 acres and upward to total acreage irrigated.....	26. 49
Average size of irrigated farms under 160 acres..... acres	39
Average first cost of water right per acre.....	\$4. 74
Average annual cost of water per acre.....	\$0. 80
Average first cost per acre of preparation for cultivation	\$9. 31
Average value of irrigated land, including buildings, etc., in June, 1890, per acre	\$46. 50
Average annual value of products per acre in 1889.....	\$12. 93

In addition to the facts given in the above statement, it has been ascertained by comparison with similar statistics for other states that Idaho is fourth in the number of irrigators, seventh in area irrigated, and eighth in average size of farms. In nearly all respects as regards value of farms and of products it occupies an intermediate position, in no one item standing near either extreme of cost or value of land and water, and thus the conditions, especially those in southern Idaho, may be regarded as fairly typical of the state of irrigation in the arid region during the census year. The average annual cost of water was somewhat low, from the fact that most of the ditches then in actual use were owned by the irrigators and the larger systems charging a certain amount per acre each year did not then play an important part.

TOPOGRAPHY.

The state of Idaho lies on the southwest side of the Bitterroot mountains, and extends from the crest of this range southward across the Snake river and westward to the same stream, being bounded by it until the point is reached where it turns nearly west to flow into the Columbia. The peculiar wedge-shaped form of the state, broad on the southern end and tapering almost to a point at the north, is due largely to the peculiar topography of the region. The Bitterroot trends in a northwesterly direction, while the Snake river, which in a general way governs the other boundaries of the state, takes a widely different course. It rises south of the end of the Bitterroot mountains in the continental divide near the Yellowstone park, and issuing from these mountains the main stream flows southwest, then west, northwest, and finally north, thus describing roughly a great arc of a circle. The greater part of the state of Idaho lies within this area, being bounded on the upper side by the mountains and on the lower by this great half circle made by Snake river.

On the south the state lines do not follow the Snake river, but take in a portion of the country on the south side of the river, and in order to coincide with lines of latitude and longitude they have been laid out independent of the topography. Thus, it happens that in the southeastern corner an important portion of the Bear river drainage is included within Idaho, although topographically it belongs to the drainage of the Great Salt lake. As an apparent offset to this gain on the part of Idaho, the head waters of the most important tributaries of the Snake lie beyond the eastern borders of the state of Wyoming. With these exceptions, it may be said that Idaho lies within the drainage basin of the Columbia and almost wholly on the basin of its great tributary, the Snake.



Becker & Peterson Litho Co. R. Y.

MAP OF IDAHO SHOWING AREAS IRRIGATED IN 1880

IRRIGATED

A conception of the topography of Idaho in its broad features can be had by picturing a great range of mountains extending in a northwesterly and southeasterly direction, sending off about its center spurs toward the west. Imagine then the base of these mountain masses toward the south and west buried beneath great deposits of lava, which form extensive plateaus, or high plains, stretching out in every direction; and descending by broad terraces or gradual slopes until broken by isolated groups of mountains. The rivers which flow out from the high backbone of the state on reaching these plains have cut for themselves deep channels, and often disappear into narrow gorges or canyons, continuing on their way to the sea at a depth of from 200 to 500 feet or more beneath the general level of the plains. These two great topographic divisions of Idaho, the mountains and the high plains, afford a convenient classification for a consideration of the agricultural resources of the state, since in the mountains the rainfall is generally sufficient to mature crops, while around the bases of the mountains and out on the plains it is exceptional for anything to be produced without irrigation. The mountain counties, especially those at the north end of the state, do not need irrigation, except in rare instances for the gardens and orchards in the lower valleys, while the counties south and west of the mountain mass, with less rainfall, require the artificial application of water for almost every crop.

Although irrigation is necessary for the raising of crops outside of the mountain areas, it must not be supposed that the land is barren. Much of it in its original state was covered by the rich, though dry, "bunch grass", which has afforded pasturage for enormous herds of cattle ranging from the plains far up in the mountain valleys. Next to mining stock raising has been the great industry, although in the past few years, with the introduction of irrigation on a larger scale, the cultivation of the soil has assumed importance.

The Great Plains, though consisting for the most part of lava and having a surface occasionally broken by craters and buttes, contain in the aggregate many hundreds of thousands of acres of land, that by the application of water may be rendered wonderfully productive. Besides the high plains, there are places where the largest streams have eroded valleys of considerable width, as, for instance, along the Boise and Payette rivers, and it is here that the greatest agricultural development has taken place. There are also localities, as, for example, at the forks of the Snake river, where the streams have not yet succeeded in cutting through the lava, and where river water can be brought out upon the surface of the plain. West and south of this latter point, however, stretches out the vast expanse of broken and slightly rolling lands, to water any considerable part of which will require great irrigation systems.

WATER SUPPLY.

The water supply of Idaho as a whole is large, and there are a number of rivers whose perennial flow amounts to hundreds or even thousands of second-feet, but unfortunately the peculiarities of topography above described render it impossible to utilize the whole of this water, since the greater part of it sinks rapidly beneath the general level of the agricultural lands. This is the case with the waters of the Snake, the Salmon, and the Clearwater. The smaller streams, which rise mainly in the foothills and flow out toward the lower lands, have a very small summer discharge, from the fact that they drain lower mountains, and their waters for the greater part of the year sink into their pervious channels. In order to render these small streams useful in the highest degree it will be necessary to hold their waters from March and April until later in the season.

As an example of the fluctuation of the streams of the state in their discharge month by month, the monthly percentages of the total annual flow are given in the following table. These percentages were obtained from the results of stream measurements made by the United States Geological Survey.

DISTRIBUTION OF FLOWING WATER AND OF RAIN IN IDAHO.

MONTHS.	Average monthly discharge of upper tributaries of Snake river. (Per cent.)	Average monthly discharge of lower tributaries of Snake river. (Per cent.)	Average monthly precipitation at Boise, Idaho. (Per cent.)
Total	100.00	100.00	100.00
January	3.9	1.4	17
February	4.0	4.3	12
March	4.0	27.0	13
April	7.7	30.0	11
May	24.0	24.7	9
June	21.0	6.4	5
July	11.0	1.7	1
August	6.0	0.6	1
September	5.9	0.5	2
October	4.5	0.7	7
November	4.5	1.2	8
December	4.4	1.5	14

To illustrate the difference in character between the upper and lower tributaries of the Snake, the two classes have been separated and the percentages computed for each. As examples of the upper tributaries, the streams on the extreme west in Bingham county have been taken, and for comparison with these is given the average distribution of water throughout the year in the Weiser in Idaho and the Owyhee and Malheur, which flow into the Snake from Oregon. These latter rivers flowed from lands of lesser altitude, and, as shown by the percentages, the greater part of the water came down in March, April, and May, over four-fifths of the water of the entire year being discharged in these three months. The waters from the higher mountains, as shown by the first series of percentages, were more evenly distributed through the year. The main discharge was, however, in May and June, nearly one-half the entire amount for the year coming in those months. The smallest amount discharged in any one month was in the eastern rivers, nearly 4 per cent, while in the case of those farther west, at a lower altitude, the discharge fell in September to one-half of 1 per cent.

It is instructive to compare the distribution of the available flowing water with that of rain. For this purpose it is convenient to take the normal monthly rainfall for Boise city as published by the signal office. Taking a range of 16 years, the average annual rainfall was 15.61 inches, this being distributed by months as shown in the table. From December to April, inclusive, two-thirds of the entire amount for the year fell; in May and June about one-seventh, and in July, August, and September only one twenty-fifth. While the greatest amount of rain falls during the winter months, the water which is available for agriculture is found in the smaller streams in early spring and in the larger streams a few weeks later.

The irrigators who depend upon water from the lower mountain slopes have an excess during April and May, as shown by the above table of percentages, but in June the supply diminishes rapidly, and toward the end of that month the streams become almost, if not quite, dry. The methods of using water must, to a certain extent, conform to this state of things, and therefore while the water is plentiful it is applied to the ground even though the plants may not need it at that time. The ground, however, must be thoroughly saturated in order to store up moisture for future needs. Those farmers who are so fortunate as to have ditches leading from streams flowing out of areas of high mountains depend upon receiving water later in the season, since the discharge of the streams during June is nearly as great as that for the month previous, and even during July the streams maintain a discharge above that of the average for the year. Moreover, during August and September the waters fall not very far below the mean annual discharge, and thus with a less wide range of fluctuation these rivers and creeks are far more valuable to agriculture.

Water storage is of the utmost importance, especially on the small streams, showing a great range in discharge from month to month. Certain irrigators have already begun the construction of small reservoirs at various points and have attempted in their own way to hold over some of the flood waters of March and April into the dry time in the latter part of June and July. They state that there are many valleys which, in their opinion, are suitable for holding water, and there is every probability that many works of this character will be built. The problem, however, of greater general interest at present is that of utilizing the large rivers by bringing them out upon the high plains through which they flow.

DITCH CONSTRUCTION.

From the fact that considerable capital will be required to divert the waters of the principal rivers of the state from their deep channels, the attempts of the irrigators in the past have been confined almost exclusively to those localities where streams of moderate size flow from the foothills into small open valleys or upon the edge of the larger plains. Here, at favorable points, small ditches have been dug running for a few miles along the river and as far away from it as the contour of the ground will allow. The early settlers generally constructed very small ditches, and as the population in any one locality increased other ditches were made, either higher or lower on the stream, each of these leading to the lands of a few irrigators. As a general rule the ditch last constructed is the largest and best, although, on account of the existence of other older ditches, it may not be well located or have rights to any but surplus water.

Taking the state as a whole, there was in 1889 an independent ditch leading from a river for every 385 acres of crop irrigated, deducting in this, however, a few of the larger canals. It has been shown that in Montana the corresponding area per ditch was 225 acres.

DUTY AND USE OF WATER.

The duty of water has been estimated in many cases by ditch owners, and the statements range from 50 to 250 miner's inches for 100 acres, the average being 120 miner's inches. Assuming that 50 of these miner's inches make a second-foot, this would be equivalent to an average water duty of 42 acres per second-foot. The accuracy of these statements is open to question, from the fact that water measurements are rarely made with any care, if made at all, in obtaining these figures. The miner's inch is exceedingly variable, and it is rare that any two irrigators agree in their opinions as to the methods of measuring it. Thus, since even the unit of measurement is undetermined it is doubtful whether the results expressed in this unit are of value.

The methods of using the water upon the land are as varied as the experience of the persons using it. As a general rule the farmers confess that they have much to learn in this direction, that the majority of the land is not well irrigated, and that the crops are not as large as they should be. In irrigated counties it is possible to pick out many areas on which wonderful crops are raised largely through the exercise of unusual skill and intelligence on the part of the irrigators, and were these instances taken alone the conclusion could be drawn that the farmer employing irrigation was the most successful and prosperous individual of his kind. Unfortunately the rank and file of farmers who have been forced to adopt irrigation have done so almost under protest, and do not in the majority of cases exhibit great skill. Great disparity is to be seen between crops on adjacent farms where all the physical conditions are similar.

The most widespread method of irrigating is to turn the water out upon the field and let it find its own way. This is the lowest stage of development, and from this as one extreme every method can be found in use in Idaho up to the case of the farmer who levels his ground, plowing down the high places, filling depressions, and systematically laying off furrows so that every portion of the field receives only its due share of water. This difference in the preparation of the ground, as well as in the character of the soil and subsoil and the kind of crop, gives rise to the widest range in the duty of water, so that any generalization must be taken as such and not applied to particular cases or localities.

The irrigating season begins in April and continues until September, although some farmers at lower altitudes begin to use the water as early as March, and others, higher in the mountains, as late as June. For the greater number of the irrigators scarcity of water puts an end to irrigation, while those who hold prior rights and can obtain the water use it until frosts set in. The principal irrigated crop is for forage, and of the forage plants the most valuable is lucern, or alfalfa. In general, two crops of this product are cut, and in some cases three or even more, but often on account of the scarcity of water only one crop is successful.

The laws regarding the control of the water and the rights of the different irrigators depending upon any one stream are not satisfactory to the farmers, for they do not appear to guard the rights of individuals. There is a general complaint that no one can enjoy the undisturbed ownership of water sufficient to render his farm productive until his rights have been tested by lawsuits, often of the most expensive and protracted nature. Even then there may be questions of doubt to disturb the value of his lands. Points in the present statutes are stated to react injuriously upon agricultural interests. The situation in many localities is complicated by the rapid growth of new and improved systems of irrigation, the rights of such systems to water being, however, secondary to those of the older, poorly built ditches. Some of these systems are being built by corporations that are investing considerable capital in bringing large areas under ditch and increasing the extent of the agricultural lands.

The feeling of the farmers toward the corporations owning canals and renting the water, or rather charging so much per annum for bringing it to the land, is not always friendly. The water rates are burdensome to the farmers although not necessarily profitable to the canal owners. The farmers complain that in the first instance inducements are held out to them of benefits that are never fully realized. They are persuaded to pay from \$8 to \$10 per acre for a water right which entitles them to a certain amount of water upon the annual payment of from \$1 to \$3 an acre for what may be considered the expense of transporting the water to the land. In certain instances the farmers have signed agreements which virtually amount to mortgages upon their land, and upon failure to comply with the conditions the canal company has acquired possession, the farmer perhaps becoming a tenant of the company.

SPRINGS AND WELLS.

The supply of water from springs and wells has considerable local importance. Along the Snake river, especially in Logan county, are some wonderful springs, which gush from the canyon walls and fall into the gorge. This water is probably the drainage of the mountains to the north which has disappeared into the lava plain and traversed the pervious rock layers. Some of the water can be used for irrigation either by conducting it by flumes and canals to lower lying lands or by utilizing the water power to force a portion of the water to higher levels.

Attempts have been made to find artesian water, but with little success. The railroad known as the Oregon Short Line has drilled several deep wells at stations on the lava plain north of the Snake river, and has struck water at various depths and in large quantities, none of which, however, rises to the surface. The wells range from 150 to 425 feet in depth, and water is brought to the surface by suitable pumping machinery. From the fact that water escapes so freely in the large springs along the Snake, it is doubtful whether flowing wells can be obtained on this plain. In the southeastern corner of Idaho are a number of comparatively shallow flowing wells, principally in the vicinity of Oxford, in Bingham county, and of Malad, in Oneida county. Each of these consists simply of a 1.5 or 2 inch pipe driven into the ground to a depth of from 50 to 150 feet, the water flowing up through the pipe to a distance of a foot or more above the surface. These wells are a very great convenience for house and barn use, but being upon low ground, below irrigating ditches, they are of comparatively little importance in agriculture.

In the vicinity of Boise, in Ada county, are a number of artesian wells, some of them discharging hot water. Two of these, put down by the Boise water works to the depth of about 400 feet, are reported to deliver water at

a temperature of from 165 to 170 degrees fahrenheit. These wells flow at the rate of about 1.5 second-feet, or 1,000,000 gallons a day. Other wells north of the town discharge cold water suitable for drinking. At Boise barracks a well 120 feet deep yields about 800 gallons per day. Near Moscow, in Latah county, are wells 7 inches in diameter, discharging sufficient water to supply the town. None of this water is used for irrigation, as it is not necessary in that locality.

CONDITION OF IRRIGATION IN EACH COUNTY.

NUMBER OF IRRIGATORS, AREA IRRIGATED, FARMS, AND CROPS IN EACH COUNTY IN IDAHO IN 1889.

COUNTIES.	Number of irrigators.	Area irrigated in acres.	Average size of irrigated farms in acres.	OWNERS OF FARMS. (a)		IRRIGATORS.		Area of county in acres.	FARM AREA.		AREA IRRIGATED.			Average value of products per acre.		
				Total number.	Per cent of population.	Per cent of farm owners.	Per cent of population.		Acres.	Per cent improved.	Cereals. (Acres.)	Alfalfa. (Acres.)	Per cent of area of county.		Per cent of total farm area.	Per cent of land owned by irrigators.
Total.....	4,323	217,005	50	6,603	7.82	65.47	5.12	53,945,000	1,302,256	46.56	98,175	31,895	0.40	16.66	26.08	\$12.93
Ada.....	547	38,919	71	580	6.93	94.31	6.54	1,600,000	111,048	50.90	7,055	3,947	2.49	35.05	36.87	15.04
Alturas.....	104	4,328	42	104	3.96	100.00	3.96	4,288,000	22,083	23.00	520	316	0.10	19.60	19.60	17.61
Bear Lake.....	387	19,844	51	392	6.47	98.72	6.39	704,000	49,623	42.53	3,962	1,110	2.82	39.99	40.20	10.52
Bingham.....	837	40,912	49	951	7.01	88.01	6.17	6,720,000	183,041	35.05	9,501	10,584	0.61	22.35	25.10	8.81
Boise.....	164	7,829	48	308	9.22	53.25	4.91	2,560,000	50,008	39.50	1,563	418	0.31	15.66	28.56	15.20
Cassia.....	402	19,800	49	416	13.24	95.63	12.79	2,880,000	80,577	41.88	2,977	4,520	0.69	24.57	24.93	10.41
Custer.....	171	8,570	50	178	8.18	96.07	7.86	2,240,000	42,970	34.56	2,132	645	0.38	20.13	29.09	17.48
Elmore.....	87	3,437	40	96	5.13	99.63	4.63	1,920,000	18,368	33.73	20	294	0.18	18.71	18.71	11.72
Idaho.....	36	466	13	487	16.48	7.39	1.22	7,296,000	118,538	59.94	3,001	11	0.01	0.39	8.07	(b)
Kootenai.....	2	9	5	210	5.11	0.95	0.05	3,584,000	39,483	38.54	933	18	.....	0.02	2.80	(b)
Latah.....	.....	.....	.....	857	9.34	.....	.....	691,200	170,508	67.76	31,765	21	.....	.....	.....	.....
Lemhi.....	140	9,984	71	143	7.73	94.59	7.31	3,456,000	37,682	44.27	2,272	736	0.29	26.50	26.50	15.80
Logan.....	316	15,793	50	381	9.14	82.94	7.58	3,712,000	83,893	41.00	1,543	2,086	0.43	18.83	21.08	13.02
Nez Percés.....	22	482	22	226	7.94	9.73	0.77	1,030,400	71,281	57.84	13,684	3	0.05	0.68	5.27	(b)
Oneida.....	630	21,423	34	637	9.34	98.90	9.24	1,728,000	94,518	48.62	11,460	4,869	1.24	22.67	23.00	13.15
Owyhee.....	155	9,076	59	164	8.11	94.51	7.67	4,992,000	42,228	31.57	448	1,539	0.18	21.49	23.74	13.90
Shoshone.....	.....	.....	.....	40	0.74	.....	.....	2,816,000	5,833	32.09	220	.....	.....	.....	.....	.....
Washington.....	323	16,133	50	428	11.16	75.47	8.42	1,728,000	80,974	36.87	4,519	778	0.93	19.92	25.24	15.50

(a) Includes owned and hired farms, assuming one farmer to each.

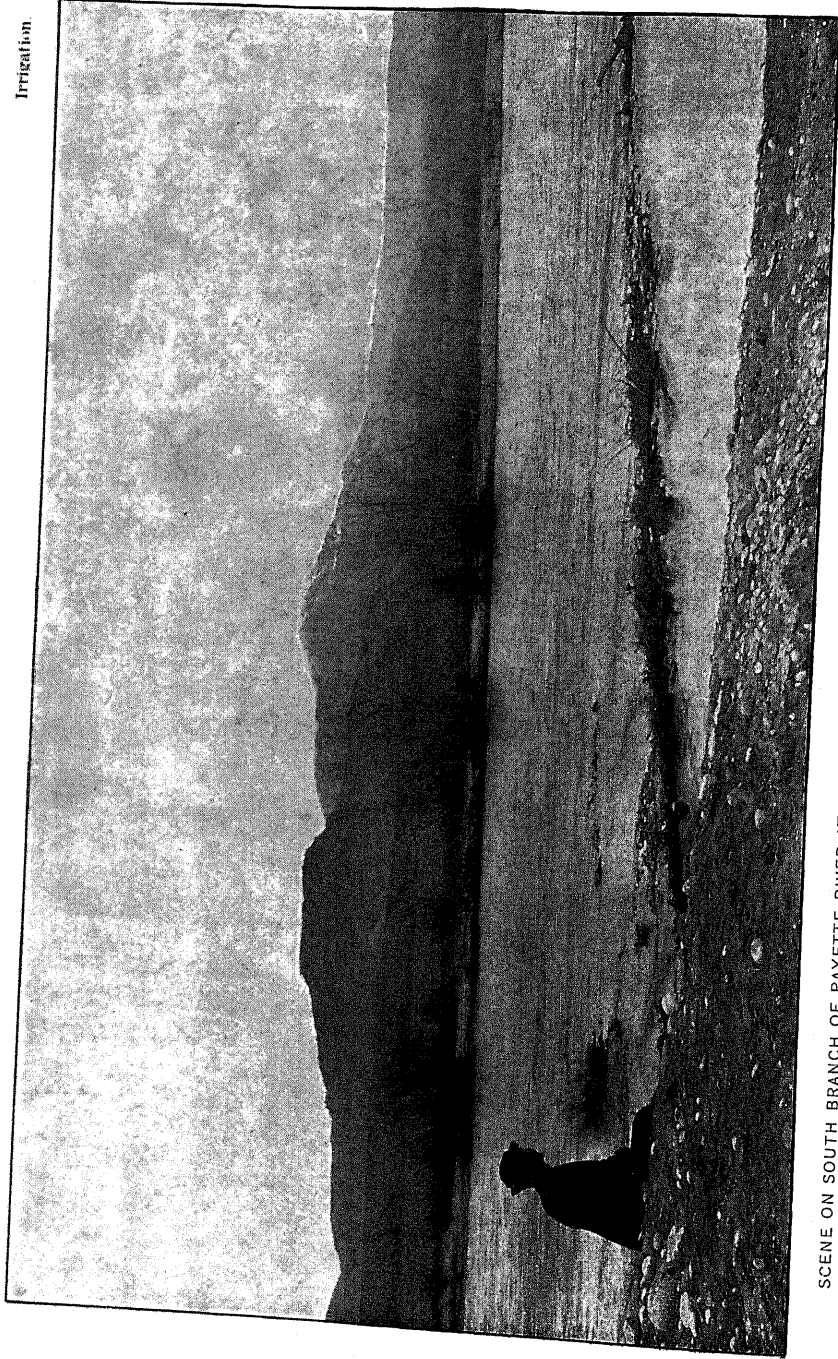
(b) Not reported.

ADA COUNTY is in southwestern Idaho, on the north and east of the Snake river, covering the comparatively level ground between that river and the mountains. It is crossed by two large streams, the Payette on the north, and the Boise at about the center. Each of these streams carries a large and perennial supply of water, and coming from a mountainous region in Boise and Elmore counties, they are not liable to notable diversion before reaching Ada county. The opportunities for irrigation development in this county are exceptionally good on account of the character of these rivers and the existence of great areas of fertile land to which the water can be brought. Already a number of canals of large size have been built, besides numerous small ditches, and some of the greatest irrigation projects in the country have been begun.

On the lower lands, along the Payette and Boise, crops can sometimes be raised by the moisture which seeps through the ground at the time of flood. The farmers have taken out small ditches from the rivers and perennial creeks, and in this way have brought considerable areas under irrigation at small cost. Following the construction of the individual ditches have come the associations of farmers, who by united effort have built canals from the Payette and Boise rivers, the ownership being largely in the hands of those using the water. In the northern part of the county a large proportion of the arable land can be covered by water from the Payette or the Boise river, but at the southern end the elevation is too great to allow of water being brought from any large sources of supply. The Snake river, which bounds this land on the southwest, flows in a gorge or canyon at such a depth that there is no probability that water can be brought out even by canals heading farther up the river.

Most of the irrigation from the Payette is on the south side of the river, but on the north side is a canal, known as the Lower Payette ditch, taking water from the river about 7 miles above the town of Payette and carrying it for a distance of nearly 22 miles into the Snake River valley, and extending into Washington county. The average width is said to be 20 feet, the average depth 4 feet, and total cost \$32,000. On the south side of the river are a number of large ditches, among which may be mentioned the Last Chance, 7 miles long, 8 feet wide on bottom, 1.5 feet deep, the cost of which was \$10,000. The head of the ditch is about 30 miles above the mouth of the Payette river. The Rossi ditch also takes water from the south side of the Payette river, heading 4 miles below Emmett. Its total length is 10 miles, its average width 9 feet, and its total cost about \$10,000. The ditch is owned by an unincorporated company. Each ranchman under the ditch takes as much water as he chooses when there is plenty and at other times the watermaster regulates the supply.

The largest project along this valley is that of the Payette Valley Irrigation and Water Power Company, diverting water from the south side of the river at a point nearly 2 miles above the town of Emmett. The canal



SCENE ON SOUTH BRANCH OF PAYETTE RIVER AT POINT OF DIVERSION OF THE CANAL OF PAYETTE VALLEY IRRIGATION AND WATER POWER COMPANY, ABOUT TWO MILES ABOVE EMMETT, ADA COUNTY, IDAHO.

at the head has an estimated capacity of 556 second-feet, diminishing to 104 second-feet in the last section. It is the intention of the company to use this canal at certain times of the year in order to float logs down the valley, avoiding the risks incident to their transportation by the river. Along the line of the canal are several flumes, one of which is nearly 3,000 feet in length. Several gulches on the line of the canal have been closed by dams, forming small reservoirs, one of which at least will be utilized for the storage of logs. At a distance of about 7 miles from the head the canal divides, one branch continuing west to cover lands on the Snake river bottom, the other branch, known as the Flotation lateral, extending northerly to the Payette river. Along the canal line are a number of drops at which a considerable power could be developed. The accompanying illustration shows the general character of Payette river and also the temporary brush and stone dam of the usual character for diverting the river water into the head of the canal.

On the north side of the Boise river, among the canals worthy of mention is the Boise City canal, 5 miles long, 8 feet wide, and costing about \$12,000. The ownership is divided into 12 shares. There is also the Dry Creek ditch, 6.5 miles long and 9 feet wide, the cost of which was \$4,000. It was built and owned by the farmers, each share entitling the owner to a certain proportion of the water. The largest canal on this side of the river is that of the Idaho Irrigation and Colonization Company, heading about 30 miles below Boise city and 1 mile above Caldwell. Its general course is northwesterly in the direction of the Snake river. Its total length is 24 miles, its average width 10 feet, and its cost about \$35,000. Besides these are many other ditches, large and small, taking water in the same general direction.

On the south side of Boise river is the Ridenbaugh ditch, owned by the Boise City and Nampa Canal Company, the Settlers canal, and the unfinished works belonging to the Idaho Mining and Irrigation Company, besides smaller ditches farther down stream. The Ridenbaugh ditch has been enlarged and extended in order to cover lands on the mesa from Boise to Nampa. The ditch is stated to be 22 feet wide at bottom and 32 feet wide at top. It is the intention of the company to further enlarge and extend this canal to cover upward of 200,000 acres of land. The high line canal of the Idaho Mining and Irrigation Company has been planned with the purpose of diverting water at a point in the canyon about 12 miles above Boise. A large part of the earthwork has been completed, but owing to financial difficulties the headworks have not been built. The Phillis canal, owned by the same company, although nearly completed, has not been utilized. This has an estimated capacity of 175 second-feet, the bottom width being 20 feet and the length approximating 50 miles.

The Dixie canal of the Boise Land and Water Company utilizes as a portion of its main channel a depression known as Dixie slough. The waters of Boise river are diverted into this at a point about 1.5 miles below Caldwell by means of a cut 500 feet long and 8 feet deep. The water follows along the old slough for about 6 miles, and is there turned into the canal proper by a suitable dam. From this point the main ditch follows the general contour of the land for a distance of 9 miles. It was originally built by farmers, at a cost of \$20,000. The company now owning this work intends to improve and extend the line so as to cover the lands in the triangular area between the Snake and Boise rivers, it being proposed to charge at the rate of \$10 per acre for a perpetual water right and 50 cents per acre a year for maintenance.

The discharge of the Boise river has been measured by Mr. A. D. Foote, and has been found to range from about 1,200 second-feet in low water up to 10,000 second-feet at the time of the spring floods, the greatest known discharge being about 30,000 second-feet. In order to supply water for all the canals now in operation or projected it will probably be necessary to supplement the low water discharge by storage on the head waters in Boise and Elmore counties, excellent sites for reservoirs having been discovered. The discharge of the Payette is not known, but is probably not very different from that of the Boise, averaging, it is stated, about 3,000 second-feet.

ALTURAS COUNTY is a little south of the center of the state, extending east and west in a long, narrow belt north of the Snake River plains. On the west it includes the head waters of the tributaries of the Wood river, all of which flow southward into Logan county. It also includes on the extreme west a portion of the Sawtooth range, from which streams flow northeast into the Salmon river, and westward into the Boise. The area of agricultural land in this part of the county is comparatively limited, and the water supply is ample, although farther to the south, in Logan county, are vast areas for which the amount flowing from Alturas county is insignificant.

On the east, the county extends to the lava plain of the Snake river, into which sink the rivers which flow from the ranges to the northwest. This fact has given rise to the names of the streams, namely, "Big Lost river" and "Little Lost river". Big Lost river rises in Custer county on the west side of the Lost River range and flows southeasterly into Alturas county, where its waters are used upon ranches along the stream. In time of flood the water flows far out upon the lava plain toward the Snake river. In 1889 it ran to a point 3 miles below Arco, but in the middle of June of the same year it was dry up to the mouth of Antelope creek, 20 miles above Arco. Not only are the channels of the streams very porous, allowing great quantities of water to escape into the lava fields, but the soil also is in many places very pervious, and a large amount of water is needed for irrigation, especially during the first few years.

The water of the tributaries of the Big Lost river is used to a large extent in Thousand Spring valley and other valleys in Custer county, so that the amount which escapes into Alturas county is gradually diminishing. It has been proposed to make an effort to remedy this state of things by constructing reservoirs at points in Custer county, but no active steps have been taken in the matter. Stock raising and mining are the principal industries, the cultivation of the soil being carried on largely in connection with the former. The ditches of the county are owned by individuals or associations of irrigators, and have been built for the most part in the cheapest possible manner. The noria, or undershot water wheel, carrying buckets upon the rim for raising water, has been introduced, and is used upon the swifter streams.

BEAR LAKE COUNTY is in the southeastern corner of Idaho, adjoining Rich county, Utah, on the south, and Uinta county, Wyoming, on the east. It includes that portion of the drainage area of Bear lake which lies in Idaho, being bounded on the west by the summits of the Bear River range, and on the northeast by the Aspen range, which forms the divide between the Blackfoot and Bear rivers. The southern boundary of Idaho, extending east and west, crosses Bear lake near its center, leaving the northern half in Bear Lake county and the southern half in Rich county, Utah. North of the lake is an almost level plain, about 16 miles long and 8 miles wide. A portion of it is swampy, and on the maps of the General Land Office it is represented as an open body of water called the North lake, but on the Hayden map, published in 1877, it is shown as it actually is, namely, a marsh with a small body of open water to the south. In 1889 this marsh was perfectly dry, excepting the small area of water in the southeast corner near the head of Bear lake. Roads cross this level land in all directions, and it is occupied by farmers who have built houses, barns, and fences, and are raising large crops of hay. No title, however, could be secured from the government on account of the official designation of the land as a lake.

The upper Bear river, rising in Summit county, Utah, first flows into Wyoming, then westward into Rich county, Utah, then back into Wyoming, and finally, turning westward again around the northern end of the boundary hills and the Bear Lake plateau, it enters the eastern side of the plain north of Bear lake, where its waters divide into many channels. At the northern end of this plain the lower Bear river takes its origin, winding northerly between hills to the vicinity of Soda Springs, in Bingham county, where it is deflected and turned southward toward Cache valley.

The water from the upper Bear river in times of flood partially submerges the plain and backs up into Bear lake, and in times of drought the waters of Bear lake, escaping through marshy channels, traverse the level country and finally make their way into the lower Bear river. Thus the lake and low lands to the north act somewhat as a safety valve to the floods of the upper river, receiving them and slowly delivering them, at least in part, to the lower section of the drainage system. To represent the condition of affairs clearly, it will be well to picture a long, narrow lake basin, 35 miles or more in extent from north to south, and about 8 miles in average width. Into this a river has flowed for long periods of time, entering near the northern end and gradually building a delta and filling the upper half of the basin with debris brought down in floods. In this way a level plain of great fertility has been formed at the northern end of the old lake basin, and at the same time the open water at the south end of the basin has, under the influence of prevailing winds, built for itself a barrier 4 miles or more in length and lying nearly east and west. The barrier consists of a ridge of sand from 100 to 200 feet in width, and from 4 to 6 feet above the ordinary level of the water. Toward the lake the barrier presents a smooth and beautiful beach, and on the north it gradually subsides into the marsh.

The future development of agriculture along the lower Bear river depends largely upon the control of this magnificent reservoir site, and at the same time the prosperity of a large part of Bear Lake county is at stake. The problem before the people of the Bear River drainage, whether in Wyoming or in Utah, is so to utilize Bear lake as a reservoir that a supply of water shall be insured ample for all demands along the lower Bear, and also that all of the agricultural land of Bear Lake county shall be utilized. Without entering upon the engineering details it is sufficient to state that the best use of the waters can probably be secured by the construction of an outlet canal to lower the level of Bear lake in times of need, suitable headworks being provided, so that the water can be held up to its present area. By diverting the upper Bear river directly into Bear lake and by drawing the waters down to the lowest possible level, a vast amount of water can be secured for use upon the lands in the lower valleys. The satisfactory execution of works will, however, require large capital, skillful engineering, as well as hearty co-operation between the people of Idaho and those of Utah.

The agricultural areas of Bear Lake county are principally along the eastern foot of the Bear River range, stretching in a comparatively narrow strip between the mountains and the lake, or extending from the hills out upon the plain to the north of the lake. A number of streams flow from this range with rapid fall, so that water has been taken out upon the land with comparative ease. A town has grown up at each point where a large stream issues from the mountains, the population being almost wholly supported by agriculture or stock raising. The creek near Paris discharges in summer about 40 second-feet, running a flour mill and sawmill. St. Charles creek on October 3, 1889, was flowing at the rate of from 90 to 100 second-feet, and also furnished power for a flour mill besides irrigating a considerable area.

The east side of Bear Lake valley is in most respects similar to the west side, although the mountains being, as a general rule, of less height, the water supply is smaller and the number of agricultural settlements less. East of this valley, on the other side of the Preuss range, is the valley of Thomas Fork, the greater part of which is in this county, the state line between Idaho and Wyoming running north and south along the valley. There is a large area of fertile land along Thomas Fork, but the water supply is deficient, and an attempt has been made to bring water from Smith Fork, farther to the east.

The altitude of the agricultural lands of Bear Lake county is very nearly 6,000 feet. The climate is cool, and frosts are liable to occur even during the summer, so that some of the farmers state that oats and timothy are the only sure crops. The principal crops are for forage, although large areas of the smaller grains are cultivated, and also some potatoes and vegetables. Stock raising is the leading industry, on account of the excellent summer feed upon the mountains and the facilities for raising hay for feed during the winter. Most of the inhabitants came originally from Utah, so that the methods of irrigation are similar to those employed in that territory. The water from each mountain stream is taken by ditches which head in or near the canyons and conduct it along the slopes of the hills on each side of the stream. Generally, two, but sometimes three or even more ditches run in a course nearly parallel to each other, carrying the water in the same direction, but with less economy than could be attained by the use of one large high line canal. The advantages, however, of a number of small ditches are that each small association of farmers controls the water for a particular district and the management is greatly simplified, although, on the other hand, quarrels are apt to arise in time of low water as to the proportional amount to be taken from the stream.

At this high altitude water must be used with care, for if put upon the plants too early in the spring it chills them and retards their growth. It is stated that an error is often made in attributing the slow growth of the young plants in the cool spring to lack of water rather than to lack of warmth, and thus irrigation is begun too early with injurious results. The amount of water used is very great, especially on the gravelly slopes, where the ground is porous. It is asserted that 100 miner's inches for 40 acres are sometimes necessary to satisfy the demands of the irrigator.

As an example of the ditch systems of this county, that for Bloomington, on the west side of the valley, may be given. Four ditches take the water from Bloomington Canyon creek, the length being about 4 miles, their average width 5 feet, their depth 2 feet, and their total cost about \$8,000. The water is diverted by dams of brush and stone or of logs. The water is divided among the shareholders, each share entitling the holder to what is known as an "irrigating stream" for 48 hours, during which time he is supposed to be able to irrigate 5 acres. The water is measured, as in many cases in Utah, by the size of the cross section of the stream when not under pressure, no account, therefore, being taken of the velocity. For example, the water flowing 10 inches deep through a gate or flume 50 inches wide is considered to have a volume of 500 inches, and should give 10 "irrigating streams". It is customary to allow the use of one of these "streams" for 96 hours for every 10 acres. The streams are allotted in the order of application until the whole amount of water has been assigned, and the various applicants are then notified as to who is using the water and when each irrigator may expect to take his turn. The water right is stated to be worth \$5 per acre, and the annual assessment for cleaning the ditch and paying the watermaster is from 30 to 40 cents per acre. Of this amount 15 cents must be in cash for the pay of the watermaster, and the balance can be worked out at the rate of \$1.50 per day. In the case of another ditch the "irrigating stream" is measured through a box 1 foot square under a 4-inch pressure, this amount of water being allotted at the rate of 35 hours for every 10 acres.

In general it may be said that the water is under the control of the irrigators, who have built the ditches and have adopted methods of distribution which, although crude, are efficient so long as water is plentiful. It is the practice for each association controlling a ditch to elect annually a watermaster, who receives \$1.50 a day and upward for his services, and who apportions the water and settles disputes among neighboring irrigators according to his own judgment. The total cost of maintaining the ditch system is thus very low, as there are no salaries or expenditures beyond those for a few simple repairs.

BINGHAM COUNTY is in southeastern Idaho, adjoining Wyoming and the Yellowstone national park on the east, and separated from Montana by the continental divide on the north. It receives the drainage of the high mountain ranges of western Wyoming, and has probably as good a water supply as any county in the arid region, and it is favored not only in this respect but also in containing vast areas of almost level land, the surface of which, though broken in places, is well adapted for agriculture. The county contained in 1890 the largest number of irrigated farms.

The agricultural resources of the county are due to its peculiar history. In comparatively recent geologic time, as previously intimated, a vast quantity of lava flowed from numerous craters or openings, filled ancient valleys, and extended from the foot of the continental divide and of the Teton and Caribou ranges south and west for 100 miles or more. The surface of this lava sheet is as a whole gently inclined toward the southwest, and though appearing at a distance smooth and unbroken is often uneven. The upper layer has been partially decomposed, forming in places a rich soil, which, however, is very porous. The torrential streams flowing from

the high mountains out upon this plain become comparatively sluggish, subdividing in places, but finally uniting and forming the Snake river in the vicinity of Market Lake. Near the intersection of the principal streams large areas of fertile land have been formed by the deposition of material brought down by the torrents, the relative elevation of the land and the water being such that irrigating ditches can be easily and cheaply constructed.

In the northwestern part of the county, north of the tilled lands at the junction of the north and south forks of the Snake, the extensive lava plains have little or no water, for the streams that flow southward from the continental divide are comparatively small and often are lost in the porous lava fields. There are accordingly many townships containing arable land for which there appears to be no possible way of obtaining water. At the southern end of this county the lava has penetrated the ancient valleys and extends to the Bear river, which enters the county from Bear Lake county on the southeast. Apparently this latter river has been diverted by the lava flow, and soon after entering the county has been forced to turn back toward the south, ultimately contributing its waters to Great Salt lake. The principal body of tilled land, as before intimated, is along the lower courses of the rivers which issue from the Teton and Snake River ranges and unites in the vicinity of Market Lake, the farms extending from this point down to Blackfoot. Besides this great area, there are smaller areas of crops raised along the Bear river from Soda Springs to the Oneida county line, principally in Gentile valley and also along the Portneuf river, in the upper Portneuf valley on the head waters of Marsh creek, as well as on small areas on the Fort Hall Indian reservation.

Gentile valley is about 15 miles long and from 1 mile to 3 miles in width. There are few towns, the farms being scattered along the sides of the valley, utilizing the water from the streams which issue from the mountains on the east and west. Bear river, which flows southward through the valley, although a large stream, is not used to a notable extent on account of the difficulty of diverting water. The best irrigating streams are those coming from the Bear River range on the east, the water supply of the west side of the valley being insufficient for the area now under cultivation. The most important streams are Trout, Spring, and Bridge creeks, coming from Bear River range on the east. Cottonwood creek, which drains a larger area of lower country, is of less value, not having sufficient water for all of the land to which it can be taken.

In the extreme southern part of the county in the vicinity of Oxford and Swan lake are prosperous settlements, the water supply being derived from streams which flow from the Portneuf or from the Malade range. Some of these streams flow northward into the Portneuf river, a tributary of the Snake, and thus ultimately to the Pacific, while others find their way to Bear river, the principal feeder of Great Salt lake. The long, narrow valley in this vicinity once formed the outlet of the great interior basin to which the term Lake Bonneville has been given, and many of the peculiar features upon which its agricultural development depends are explained by this knowledge of its past history. At several points in this valley near Oxford small flowing wells are found. The present supply from the small streams is not sufficient for all demands, and schemes for storage are being agitated, several small reservoirs built by individuals having established the success of such methods.

North of this point, in the vicinity of Chesterfield, in the Upper Portneuf valley, is an agricultural community of from 50 to 60 families. Their cultivated land lies just east of the Fort Hall Indian reservation, out of which the head waters of the Upper Portneuf flow in a general southeasterly direction. The location of the Indian reservation across the head waters of the Portneuf has led to a somewhat unfortunate condition of affairs for the farmers in this valley. Nearly 6 years ago they constructed a ditch, 4 miles of the upper part of which were on the Indian reservation, and spent upward of \$3,500. Objections, however, were raised to the location of the ditch on the reservation, and as a consequence it has lain idle. The water supply is now taken from creeks heading to the east of the reservation, the amount available, however, being far below the requirements of the people, so that it is stated that only about 10 or 15 acres, on an average, can be cultivated by each family. An attempt is being made to increase the water supply by storage. Farther down the Portneuf, in the vicinity of Pocatello, are lands of great fertility, but for which the water supply of the Portneuf is insufficient. A large portion, however, will be covered in time by large canals taken out farther up on the Snake river near Idaho Falls and brought along the eastern side of the plain.

The Blackfoot river heads in the range of the same name immediately north of the Portneuf and flows westward upon the lava plain to join the Snake river. Its waters in time of drought are entirely used, and in 1889 there was not enough for the needs of the town of Blackfoot. The Eastern Idaho Water Company has a canal heading about 12 miles northeast of this town and continuing to Blackfoot, the average width being reported to be 20 feet, and the total cost nearly \$8,000. The Indian reservation is bounded on the north by the Blackfoot river, and some trouble is reported between the irrigators and the Indians, who are said to have destroyed the ends of the dams which reached their lands on the south bank of the river.

At the head of each of the streams flowing out of the short mountain ranges of this county to the Snake river are lakes or marshes, in which it is probable that considerable water could be held by storage, but the proximity of the Snake river and the magnificent facilities for water conservation which exist on its headwaters cause them to sink into insignificance. Taking all things into consideration, the Snake is the largest river in the arid lands, exceeding even the Yellowstone and the Missouri, and containing along its valley perhaps the greatest

body of irrigable land in the west. The extraordinary facilities it affords have already been used in a small way, but the greater projects remain untouched. From Henry fork of the Snake, from Falls and Teton rivers, Moody creek, and the south fork of the Snake, a large number of ditches and canals carry water out upon the lava formed plain, intermingling in a most confusing manner. The soil of the deltas or islands at the junction of these streams is very rich, and agriculture has made rapid progress, all of the conditions being favorable to rapid development by men of small means. The altitude of the valley in the vicinity of Eagle Rock, or Idaho Falls, as it is now called, is from 4,800 to 5,000 feet.

In 1889 there was no irrigation carried on in the mountain valleys of these streams above the Snake River plains, the settlers on the plains below coming up to cut the natural hay for use during the winter. Above the mouth of Falls river the country was unsettled, and on Falls river the first steps were being taken toward irrigation by the construction of two ditches, no land having been brought under cultivation. Since that time, however, rapid growth has taken place, and settlement has pushed forward actively. In the Teton River valley it may be said that all of the water of the Teton river has been appropriated, and there is land not yet supplied. Water is being brought from Falls river around the foothills into the Teton valley, the divide being comparatively low.

The water supply of this part of Idaho has been investigated by the United States Geological Survey, and measurements have been made of the discharge of the streams at various points, for example, of Henry fork of the Snake river about a mile above Falls river, also of Falls river above the canals and 6 miles from the junction with Henry fork, of the Teton river above the Willford canal near the mouth of the canyon, of the south fork of the Snake above the Eagle Rock and Willow Creek canal, and of the Snake river at Idaho Falls. (a)

a As shown by the following tables, the maximum discharge of Henry fork was up to June, 1891, 7,710 second-feet, the minimum being 1,120 second-feet, and the average annual discharge 1,589 second-feet, equivalent to 1,150,071 acre-feet for the entire year. The drainage area is approximately 931 square miles, so that this water if put back upon the catchment area would cover it to the depth of 23.2 inches. These observations extending over a period of 18 months, it would be unfair to take the direct mean of that period, since the flood season occurs twice, and this would tend to raise the mean, hence this statement is arbitrary, showing the approximate annual discharge.

Falls river discharged a maximum of 4,440 second-feet, a minimum of 450, an estimated average of 1,041, an amount equivalent to 753,684 acre-feet for the year. This is equivalent to a depth of 23.7 inches over the catchment area. The Teton discharged a volume of water ranging from 4,445 second-feet in flood down to 400 second-feet in time of low water, and averaging 802 second-feet, or for the entire year 624,450 acre-feet, equivalent to a run-off of 12.1 inches for the entire basin.

The total discharge of the Snake river, as measured at Idaho Falls, during 1890 ranged from 50,450 second-feet in time of flood down to 2,000 in low water, the average being estimated at 9,486 second-feet, or 6,807,140 acre-feet, equivalent to a run-off of 12.7 inches from the entire drainage basin.

DISCHARGE OF HENRY FORK IN CANYON, IDAHO.							DISCHARGE OF FALLS RIVER IN CANYON, IDAHO.						
(Drainage area, 931 square miles.)							(Drainage area, 594 square miles.)						
MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.		MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.	
	Maximum.	Minimum.	Mean.		Depth in inches.	Second-feet per square mile.		Maximum.	Minimum.	Mean.		Depth in inches.	Second-feet per square mile.
1890.							1890.						
January			1,200	73,800	1.49	1.29	April 25 to 30	2,480	1,250	1,730	192,935	3.25	2.92
February			1,250	69,375	1.40	1.35	May	4,440	2,630	3,342	205,533	6.49	5.63
March			1,300	70,950	1.61	1.40	June	4,050	2,030	2,706	161,007	5.06	4.56
April 6 to 30	4,920	1,120	1,875	111,562	2.25	2.01	July	2,630	1,030	1,669	102,643	3.20	2.81
May	7,710	2,750	4,580	281,670	5.67	4.92	August	1,140	840	971	59,717	1.82	1.63
June	2,800	1,860	2,270	135,065	2.72	2.44	September	930	660	774	46,053	1.45	1.30
July	1,800	1,450	1,550	95,325	1.92	1.66	October	750	570	660	40,590	1.26	1.09
August	1,450	1,450	1,450	89,175	1.80	1.56	November	570	480	541	32,189	0.95	0.86
September	1,450	1,280	1,314	78,183	1.57	1.41	December	520	520	520	31,980	0.93	0.81
October	1,280	1,280	1,280	78,720	1.59	1.38	1891.						
November	1,280	1,280	1,280	78,160	1.55	1.37	January	590	450	509	31,304	0.99	0.86
December	1,280	1,280	1,280	78,720	1.59	1.38	February			450	24,975	0.79	0.76
Per annum	7,710	1,120	1,719	1,247,705	25.16	1.85	March			450	27,675	0.87	0.76
1891.							1891.						
January	1,280	1,280	1,280	78,720	1.59	1.38	April	1,140	450	606	36,077	1.14	1.02
February	1,280	1,280	1,280	71,040	1.43	1.38	May	2,790	1,030	1,765	108,547	3.43	2.98
March	1,280	1,280	1,280	78,720	1.59	1.38	June	2,180	1,370	1,681	100,019	3.17	2.85
April	2,000	1,280	1,516	90,505	1.83	1.63	July	1,760	670	1,131	69,556	2.20	1.91
May	3,180	1,640	2,184	134,316	2.71	2.33	August	670	520	607	37,330	1.18	1.02
June	2,215	1,450	1,801	107,100	2.16	1.94	September	520	520	520	30,940	0.98	0.88
							October	520	520	520	31,980	1.01	0.88
							November	520	520	520	30,940	0.98	0.88
							December 1 to 12	520	520	520	31,980	1.01	0.88
							Per annum	2,790	450	773	561,303	17.75	1.31

IRRIGATION.

Without attempting to describe in detail the irrigating systems which extend from Falls river to below Idaho Falls, it will be sufficient to mention a few of the more prominent ditches, the location of which is shown on the map. On the west side of Henry fork the St. Anthony canal is reported to be about 21 miles in length and 28 feet wide. It is owned by a stock company, each share entitling the owner to 10 miner's inches of water. The Egin canal, which is below the St. Anthony canal and in general parallel with it, is about 14 miles long and 25 feet wide, and is said to have cost about \$20,000. The ownership is divided into 400 shares, each share entitling the holder to a proportionate amount of water.

The largest ditches are those taken from the south fork of the Snake, covering the land in the vicinity and north of Idaho Falls. For instance, the Eagle Rock and Willow Creek Water Company has a canal 25 miles long and 30 feet wide, with an average depth of about 3 feet. The cost is said to have been \$100,000. Each share in this company entitles the owner to 5 inches of water, 1 inch being considered under ordinary circumstances sufficient for 1 acre of land. The Farmers Friend ditch is 5 miles long and 20 feet wide. It cost \$11,000, and covers land below the canal just mentioned, being built by irrigators. In the vicinity of Idaho Falls are two large canals, the Great Western and the Idaho, heading on opposite sides of the river near Bear island. The latter of these is reported to be 40 feet wide and 4 feet deep, and at a distance of 12 miles from the head to be 20 feet wide.

The country has but recently been settled, and as yet the farms are hardly in good order, as is shown by the average value of products. Ditches are being built and enlarged constantly, some running parallel and others crossing from point to point. In general the irrigation systems are owned by the farmers, although a few are in the hands of corporations. A good example is here afforded of the growth which takes place without system or

DISCHARGE OF TETON RIVER AT CHASES RANCH, IDAHO.

(Drainage area, 967 square miles.)

MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.	
	Maxi- mum.	Mini- mum.	Mean.		Depth in inches.	Second- feet per square mile.
1890.						
April 5 to 30	1,295	545	740	44,030	0.85	0.77
May	4,445	1,545	2,730	167,895	3.26	2.82
June	4,065	1,925	2,812	167,314	3.26	2.91
July	2,950	935	2,130	130,995	2.51	2.20
August	935	510	678	41,697	0.81	0.70
September	510	450	462	27,489	0.53	0.48
October	510	450	475	29,212	0.57	0.49
November	450	450	450	26,775	0.52	0.46
December	510	450	459	28,228	0.55	0.47
1891.						
January			400	24,600	0.48	0.41
February 17 to 28	475	450	465	25,807	0.50	0.48
March	450	450	450	27,675	0.54	0.47
April	935	450	630	37,485	0.72	0.65
May	2,360	720	1,402	86,223	1.66	1.45
June	2,360	1,295	1,661	98,829	1.91	1.72
July	1,635	670	1,050	64,575	1.25	1.09
August	670	450	547	33,640	0.65	0.57
September	450	450	450	26,775	0.52	0.47
October	450	425	444	27,306	0.53	0.46
November			425	25,287	0.49	0.44
December			425	26,137	0.51	0.44
Per annum	2,360	400	686	504,339	9.76	0.72
1892.						
January			400	24,600	0.48	0.41
February			425	24,437	0.47	0.44
March	450	450	450	27,675	0.54	0.47
April	820	450	575	34,212	0.66	0.60
May	4,999	585	1,911	117,526	2.28	1.92
June	5,270	2,245	3,845	228,777	4.43	4.00
July	4,575	1,545	2,780	174,970	3.32	2.88
August	1,455	545	758	46,617	0.90	0.79
September	510	475	488	29,036	0.56	0.51
October	475	450	471	28,965	0.56	0.49
November	450	450	450	26,775	0.52	0.47
December			450	27,675	0.54	0.47
Per annum	5,270	400	1,084	787,265	15.26	1.12

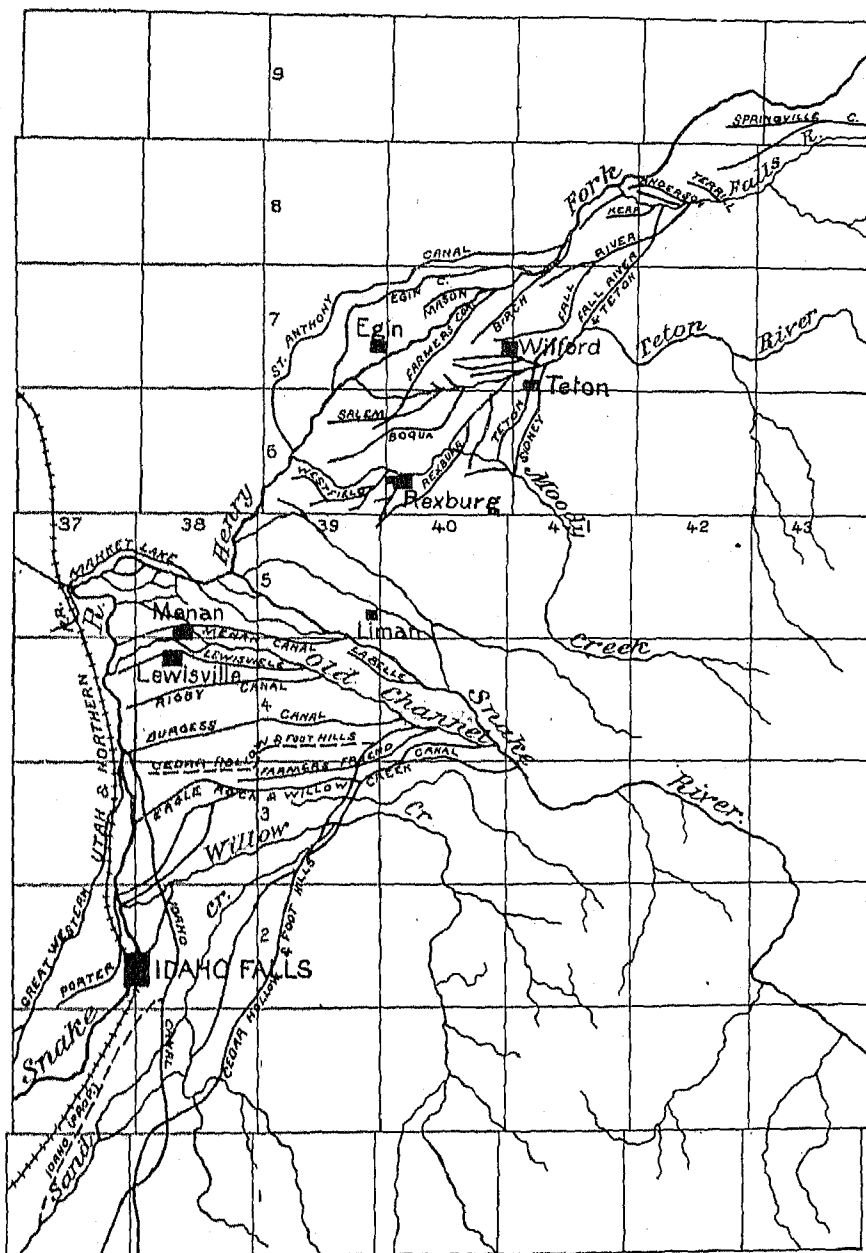
DISCHARGE OF SNAKE RIVER AT IDAHO FALLS, IDAHO.

(Drainage area, 10,100 square miles.)

MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.	
	Maxi- mum.	Mini- mum.	Mean.		Depth in inches.	Second- feet per square mile.
1889.						
July	8,646	3,174	5,184	318,816	0.50	0.51
August	3,130	2,286	2,596	159,654	0.30	0.26
September	2,508	2,286	2,300	136,850	0.25	0.23
October	2,730	2,286	2,425	149,137	0.28	0.24
November	2,352	2,508	2,737	162,851	0.30	0.27
December	2,730	2,508	2,601	159,961	0.30	0.26
1890.						
January			2,000	123,000	0.23	0.20
February			2,000	111,000	0.21	0.20
March			2,000	123,000	0.23	0.20
April	15,000	2,900	5,702	339,269	0.63	0.57
May	49,350	16,900	35,006	2,180,769	4.06	3.62
June	50,450	24,930	34,870	2,074,765	3.85	3.45
July	28,800	10,700	19,970	1,228,155	2.28	1.98
August	10,380	6,250	7,875	484,312	0.90	0.70
September	5,950	4,350	4,934	293,573	0.54	0.48
October	4,600	4,350	4,552	279,048	0.52	0.45
November	4,350	3,900	4,207	250,316	0.47	0.42
December			3,900	239,850	0.45	0.39
Per annum	50,450	2,000	10,365	7,736,957	14.37	1.05
1891.						
December	2,900	2,550	2,773	170,539	0.32	0.28
1892.						
January			3,000	184,500	0.34	0.30
February			3,000	172,500	0.32	0.30
March 24 to 31	4,100	3,500	3,900	239,850	0.44	0.39
April	4,600	2,250	3,760	223,720	0.41	0.38
May	51,000	4,725	18,187	1,118,500	2.08	1.80
June	54,300	29,675	41,357	2,460,741	4.56	4.10
July	51,000	10,000	24,069	1,480,243	2.75	2.40
August	9,650	4,850	6,463	397,474	0.74	0.64
September	4,850	3,900	4,312	256,546	0.43	0.43
October	4,350	4,100	4,156	255,594	0.47	0.41
November	4,100	4,100	4,100	243,950	0.45	0.41
December			4,000	246,000	0.46	0.40
Per annum	54,300	2,250	10,025	7,279,618	13.50	1.00

comprehensive plan. Fortunately, however, the water supply is large, and the evils resulting from haphazard construction are not apparent.

MAP OF IRRIGATING CANALS IN THE VICINITY OF IDAHO FALLS, BINGHAM COUNTY, IDAHO.



Several of the canals are so located that they can be enlarged to cover much of the agricultural land to the south of Idaho Falls, but it is probable that to obtain ample water for any great system it will be more advantageous to take water from the main stream near Idaho Falls, instead of from the old channel or sloughs of the south fork. In order to give an idea of the water supply in the south fork of the Snake and also of the diversions being made, the results of a series of gaugings are given. On September 14, 1889, the Eagle Rock and Willow Creek canal was carrying 103 second-feet, the Farmers Friend canal 65 second-feet, Burgess canal 38 second-feet, and on September 16 the Lewisville canal was carrying 74 second-feet, the Old Channel 70 second-feet, La Belle 14 second-feet, Manan canal 236 second feet, and the south fork below these canals 874 second-feet. On September 19 the south fork at the United States Geological Survey gauging station above these canals was carrying 1,614 second-feet.

The ditches from the various streams, especially from the south fork of the Snake, have, as a rule, no permanent headworks, some of them taking water from side channels or sloughs. The expense of construction is relatively small, and most, if not all, of the work can be done by the irrigators. The canals heading on the main river, however, require considerable attention and expense in order to keep the headworks clear. The gravelly bed of the river channel shifts rapidly, and occasionally is scoured out so deep that it is impossible to bring water into the old headworks.

BOISE COUNTY is west of the center of Idaho, and includes the greater part of the catchment area of the Payette river. On the south it extends over the divide to the north fork of the Boise, thus including a small portion of this drainage. It has been mainly a mining county, a number of placers along the Payette having in past years been worked with success. Stock raising is an important industry, the valleys and lower mountains furnishing an excellent range.

The agricultural land lies along the Payette and its tributaries in the southern part of the county, and also on the north fork of the Payette in Long valley at the northern extremity of the county. Long valley lies in a north and south direction, being about 35 miles in length and from 6 to 8 in width. The altitude is from 4,000 to 4,500 feet, and the climate is so cold that until within a few years there has been a belief that no crops could be raised and that the land was suitable only for grazing. Of late years, however, settlers have pushed rapidly into the valley, and they have found that wheat, oats, and barley, and also potatoes and other vegetables could be raised, and that these often succeeded without irrigation. By the use of water artificially applied, however, the land is made to yield larger crops, but in the case of the small grains it is stated that by irrigation the growth is increased and often prolonged so late in the season that they do not mature before winter. At the northern end of the valley are the Payette lakes, in which the river rises, and which might possibly be used for water storage should occasion demand.

Farther down the Payette at Garden valley, and on Jerusalem creek and Squaw creek are small irrigated areas. At these points also barley and wheat are raised to some extent without irrigation, although all crops do better with artificial application of water. In the drought of 1889 the supply of water from the small streams became very scanty, and in a few instances irrigators were compelled to buy water from the miners in order to save their trees and vegetables, the rate given in one instance being 10 cents per miner's inch per day.

Irrigation is being gradually developed in this county, but the ditches are small and take water from creeks and streams as they issue from the sides of the valleys. The Payette is a river of considerable size, but its waters have not been diverted in this county on account of the expense. There is a demand for the construction of canals to cover the great areas in Long valley and in the lower part of the county. The present inhabitants, however, are mostly poor and were barely able to build the small ditches now in use. There is at present an ample supply of water, but the time is not far distant when the entire quantity flowing through the summer in all the streams except the main Payette river will be appropriated.

CASSIA COUNTY is in southern Idaho, adjoining Boxelder county, Utah, and Elko county, Nevada, from whose mountains and plateaus this county receives a large part of its water. Snake river forms the northern boundary, and the tributary streams coming from the south flow nearly due north across the county, passing through many beautiful valleys on their way. Agriculture has been gradually developed wherever water could be obtained for irrigation, and every spring and stream is utilized. The mountains from which the water comes, although rugged in places and including peaks upwards of 10,000 feet in height, are not sufficiently extensive to receive the enormous deposits of snow required to maintain large perennial streams, and for this reason most of the creeks after emerging from the valleys dwindle in the summer to proportions far below the needs of the irrigators. As an example, it has been found that the water in Goose creek falls below 300 miner's inches, as there measured, while the claim of a single irrigator owning prior rights is for 320 inches.

Water is measured usually in a short flume, or box, 16.5 feet long with a total fall of three-eighths of an inch. These boxes may be made of any width desired, but the water must be maintained at a depth of 9 inches. The number of miner's inches is obtained by multiplying the width of the box in inches by 9. It is somewhat difficult to maintain the slope of these boxes constant, and since there are many other varying details, the amount of water carried by the different boxes as an "inch" varies widely. The actual amount of water contained in the average "inch" has not been ascertained. It is stated that water has been decreed by the courts at the rate of 160 of these inches for 160 acres, but several of the irrigators assert that 100 inches should irrigate from 160 to 200 acres.

As a result of gradual settlement and corresponding increase of area under cultivation, the demand for water has grown so that great difficulty is experienced by the older settlers in securing the amount claimed by them. Judicial decisions are usually unsatisfactory, from the fact that although the water may be decreed to certain irrigators, the stream does not furnish a quantity sufficient for these decrees to be enforced. Litigation is pending among many of the irrigators, and prospects of speedy settlement are not encouraging. On nearly every creek are places which the irrigators consider suitable for reservoir sites, but few steps have been taken toward water storage. One or two small reservoirs have been constructed, and the outlet of a lake has been provided with regulating gates so that water can be held. The great demand, however, is for a canal to take water from the Snake river, and it is asserted that such a scheme is practicable, although the surveys of the United States Geological Survey seem to leave the matter in doubt. A line was run from the American falls on Snake river with the object of demonstrating the possibility of bringing the water of the Snake into the valleys of Raft river and Goose creek, but after progressing 13 miles the line was abandoned as impracticable on account of the difficulties

of constructing the canal. A higher line was then taken up, with the assumption that water could be taken from a large canal heading near Idaho Falls, but after running 17 miles this survey was also abandoned for the same reason.

Nothing can be raised in this county without irrigation, excepting, perhaps, one crop of alfalfa in the early part of the year, and this would be greatly improved by irrigation. Farming is conducted on a small scale on account of the general scarcity of water, the area prepared by the farmers each year depending somewhat upon the appearance of snow among the high peaks. On many of the main ditches the proportion to be turned to each irrigator is determined by an order of court, but even this is not satisfactory. The general complaint is voiced by one of the irrigators, when he says: "The greatest objection to irrigation is the everlasting litigation prevalent on all streams where there are numerous claimants to water, and the losses to crops from failure of water owing to the very crude law providing for its distribution".

CUSTER COUNTY is nearly in the center of the state, and includes an area of high mountains on the head waters of the main Salmon river. On the southeast it extends into the catchment basins of the Big and Little Lost rivers, and on the northeast it includes that part of the Pahsimeroi valley which lies on the left bank of the stream. It is a mining and stock raising county, but there are three valleys in which agriculture has gained a foothold. Nothing can be raised without irrigation, excepting perhaps on the low natural meadows or in the little valleys high among the mountains. The Salmon river flows north through Round valley, carrying usually a larger quantity of water than is needed, the average amount being given as approximately 600 second-feet. Many ditches are built to take water from this river and also from the tributary streams, and apparently there is an ample supply for all. There are also a number of farms in the valley of the Big Lost river, which flows southeasterly out upon the lava plains of the Snake, and there disappears. The soil in this valley is very porous; great quantities of water are necessary in order to raise a crop, and the supply is not sufficient to meet the demands in this county and also those in Alturas county, farther down the river.

In the Pahsimeroi valley is a large amount of fertile land which can be brought under irrigation. It is only recently that the cultivation of the soil has been attempted by more than a few individuals, as the cattlemen have used this as a range and have opposed the advance of settlers. There is every reason to believe that climate, soil, and water supply are equal to those of the adjacent valleys. In the case of all these agricultural lands there is great need of the construction of a few large, well built canals to receive the waters of the streams before they are lost into the permeable valley bottoms and to conduct them with the least possible loss to the agricultural lands on which they can be used to best advantage. Many of the creeks rapidly diminish in volume after June 15, and the complete development of agriculture is dependent upon the conservation of flood waters for use in the latter part of June and in July.

ELMORE COUNTY is in the southwestern part of Idaho, extending from the north fork of the Boise river south to the Snake river, and bounded on the east and west by straight lines arbitrarily located. This strip of country includes part of three minor drainage basins, these being, first, on the north a large portion of the catchment area of Boise river; second, near the center of the county a small portion of the head waters of Camas creek, which flows easterly into Logan county, opposite to the general course of the Boise; and, third, on the south areas drained by small creeks flowing toward the Snake over or through the lava formed plain bordering that river. The divide between the drainage basin of the Boise and that of the streams to the south is comparatively low, so that these latter streams do not as a rule receive a large or perennial supply of water.

On the northeastern corner of the county is a part of the Sawtooth range, containing summits which rise to heights of 7,000 feet and upward. The water supply of the Boise is therefore large, but the area of tillable land along the river in this county is limited. To the west, however, in Ada county, as previously described, are immense tracts of fertile land requiring all the water which can be furnished by this stream. On the narrow bottom lands in Elmore county are a number of ranches, the average area of the level land of which is from 50 to 100 acres. There still remain other small patches to be taken up by settlers along the mountain valleys, the altitude of these, however, being so great that only forage crops or the hardier grains and vegetables can be successfully raised.

The principal agricultural settlements of the county are along the southern foot of the low range which separates the Snake River plain from the Boise drainage. Along each of the small creeks which issue from these mountains are areas of cultivated land, the water supply without storage being hardly sufficient to cover the land now tilled. Wherever water can be had large crops of wild hay, alfalfa, wheat, rye, and vegetables are raised. There are no canals in this county, irrigation being carried on by means of small private ditches. The inhabitants are hopeful, however, that in the future a great canal may be built to take water from the Snake river far to the east and bring it out upon the broad plain which stretches from the foothills to the edge of the gorge in which the Snake river flows.

The broad, fertile plain extending from the Snake river northward to the foothills is underlaid by lava, and as the streams leave the mountains and flow out upon this lava sheet many of them lose a large part, if not all,

of the water into the porous strata, so that on the open ground at a distance from the mountains the water supply is usually more uncertain and less in quantity than it is in the narrow valleys. Among the foothills there is usually an ample supply from February to April, the amount depending largely upon the temperature of the season and the rate at which the snow melts, whether gradually, giving a continuous flow, or rapidly, resulting in short, early floods, followed by droughts, as was the case in 1889. In this region stock raising is the principal industry, the tilling of the soil being of secondary importance. The settlers have taken up the land near each spring and along every stream, and have used the water according to the best of their ability. Both hot and cold springs are to be found along the foothills and near the Snake river, and most of these are now used for agriculture. In some instances the owners of these springs have built small reservoirs to hold the surplus waters, and they can thus irrigate comparatively large areas of ground. Other works of this kind are projected or are being executed as fast as the means of the settlers will allow.

One of the largest storage enterprises in the state is that of the Elmore County Irrigation Company, whose main reservoir is about 2.5 miles northeast of Mountain Home, a town on the Oregon Short Line. This reservoir has a surface area of nearly 560 acres. It is formed by an earth dam thrown across a narrow place on Rattlesnake creek. An additional supply will probably be obtained from Canyon creek by a feeding canal 30 feet wide on bottom, and other storage reservoirs may be built to increase the amount available. From the main reservoir the waters flow down the natural creek bed for a distance of 1.5 miles and are there diverted by canals, one toward the west to supply Mountain Home, the second toward the south, covering with its branches lands along both sides of the railroad. The lands under these canals are reported to be very fertile and adapted for the cultivation of fruit.

The Orchard Irrigation Company has a storage reservoir in this county, built for the purpose of reclaiming lands in the southern part of Ada and Elmore counties. Water is to be obtained from Indian creek, which heads on the south slope of the ridge separating the south fork of Boise river from the catchment area of small creeks emptying into Snake river. This stream is intermittent, being fed mainly by melting snow and rain waters. The reservoir has been formed by placing an earth dam across a canyon 100 feet in width. The greatest height of the dam is 65 feet, the bottom width 225 feet, and the top width 14 feet. The capacity of the reservoir is estimated to be, when filled to the bottom of the waste weir, 645,000,000 cubic feet. Water is drawn from the reservoir by means of a tunnel driven through the solid ground. About 2.5 miles below the dam the water is diverted from the natural channel into two canals, one running to the east and south and the other to the west, covering the town site of Bisuka. The total cost of the dam and tunnel is stated to have been \$65,000. The lands to be irrigated will be set out mainly with prune and other fruit trees. An additional supply will probably be obtained from a second reservoir built on Blacks creek, north of Indian creek. Perpetual water rights have been sold at from \$15 to \$20 per acre.

IDAHO COUNTY is north of the center of the state, and extends from the Bitterroot mountains on the east to the Snake river on the west, thus reaching across the state. The greater part of the county is composed of mountain ranges, which have been but partially explored even for their mineral wealth. The agricultural land lies in the northwestern part of the county on the almost level divide known as Camas prairie, between Clearwater and Salmon rivers. The northern part of this prairie is in the Nez Perces Indian reservation, but the greater portion of this high, slightly rolling country is utilized for grazing, and to a small extent for agriculture. The Clearwater and Salmon rivers flow through deep canyons or narrow valleys 1,000 feet or more below the general level of the prairie, and their waters can not be diverted upon this large body of fertile land. There is usually sufficient rainfall to mature the crops, and farming operations have been successful except during the droughts of the past few years. On the low lands in the deep valleys along the Salmon river small gardens, orchards, and vineyards are irrigated mainly by the use of ditches built for placer mining, some of which have been abandoned by their former owners. On Camas prairie wheat, oats, barley, rye, flax, and timothy, and occasionally some vegetables, are raised without irrigation, and upon the whole dry farming is successful. It does not seem probable at the present time that any of this high land will be brought under irrigation, except perhaps close to the mountains at a few points where streams issue. This county may be said to be on the dividing line between the counties to the south, in which irrigation is the rule, and those to the north, in which it is the exception.

KOOTENAI COUNTY is at the northern end of Idaho, adjoining British Columbia, and comprising the comparatively narrow strip between the states of Montana and Washington. For the greater part it consists of mountains, generally well timbered, between which are many lakes, some of them of notable size. The agricultural land of the county lies principally on the Spokane prairie, a high, rolling tract along the Spokane river, extending in a belt 30 miles long and about 5 miles in width from Lake Cœur d'Alène to the city of Spokane, in Washington. The rainfall is usually sufficient to mature the crops, although severe droughts have been reported and the climate is favorable for the growth of all of the small grains and hardier vegetables. It is reported that corn does not

mature, but is raised for fodder. Great difficulty is experienced on the Spokane plains in obtaining water for stock and domestic purposes, it being necessary in many instances to haul it for distances of from 2 to 5 miles. A number of wells have been sunk to a depth of from 80 to 320 feet, and from these water is obtained by pumping. No flowing wells have been found. On the eastern side of Pend d'Oreille and Cœur d'Alène lakes are low lands which are cultivated or upon which hay is cut, but in that locality there is no necessity for irrigation. In fact the settlers are more anxious to get rid of the excess of water than to obtain an additional supply. In springtime when the snow melts in the mountains the floods entering these lakes escape slowly through the narrow outlets below the lakes, and thus the water level is raised 15 or 20 feet or more, flooding the lower lands around the borders. The two instances where irrigation is practiced in this county are cases in which, owing to the exceptionally favorable location of the land, water can be brought to orchards and gardens.

LATAH COUNTY is south of Kootenai county, north of the Snake river, and lies principally on the head waters of the Palouse river and of tributaries of the Clearwater. The country is in the main a high, rolling prairie, into which the rivers have cut deep canyons. The rainfall is ample for raising crops and no irrigation is practiced, beyond, perhaps, the watering of a few gardens or fruit trees, which can hardly be called systematic irrigation. Wheat, oats, barley, flax, rye, and the hardier vegetables, as well as many kinds of fruits, thrive well and bountiful crops are produced on the rich, deep soil of the high, rolling lands. Although there have been several dry years the drought does not appear to have been so severe as to lead to serious losses or to suggest the necessity for irrigation.

LEMHI COUNTY lies along the Bitterroot mountains on the eastern side of the state. The Lemhi river flows in a general northwesterly course, mainly through an open valley, along the base of the mountains to its junction with the Salmon river, at which point Salmon city is located. Mining and stock raising are the principal industries, but irrigation is making gradual progress, water being taken mainly from the small streams which flow into Lemhi river from each side. Lemhi river is bounded by bench lands, portions of which are locally known as "bar lands". The soil on these "bar lands" is often better than that in the bottoms, but water from the main stream can not be taken out upon these areas, lying 100 feet or more above the stream, except by the construction of expensive canals. The smaller tributaries, however, having a rapid fall, can be readily diverted, and have been diverted in some instances. These smaller streams in many cases become nearly or quite dry in summer, and therefore are not as valuable for irrigation as the main stream would be. In the lower part of the valley near Salmon city questions concerning the rights of prior appropriators have given rise to lawsuits, which have somewhat retarded developments.

On the north fork of the Salmon in the northern end of the county are a few ranches in the narrow valley along the stream. Here the water supply is abundant for the small amount of agricultural land, the minimum discharge being estimated to be 60 second-feet. In the southern or southeastern part of the county also a few ranches have been established on the head waters of Birch creek and Medicine Lodge creek, both of which flow toward the Snake River plains, supplying water for agricultural lands in Bingham and Alturas counties.

LOGAN COUNTY is in southern Idaho, north of the Snake river, being the southern portion of the area formerly included in Alturas county. It extends from the foothills of the Wood River mountains on the north to the lava fields bordering the Snake, and contains in the northwestern corner the beautiful Camas prairie, one of many of that name, as well as a number of fertile valleys along the Wood river and its tributaries. The tilled lands of the county are near the foothills on the northern edge of the county, or along the valleys of the Big and Little Wood rivers and their tributaries. There are also small areas under cultivation down on the low lands within the canyon walls of the Snake. These lands are irrigated mainly from springs which issue from the precipitous sides of the gorge, some of them falling from a height of 150 feet or more. Here, also, along the river are many placer mines, and the water from the springs is employed for mining as well as for irrigation.

The Big Camas prairie is a broad, fertile tract lying in a general east and west direction, its length being about 50 miles and its width 6 to 8 miles. Malade river, or Camas creek, flows easterly through the center of the prairie, receiving on its way a number of small streams that come from the mountains to the north. These streams discharge considerable water at the time of melting snow, but in the latter part of June they diminish rapidly in volume, and in July and August little, if any, water reaches the Malade, although there may be a constant flow in the streams near the mountains. On June 28, 1889, Camas creek was measured above the backwater from the Wood river, and it was found to be discharging only 2 second-feet. The fall of the river is very slight, and water from the Wood river backs up for a distance of 6 miles.

Agricultural operations are almost entirely confined to the northern side of the prairie, at which point all of the water to be obtained in summer is utilized. In wet years crops can sometimes be raised successfully upon the prairie without irrigation, but in times of drought, as in 1889, even the small, comparatively well watered areas near the mountains suffer. Rye is often cultivated without the artificial application of water, and after alfalfa has once been started one crop a year can be obtained from the dry ground.

Along the Wood river, in the vicinity of Bellevue and Broadford, are many ranches, taking the full supply of that stream, except for a few weeks when the rivers are in flood. On the Little Wood river and its principal tributary, Silver creek, there are comparatively large areas of irrigated land. From these streams a great number of small ditches have been laid out, and there is no doubt among the farmers that the available water supply could be greatly increased if in place of these little ditches one or two well made canals could be constructed. In their lower courses the rivers flow over pervious beds, and thus lose a great part, if not all, of their water, and if canals with well puddled sides and bottoms could be constructed to cut off the meanders of the stream and carry the water with moderate velocity to the places where it is needed, a far larger acreage could be cultivated. One or two reservoirs are being constructed above narrow places along the rivers, and hopes are entertained of greatly increasing the crop area by this means. There was great loss of crops in 1889, not only on account of drought, but also through the ravages of grasshoppers. The damage done by these pests would have been greatly lessened if there had been ample water to irrigate the fields and prevent the development of the young insects.

Owing to the peculiar character of the soil, what is known as subirrigation is largely practiced, that is, the water is turned out of the laterals upon the fields. After saturating the surface it soon reaches an impervious layer, upon which it spreads laterally, wetting the ground at a distance beneath the surface. Enormous quantities of water are used in this way, and a good deal of it is wasted. Smaller ditches, dug nearer together over the field, would irrigate a larger area with less water.

A few measurements of river discharge have been made in this county by the United States Geological Survey, but no continuous records have been kept. The Wood river, as described in the statement concerning Alturas county, was measured near Hailey. On June 20, 1889, the river at that point was discharging at the rate of 300 second-feet, while 50 miles or more below, at the junction of Big and Little Wood rivers, its bed was almost dry. At the same time the Little Wood river at a point about 30 miles above the junction was discharging 30 second-feet, and its principal tributary, Silver creek, 170 second-feet, or in all 200 second-feet for the Little Wood. This added to the 300 second-feet in the Big Wood river at Hailey would make 500 second-feet, which, aside from the discharge from other sources, should theoretically be found at the junction, since a very small amount was being appropriated for irrigation. It thus appears that at least 500 second-feet was lost in the passage through the lava beds.

DISCHARGE OF WOOD RIVER AT HAILEY, IDAHO.

(Drainage area, 906 square miles.)

MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.	
	Maxi-mum.	Mini-mum.	Mean.		Depth in inches.	Second-feet per square mile.
1889.						
July	238	119	163	10,024	0.21	0.18
August	126	113	123	7,564	0.16	0.13
September	126	113	123	7,318	0.16	0.13
October	153	126	138	8,487	0.18	0.15
November	153	126	145	8,627	0.18	0.16
December	153	126	138	8,487	0.18	0.15

NEZ PERCES COUNTY is in the northwestern part of Idaho, opposite the southeastern corner of the state of Washington, and includes the country from the Snake river eastward along a portion of Clearwater river. The Lapwai, or Nez Perces, Indian reservation has until recently covered the greater part of the county back from the Snake river, and settlement has been retarded pending the opening of at least a portion of this reservation. The greater part of the county consists of high, rolling prairies, or table-lands, through which the streams flow in great ravines or canyons at a depth of from 200 to 500 feet or more below the general level. The altitude of these uplands is from 2,000 to 3,000 feet, and usually there is sufficient rainfall to produce fair crops of wheat, oats, rye, barley, corn, as well as potatoes and other vegetables. The soil is very fertile, and in years of abundant rainfall the crops are exceptionally large. Often, however, as in 1889 and 1890, the rainfall is deficient in quantity, and the crops, if not a total loss, are so scanty as hardly to repay the value of the seed and the labor of planting.

Water can not readily be taken to these plateaus on account of the depth to which the streams have eroded their channels. It is possible, however, that careful surveys may discover localities to which the streams can be conducted by long canal lines. The water supply from the Clearwater and its principal tributaries is excellent, but the smaller streams of the plateaus are very uncertain in their discharge. If found necessary as a protection against droughts, reservoirs can be built on the head waters of some of these small streams, especially in the

vicinity of Craig mountains. In one case at least a small lake has already been utilized. As irrigation is not always essential on these high lands, it is doubtful whether many attempts will be made at present. On the low lands in the narrow valleys it is necessary to irrigate the gardens, orchards, and vineyards, as well as many of the field crops. The Lewiston Mining, Milling and Irrigating ditch from Clearwater river, 5 miles long and 4 feet wide on bottom, supplies water to a number of gardens and orchards at Lewiston, and there is also an irrigation ditch in the valley of the Sweetwater. Most of the irrigation in the county, however, is from small springs or by water raised by steam pumps, pulsometers, pumps driven by water wheels or by norias.

ONEIDA COUNTY is in southeastern Idaho, west of Bingham and Bear Lake counties and south of the Snake river. It is irregular in shape, a narrow projection from the southeastern corner extending along the Utah line across the northern end of the Cache valley to the summits of the Bear river range. It thus includes several distinct drainage districts, those of the streams flowing into the Bear river on the north, that of the Malade and its tributaries on the south, and the Cache valley streams on the southeast. The greater part of the county is mountainous, although the peaks, as a rule, do not rise to great heights. As a consequence of the general low altitude the water supply is comparatively small even for the narrow valleys, and is not sufficient to irrigate all the cultivated land, although this forms but a small proportion of the total amount arable. In the northern part of the county the valley along Bannock creek and the Portneuf river has been a part of the Fort Hall Indian reservation, and accordingly agriculture has not been developed along these streams. To the west of these, however, are a number of creeks flowing northward from the short mountain ranges, and each of them is used to its full extent in summer. The largest of these is Rock creek, along which in the vicinity of Rockland are irrigated areas of considerable extent.

In the southwestern part of the county are many valleys, some of them broad and containing thousands of acres of fertile land. The water supply from the hills is, however, very small, and cultivation is possible only in favored spots close to ravines from which small streams flow. At these points some forage is raised for the cattle which roam over the higher lands, where, as a rule, they find an excellent range. The Malade river receives the greater part of its water from the Bannock and Malade ranges to the east. Each of the tributary streams from these mountains is utilized at the point where it issues from its canyon, and a large portion of the northern and eastern edge of the Malade valley is thus irrigated. The farmers have found it impossible to water the whole of their land by the unregulated flow of the streams, and have attempted to construct storage reservoirs, but on account of lack of engineering skill and of capital not all of these have been successful. The Malade range, which separates this valley from Cache valley, is too low and too small in area to give rise to any very large streams, and as a consequence the greatest economy must be used in employing the waters upon the rich lands lying on either side.

In Cache valley is probably the largest body of level land in the county. The Bear river, coming from Gentile valley on the north, flows in a southwesterly course through narrow canyons, descending by rapids or small falls, and enters Cache valley through a deep gorge which it has cut in the ancient lacustrine sediments. The lands in the upper end of the Cache valley are 100 feet or more above the river, but the plain descends rapidly toward the south, so that in Cache county, Utah, the river is only a few feet below the general level. The part of the valley which is in Oneida county is so high above the river that up to the present time none of the water from Bear river has been used, except in the case of small ranches on the bottom land fringing the stream.

On the east side of Cache valley flowing into the Bear river are several large streams, each of which is diverted upon the lands extending out from the foothills toward the center of the valley. Several towns of importance have sprung up near the canyons of these streams, each depending upon the waters coming from the mountains. On the west side of Cache valley are enormous tracts of fertile land, extending from Deep creek to Western creek, for which no water is at present available. As previously stated, the Malade range, bounding the valley on the west, does not furnish sufficient water for the needs of the small agricultural towns, and water storage has already been found necessary, at least four reservoirs being under construction.

Surveys have been made to demonstrate the possibility of taking water from the Bear river at some point in the canyons below Gentile valley, and it has been found that there is sufficient fall to the river to allow of a canal being taken out to cover this west side land, but the difficulty of constructing and maintaining a canal in the sides of the steep bluffs of unconsolidated materials is so great that it is questionable whether such a canal would be profitable. By utilizing the storage facilities of Bear lake, mentioned in the description of Bear Lake county, it is probable that sufficient water can be secured for such an enterprise even after the lower canals have been supplied.

The measurements of water flowing in the Bear river made by the United States Geological Survey have been at two points, the first at Battle creek, at the head of Cache valley, in Oneida county, and the second near Collinston, in Boxelder county, Utah, below Cache valley. The discharge at Battle creek varied from 270 to 5,980 second-feet in 1890. (a)

^a The average for two years was 1,423 second-feet. This amount of water flowing throughout the year is equivalent to 1,630,252 acre-feet. The drainage area is

On some of the fertile lands to which water can not be brought, dry farming, that is, farming without irrigation, has been attempted, often with successful results. In fact, many of the farmers state that although the yield per acre is smaller, the returns as a whole are greater than on irrigated land, from the fact that larger acreages are tilled with less labor and expense, and thus the cost per bushel of product to the farmer is less. Rye, wheat, and corn are reported to be the principal crops thus raised, the greatest acreage being that in rye. As a general rule, however, it may be said that irrigation is necessary in this county, and it is only when water can not be had that more precarious methods of agriculture are attempted.

Irrigation is carried on by means of small ditches built by the farmers individually or in partnership, or occasionally by corporations whose members are the irrigators using the water. Most of the agricultural towns are incorporated, and the management of the water is assumed by the town officers. In this case, however, since all of the voters are farmers, the control is practically in the hands of irrigators. Many of the ditches have been built for so many years, and have been so often enlarged that it is impossible to ascertain either their cost or dimensions. Irrigation is usually begun about May 1, water being used upon the lucern, or alfalfa, and one good irrigation insuring a crop. By the time these fields are irrigated the small grains need water, and the alfalfa receives no more until these are harvested. The grains usually require three waterings at intervals of about 18 days, the practice varying, however, with different individuals. If there is plenty of snow in January and the wind blows it into drifts the farmers can expect a good supply of water in June and plant a full acreage. They are accustomed to regulate to some extent the area of ground cultivated by the appearance of snow in the mountains and the probable amount of water to be received. If there is an excess of water in the fall, it is frequently turned upon the ground in the hope of securing a saturation sufficient to be of benefit the next spring.

OWYHEE COUNTY is in the southwestern corner of Idaho, adjoining Oregon and Nevada. The Snake river forms the northern boundary, and receives the drainage of the county by a number of streams, most of which are short and carry a small volume of water. The Owyhee river, rising in the mountains of northeastern Nevada, flows across the southwestern corner of the county into Oregon and finally enters Snake river a short distance north of the county line. This river receives most of the streams that rise in the western side of the county.

The great lava sheet of southern Idaho extends from the east, halfway across this county, forming a great plateau with a rough, barren surface. The Snake river has cut across this plateau, forming a deep, narrow gorge, which widens in places, and is occasionally fringed with bottom lands. The larger tributaries also have cut deep ravines or gorges in the lava, making long, narrow valleys, while the smaller creeks issuing from the mountains

about 4,500 square miles, and this water if placed upon a plain of the same size would cover it to the depth of 4.3 inches. The following are the gaugings for a series of years:

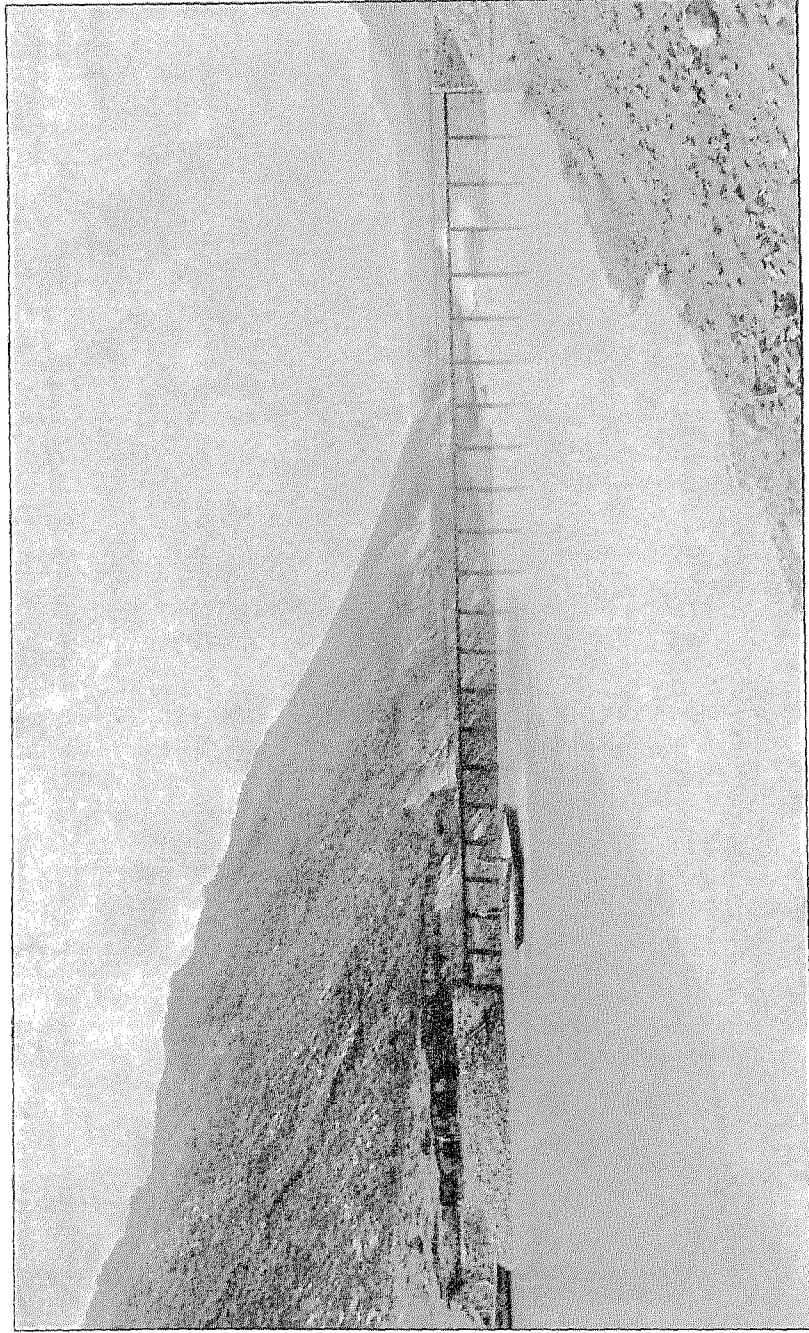
DISCHARGE OF BEAR RIVER AT BATTLE CREEK, IDAHO.

(Drainage area, 4,500 square miles.)

MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.		MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.	
	Maximum.	Minimum.	Mean.		Depth in inches.	Second-foot per square mile.		Maximum.	Minimum.	Mean.		Depth in inches.	Second-foot per square mile.
1889.							1891.						
October 11 to 31..	430	300	355	21,832	0.09	0.07	June.....	2,370	1,660	2,245	133,578	0.56	0.50
November.....	820	430	487	28,976	0.12	0.11	July.....	1,660	990	1,288	79,213	0.33	0.20
December.....	735	350	565	34,747	0.14	0.13	August.....	980	780	835	51,352	0.21	0.10
1890.							1892.						
January.....	1,255	270	875	53,812	0.22	0.19	September.....	980	690	798	47,481	0.20	0.18
February.....	2,040	600	809	44,900	0.18	0.18	October.....	980	980	980	60,270	0.25	0.22
March.....	2,040	780	1,271	78,166	0.32	0.28	November.....	980	880	957	56,941	0.24	0.21
April.....	3,960	2,170	2,978	177,191	0.74	0.66	December.....	1,910	880	1,053	64,759	0.27	0.23
May.....	5,980	3,960	5,199	319,738	1.33	1.60	Per annum..	3,030	690	1,224	887,511	3.70	0.27
June.....	5,980	2,300	4,074	242,403	1.01	0.91	1892.						
July.....	2,170	1,200	1,532	97,293	0.40	0.35	January.....	800	800	800	49,200	0.21	0.18
August.....	1,200	880	1,000	61,500	0.26	0.22	February.....	880	780	855	49,102	0.20	0.19
September.....	880	780	843	50,158	0.21	0.19	March.....	1,540	880	1,304	80,196	0.33	0.20
October.....	880	780	854	52,521	0.22	0.19	April.....	2,040	1,540	1,824	108,528	0.45	0.41
November.....	880	780	783	46,588	0.19	0.17	May.....	4,370	2,040	2,710	166,005	0.69	0.60
December.....	780	690	748	46,002	0.19	0.17	June.....	5,260	3,200	4,446	204,537	1.10	0.99
Per annum..	5,980	270	1,751	1,270,272	5.27	0.42	July.....	3,200	1,540	2,345	144,217	0.60	0.52
1891.							1893.						
January.....	690	690	690	42,435	0.18	0.15	August.....	1,420	880	1,025	63,037	0.26	0.23
February.....	880	780	780	48,290	0.18	0.17	September.....	880	780	793	47,183	0.20	0.18
March.....	880	780	790	48,585	0.20	0.17	October.....	780	780	780	47,970	0.20	0.17
April.....	2,950	780	1,623	96,509	0.40	0.36	November.....	780	600	687	40,876	0.17	0.15
May.....	3,030	2,440	2,652	163,098	0.68	0.59	December.....	880	880	880	54,120	0.23	0.20
Per annum..	5,260	600	1,537	1,115,619	4.64	0.84							

Eleventh Census of the United States.

Irrigation.



VIEW OF BRUNEAU DAM AND CANAL, OWYHEE COUNTY, IDAHO

are often lost in the porous mass, to reappear probably as springs in the deeper valleys. The Bruneau is the principal river in the eastern end of the county. It rises in the mountains of Nevada north of the sources of the Humboldt river. This stream flows northward through deep canyons and furnishes a perennial supply, which can be used in irrigating the lower valleys. About 12 miles from the mouth of the river the canyon walls open, forming the Bruneau valley, which extends for about 8 miles, averaging 1 mile in width. The valley lands are very fertile, but are only irrigated to a small extent by a few farmers' ditches. The surrounding country is used as a winter range for sheep, herds aggregating thousands of sheep being kept there during the winter months. At the lower end of Bruneau valley the river enters a rocky canyon, through which it has an average fall of about 10 feet per mile.

The principal irrigation project is that of the Owyhee Land and Irrigation Company, organized for the purpose of bringing under irrigation a tract of about 60,000 acres lying on both sides of the Snake river, it being proposed to cross the river by means of a flume. This company has constructed a dam across Bruneau river about 1.5 miles above its mouth. ^(a) The dam, shown in the accompanying illustrations, consists of a rock filled foundation 25 feet high, 190 feet wide on bottom, and 180 feet from side to side of the canyon. Upon this foundation is a timber crib dam 176 feet long on the crest, terminating at each end in vertical masonry abutments. At the south side are the head gates of the canal, having an opening of 40 feet in width. From this point the canal follows the contours in a general westerly and northwesterly direction at a distance of from 1 to 2 miles south of the Snake river.

In the northwestern corner of the county are small mountain ranges, from which streams flow in all directions, those toward the north and east directly into the Snake, and those to the south and west into the Owyhee. The snow on these mountains melts early in the spring, and as a consequence the floods occur in April or May, some weeks earlier than in the high mountains farther to the east around the head waters of the Snake. The water begins to diminish early in the summer, and many of the streams are dry by the latter part of June or in July, so that occasionally when the grain is well headed out it is impossible to secure sufficient water to completely mature it. These mountains are among the largest gold and silver producing areas in the state, and as a consequence there is a good local market for agricultural produce. There are several small valleys among the mountains, the agricultural land being at an elevation of less than 5,000 feet. Among them may be mentioned Pleasant valley, on the head waters of Jordan creek, and opening toward the west into Oregon, the portion in that latter state being known as Jordan valley.

SHOSHONE COUNTY includes the high mountain region west of the Bitterroot mountains and east of Nez Perces, Latah, and Kootenai counties. It contains the head waters of the Clearwater and Cœur d'Alène rivers. It is a mining region, and also contains excellent grazing areas. For the most part it is heavily timbered, and what little farm produce is raised is successful without irrigation. At the altitude of the cultivated lands of the valleys there is sufficient rainfall to produce wheat, oats, timothy, and the ordinary vegetables. Summer frosts are apt to occur, and are of more injury than a scarcity of water.

WASHINGTON COUNTY is on the western side of Idaho, lying along the Snake river. It includes the drainage basin of the Weiser river and a very small part of the head waters of Little Salmon river, and also on the west the narrow strip of country draining into Snake river. Along the Weiser is a succession of valleys, in each of which agriculture has been gradually developed, mainly as an adjunct to stock raising. In the highest of these valleys fair crops are sometimes obtained without irrigation, but success is not always certain, and the yield is less than that on well irrigated land. Small ditches have been built by the farmers to bring the water of the tributaries of the Weiser, and in some cases that of the river itself, upon the lands adjacent to the stream, but most of these ditches are very small and poorly constructed, from the fact that the farmers are poor and have had little experience in handling water to the best advantage. In the lower part of the county near the Snake river are larger ditches built by associations, and there is also a canal from the Payette river, as mentioned in the description of Ada county, extending northerly into this county.

Many of the streams, especially those coming from the west into the Weiser, are dry in summer, and as a general thing the water supply throughout the county becomes scanty after the first of July. This was especially the case in the great drought of 1889. Along the bottom lands good crops are occasionally secured by means of the moisture which saturates the ground when the streams are high, but even on these lands during the recent droughts very little was raised. Water storage is believed to be a necessity, and the irrigators have discussed the matter and designated various places which might be used. One or two individuals have built small storage works, but the greater number of the irrigators have about exhausted their means in digging the small ditches. In this county large tracts have been taken up by men too poor to improve more than a small fraction of the land, but who are struggling along in the hope that either the government or some great corporation will construct irrigation works that will be of benefit to them.

As an example of the ditches, may be mentioned the Farmers ditch, in Council valley, taking water from the Weiser river, about 6 miles from Council valley post office, and bringing it out upon the east side. The length of

^a The discharge of the river at this point on June 1, 1892, was estimated from float gaugings to be 2,500 second-feet, this probably being the maximum for the year. It was also estimated from flood marks that the greatest known flood discharged at the rate of 7,000 second-feet.

this ditch is 6 miles, and its bottom width 4 feet. It is owned and is being completed by private parties, each share entitling the owner to 50 miner's inches. Farther down, in Indian valley, is the Indian Valley and Gray Creek ditch, taking water from the Little Weiser river and carrying it in a northwesterly direction. It is 7 miles long, 5 feet wide, cost \$1,350, and is owned by a corporation, each share entitling the owner to 100 miner's inches of water. The annual assessment per share for cleaning and repairing the ditch is \$8, and if the duty of water is 1 inch to the acre, the annual cost will thus be only 8 cents per acre. The stream occasionally dwindles in summer to a quantity so small that the shareholders can not always obtain as much as they wish. In fact, the farmers on all the smaller streams in this vicinity suffer more or less for want of water at critical times.

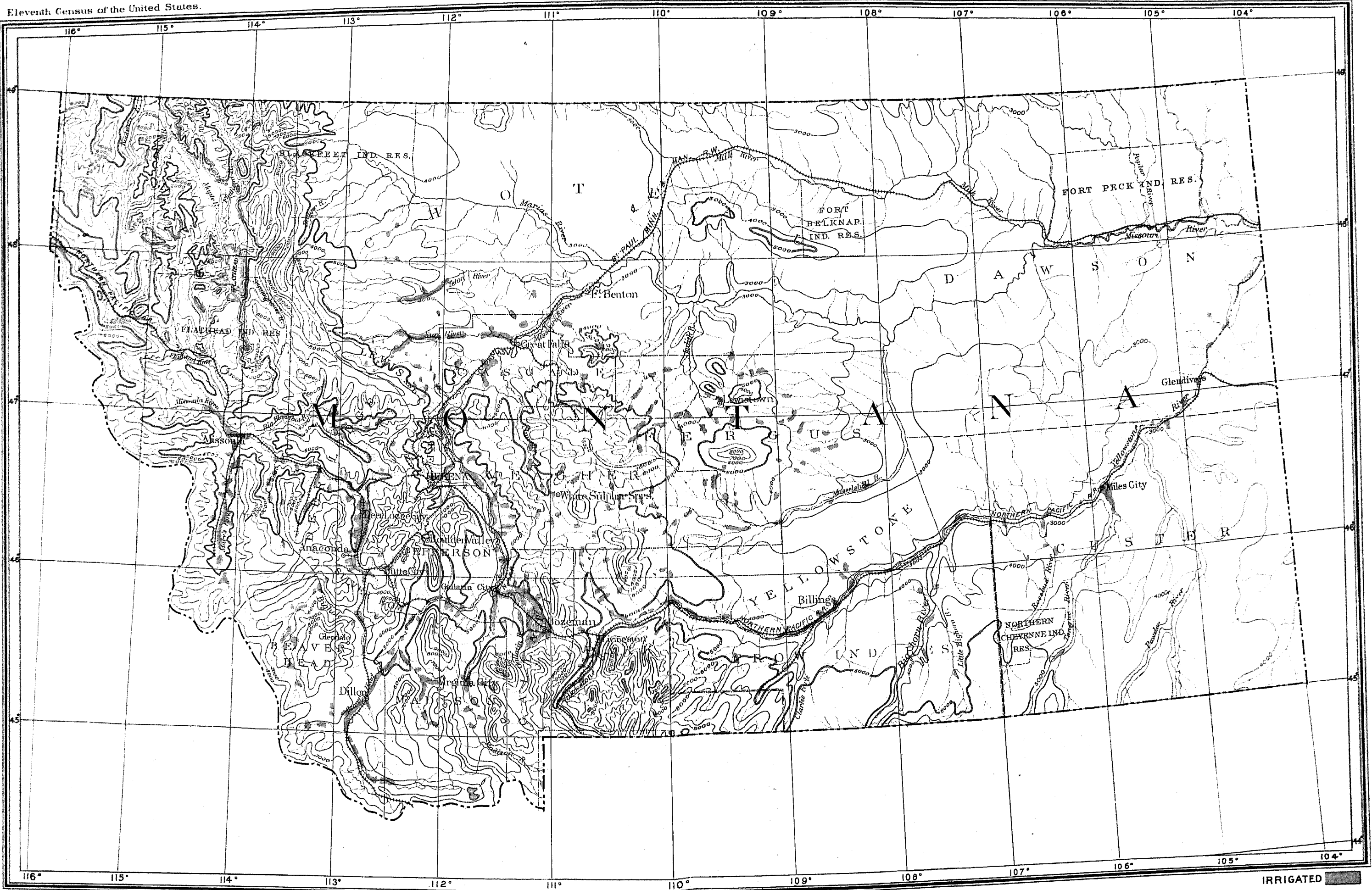
The Middle Valley Irrigation ditch takes water from the east side of the Weiser river, carrying it southward about 4 miles. Its average width is 8 feet, its capacity, approximately, 20 second-feet, and its cost, \$6,000. There is plenty of water in the river at this point, and no complaint of loss of crops. On Mann creek, in the southern end of the county, is a ditch taking water from the east side and carrying it a distance of 8 miles. The average width is 3 feet, and the cost about \$2,000. As an example of prior rights may be cited the case on this creek, different in no way from the conditions obtaining in other parts of the country. Here 8 ranches have prior rights, while other ranches, to the number of nearly 30, have secondary claims to the water. In time of drought these 8 ranches have the entire stream, while the others, equally good in every respect, must suffer. Measurements of the discharge of the Weiser river have been made by the United States Geological Survey at the mouth of the canyon, 9 miles above Weiser, and computations of daily discharge have been made. (a)

a As continued since 1890 the measurements cover a period of nearly two years:

DISCHARGE OF WEISER RIVER IN CANYON, IDAHO.

(Drainage area, 1,670 square miles.)

MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.		MONTHS.	DISCHARGE IN SECOND-FEET.			Total for month in acre-feet.	RUN-OFF.	
	Maxi- mum.	Mini- mum.	Mean.		Depth in inches.	Second- feet per square mile.		Maxi- mum.	Mini- mum.	Mean.		Depth in inches.	Second- feet per square mile.
1890.							1891.						
March 15 to 31 ..	11,220	1,550	5,773	355,630	3.99	3.45	January	320	190	202	17,958	0.20	0.17
April	7,920	2,470	4,792	285,124	3.20	2.87	February	1,860	320	678	37,629	0.42	0.41
May	7,060	2,610	4,882	300,243	3.37	2.92	March	9,300	1,010	2,855	175,582	1.97	1.74
June	2,470	1,280	1,792	104,624	1.20	1.07	April	2,220	1,260	1,777	105,731	1.26	1.06
July	1,130	220	590	36,285	0.41	0.35	May	1,640	1,010	1,331	81,856	0.93	0.80
August	100	100	138	8,487	0.09	0.08	June	1,010	500	703	41,828	0.47	0.42
September	140	80	103	6,128	0.07	0.06							
October	190	140	166	10,209	0.11	0.10							
November	400	160	222	13,209	0.15	0.13							
December	480	280	396	24,354	0.28	0.24							



MAP OF MONTANA SHOWING AREAS IRRIGATED IN 1889.

Source of Map: U.S. Geol. Surv. Geol. Surv. Map No. 1000.