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Oregon Agricultural Experiment Station.

CORVALLIS, OREGON.

Irrigation in Klamath County

Cooperative Irrigation Investigation with the Office of Experiment Stations, United States Department of Agriculture.

By F. L. KENT.

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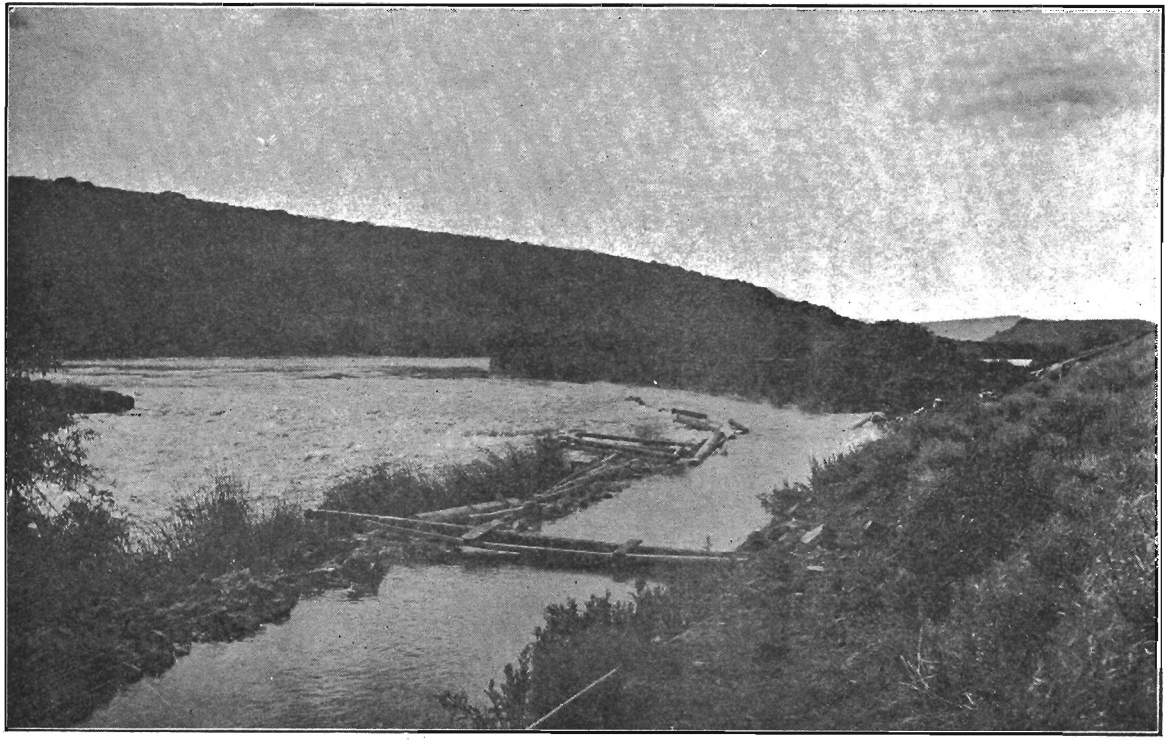


I. WING DAM AT INTAKE OF ANKENY CANAL.

INTRODUCTION.

Irrigation has been practiced in Klamath County for a considerable time, the property of the Klamath Falls Irrigation Company, commonly known as the Ankeny Ditch, having been built in 1884, and that of the Little Klamath Ditch Company, locally known as the Adams Ditch, having been built in 1885. Each of these systems have been enlarged to more than twice their original water carrying capacity. The first named system is now supplying water to about 4,000 acres, but could easily be enlarged to cover about 10,000 acres, which amount of land lies within easy reach. Under this system water is sold on the basis of $2.50 per California miner's inch, each user taking about one inch for every two acres. The water supply is taken directly from Klamath Lake, and distributed along about 16 miles of main ditch.

The Little Klamath Ditch Company (Adams Ditch) takes its water supply from Little Klamath Lake, by a channel recently cut through about four miles of tule growth discharging into White Lake, thence through a deep cut of about one mile into the Lost River valley. Here two branches about eight miles in length supply about 5,000 acres, on the south side of Lost River, while the greater portion of the water passing through the cut is flumed across Lost River, and distributed by means of two main ditches of about 32 miles total length, to about 8,000 acres. Under this system water is delivered to users at the rate of $1.50 per acre for the season. That portion of the water which is not flumed across Lost River belongs to a stock organization known as the Van Brimmer Ditch Company, which operates about as follows: There are about 5,000 acres under the ditch, each acre of which represents one share. On May 1st, 1903, when the ditch property was purchased from Van Brimmer Bros., the originators of the system, the sum of $5.00 per share was paid in for the purchase of the property. The cost of maintenance is to be assessed pro rata per share, and it is estimated that this item will amount to less than 25 cents annually, which assumption is warranted by the results of the past two growing seasons.

On Sprague River, the North Fork Irrigating Company and the Sprague River Irrigation Company each cover about 2,000 acres. These ditches are about twelve and eleven miles long respectively which lengths include the principal laterals. They are both stock concerns, the shares being held by the water users.

On Wood River Prairie, which lies northward of Klamath Lake, some 3,000 or 4,000 acres are irrigated from the mountain streams fed by the snows of Crater Lake Mountain (Mt. Mazama) and other high elevations. Here, as on Sprague River, the water is very cold

(54°F. observed at 2:00 p. m. July 7th) and is used mainly for the irrigation of wild grasses. It is doubtful if simpler irrigation engineering problems can be found anywhere than those of the Wood River prairie. The whole erea slopes uniformly toward the south with a fall of 3 to 5 feet per mile. Wood River and smaller streams have such very low banks that the water may he diverted at almost any point. The uniformity of the surface, and the ease with which the soil is worked, make it possible, as reported, with three horses on a plow, and six on a road machine, to construct between four and five miles of "surface ditch" in a day. And the system of applying the water is quite as simple. As one user expressed it, "there is no system; water is simply led out on the higher lands and allowed to flood those of a slightly lower level." The water is generally turned on to wild meadows about June 1st and left on from four to six weeks.

Under the Ankeny and Lost river systems, the principal crop grown is alfalfa, although wheat, oats and barley are largely grown. Alfalfa yields four to five tons of hay per acre per season, there being two cuttings. Wheat yields, per acre, 20 to 30 bushels; oats, 30 to 50 bushels and barley 40 to 60 bushels. Two, and sometimes three irrigations per season are applied to alfalfa; the first about May 15th, and the second about July 15th. Grain usually gets but one irrigation and that about June 15th to 30th. Irrigators estimate that about the same amount of water is applied at each of the aforementioned irrigations.

In addition to the systems already mentioned, considerable irrigation is done with the water of springs. The Griffeth and Bord water wheels on lost River each furnish sufficient water to irrigate 250 acres, and Mr. F. J. Bowne of Bonanza (upper Lost River Valley) has this year installed a steam pumping plant designed to supply water for the irrigation of about 1800 acres.

Climatic Conditions.—Some idea of the climatology of the region may be gained from the Weather Bureau reports as furnished by voluntary observer, Marion Hanks, near Klamath Falls, and set forth in the table below:

RAINFALL.

Year	Jan.	Feb.	Mch.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1901	5 30	1 85					T	T	1 63	.90	1.29	2.29	
1902	T	2.50	.50	1.17	.50	.00	T	1.75	.00	.85	79	3 20	11 26
1903	3.90	T	1.18	.20		1.93	.00					1.86	
1904	1.00	4.60	3.62		.45	75							

MONTHLY TEMPERATURE AVERAGES.

1901	25.2	31 3	37.6	43.7	54.8	57.2	68.1	70.0	54 6	51.9	40.8	32 6	47.3
1902	30.2	37.8	38.6	45.2	52.8	60.7	63.2	68.3	64.0	47.4	38.4	33.3	48.3
1903	31.6	26.8	37.8	45.8		63.4	65 1					33.8	
1904	37.2	30.8	33.3	47.2	58.0	59.0							

In the Wood River region the average temperature is somewhat lower and the precipitation somewhat greater than near Klamath Falls, while in the Lost River region the average temperature is higher and the annual precipitation rather less. The Sprague River section very closely resembles the Wood River region as to temperature and precipitation. The whole area is above an elevation of 4,200 feet, consequently summer frosts are quite liable to occur.

The work discussed below was carried on during the months of July and August. A very unusual rainfall during the first ten days of the month of July interfered with the work, as the Ankeny ditch was injured to such an extent that it supplied no water to users for more than a week. An unusual amount of spring rain delayed plant growth and threw the irrigating periods considerably later than usual. In fact the July rains furnished so much water that several growers deemed it unnecessary to irrigate their grain crops, hence it is probable that the duty of water as indicated by these investigations is higher than would ordinarily be the case.

Units of Measurement.—Three units of measurement are in common use in estimating the amount of water used in irrigation, viz: (1) the inch; (2) the cubic foot per second; and (3) the acre-foot or acre-inch. These units may be briefly defined as follows: The *inch* is the volume of water that will flow through an inch square opening under a specific and uniform pressure. The different pressure requirements of various state statutes cause a considerable variation in the quantity of water represented by the *inch*. The *cubic foot per second* or *second foot* as it is also called, is a discharge or flow of one cubic foot in one second of time, or the equivalent thereof. Since this unit is always a definite quantity, and is adapted to various methods of measurement, it is much to be preferred in accurate determinations, and is gradually displacing the inch as a unit of measurement. The *acre-foot* is the amount of water required to cover one acre of land to a depth of one foot. The *acre-inch*, sometimes used, is the one-twelfth part of the acre-foot.

In the discussion of the use of water which is to follow, the cubic foot per second has been taken as the basis of computation. In order that it may be readily converted into terms of the *inch*, and the *acre-foot*, the following equivalents are given:

One cubic foot per second	50 California inches
One " " in 24 hours	1.98 acre feet
Also:	
One " "	7½ gallons per second (nearly)
One " "	450 gallons per minute (nearly)

1. Losses on Adams Ditches.—(a) "Old ditch"; about 600 feet below Lost River flume; area of cross section, 16.09 square feet; velocity, 1.056 feet per second; discharge, 16.99 cubic feet per second. Measured at a point about 6 miles below; area of cross section, 12.4 square feet; velocity, 1.12 ft, per second; discharge 13.88 cubic feet per second. Add 1.37 cubic feet per second for amount being used, discharge is equivalent to 15.25 cubic feet per second or a loss by

evaporation and seepage in the 6 miles of 1.74 cubic feet per second equal to a percentage loss of 10.24 per cent The original survey of this ditch gives it a fall of 1.8 feet per mile.

(b) "New ditch", about 300 feet below Lost River flume; area of cross section, 41.65 square feet; velocity, .436 foot per second; discharge 18.16 cubic feet per second. Measured at a point about 8 miles below: Area of cross section 18.55 square feet; velocity, .856 foot per second; discharge, 15.88 cubic feet per second, which gives a loss in the 8 miles of 2.28 cubic feet per second or a percentage loss of 12.55 per cent.

This ditch is constructed on an average grade of .7 foot per mile but is not strictly uniform. Above determinations made on July 15 and 16 respectively.

2. Losses on Ankeny Ditch.—Measured about ¾ mile below headgate and about 200 feet below point at which water is taken out for power purposes. Discharge 43.41 cubic feet per second. Measured at a point about 6.5 miles below: Discharge 35.57 cubic feet per second; loss 5.84 cubic feet per second, or 13.5 per cent. These determinations were made in company with Mr. T. H. Humphreys of the Reclamation Service, using a Price current meter. This determination made about August 20.

Determinations made on August 9th by the use of rod floats gave results as follows: Area of cross section 200 feet below power plant, 23.1 square feet; velocity, 1.904 feet per second; discharge, 43.98 cubic feet per second. Area of cross section, about 6.5 miles below, 27.35 square feet; velocity, 1.33 feet per second; discharge 36.38 cubic feet per second. Add 2 cubic feet per second being used, discharge equivalent to 38.38 cubic feet per second, indicating a loss of 5.6 cubic feet per second, or a percentage loss of 12.73 per cent.

This ditch was built on a grade of 1.0 foot per mile for the distance above mentioned. The first mile follows a very rocky and in places, steep hillside, where much of the loss doubtless occurs.

3. Losses on Mitchell Lateral.—Aug. 9. Water measured over Cippoletti weir ½ mile from headgate; discharge, 3.92 cubic feet per second. Measured over rectangular weir, where used in field, about 1½ miles from Cippoletti weir; discharge, 3.12 cubic feet per second, being a loss of .8 cubic feet per second or a percentage of 20.4%.

For a large part of the distance between the weirs this lateral was overgrown with sweet clover, alfalfa, etc., while in other places occasional gopher holes allowed considerable water to escape. It doubtless represented as unfavorable conditions as would be found on any of the laterals of the Ankeny system.

4. Duty of Water on N. S. Merrill's 38.5 Acre Tract of Alfalfa.—July 24-28. In this case a regulation Cippoletti weir, with flume and Gurley water register were installed according to regulations prescribed in Irrigation Investigation Schedule No. 2, dated March 1, 1899. The weir had a three-foot crest and at no time did the water flowing over it reach a greater depth than six inches. Water was turned in at

9:00 A. M., July 24, and from 12:00 noon on July 24 to 12:00 noon on July 29 the depth over weir ranged from 4 to 4½ inches. From then until turned off at 5:00 P. M. on July 28, the depth ranged from 5¾ to 6 inches on weir crest. The total amount of water applied amounted to 20.0868 acre-feet or an average application over the entire 38.5 acres, of a depth of 6.27 inches. In the opinion of Mr. Merrill, who personally applied the water, this amount was about the usual quantity he has been in the habit of applying at each of the two irrigations annually given this area, for several years past.

The measuring weir was placed in the lateral about 200 yards from the main ditch, and about 200 yards below the weir the water was applied to the field. The checking system was used, and is the method generally followed among the water users of the Lost River systems.

5. Duty of Water on N. S. Merrill's 5.0 Acre Tract of Alfalfa.—July 28-July 30. In this case the water was as carefully measured as in the preceding instance, passing over the same weir, but instead of being applied about 200 yards below the weir it was conducted in the lateral about one mile before being applied. Then, too, at one point the water broke over the check levee, and a considerable amount ran onto other lands. Again, there was fully six inches of water in parts of some of the checks, 24 hours after the water was turned off. These facts indicate that the results are considerably higher than would normally be obtained. The weir measurements indicated that 8.768 acre-feet of water was applied, or an average depth of 1.753 feet. Considering the small area, and the large wastes this result is not considered of much value.

6. Duty of Water on Wm. Ball's 40 Acre Alfalfa Tract.—July 17-21. Owing to delay in getting water into the main ditch this field did not receive the irrigation which it naturally should have had about the middle of June, hence had received no water prior to that applied at the time the following determinations were made. The lateral was a new one, perfectly straight for a quarter of a mile, hence surface floats could be used to advantage. Results were as follows: Area of cross section, 3.528 square feet; velocity, 1.48 feet per second; time, 68 hours. Number acre-feet of water applied, 29.289, equivalent to a depth of 8.78 inches. Observations were made three to five times daily. A break in the lateral made it necessary to turn out the water for about 18 hours.

7. Duty of Water on Wm. Ball's 95 Acre Alfalfa Tract.—July 23-27. This may be considered as a normal field, having had the usual irrigation about June 15th. Water for the irrigation upon which observations were made was applied by two laterals which were designated A and B. The flow of water was practically constant from the time of turning on at 12:00 noon, July 23, to 8:00 A. M. July 25, at which time there was a fall of about 3 inches. This

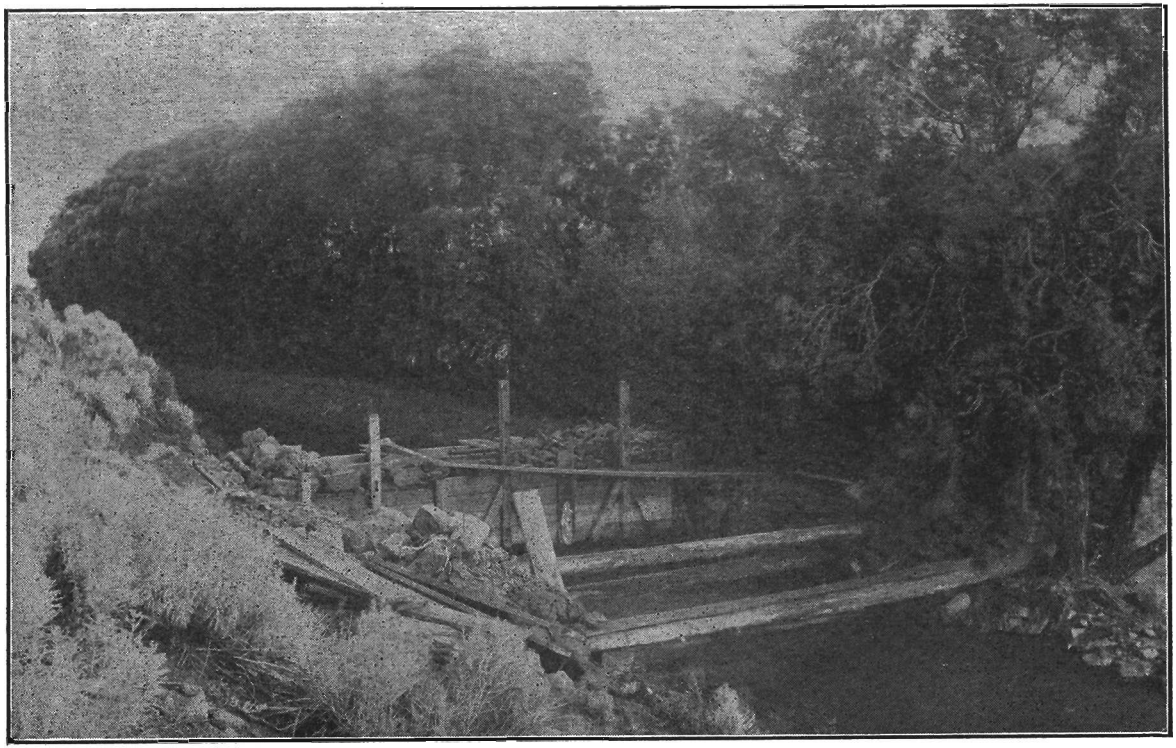
level was practically maintained for the remainder of the irrigation period. Results were as follows: Lateral A; area of cross section, 5.25 square feet; average velocity, .616 foot per second; time, 44 hours; discharge, 11.739 acre-feet. Also, area of cross section, 4.095 square feet; average velocity, .614 foot per second; time, 60 hours; discharge, 12.44 acre-feet. Total discharge for A 24.179 acre-feet. Lateral B. Area of cross section, 10.125 square feet; average velocity, .32 foot per second; time, 44 hours; discharge, 11.75 acre-feet. Also, area of cross section, 9.0 square feet; average velocity, .267 foot per second; time, 60 hours; discharge, 11.89 acre-feet. Total discharge for B, 23.65 acre-feet. Combined discharge of A and B, 47.829 acre-feet, equal to a depth of 6.048 inches over 95 acres.

In this case the area irrigated was nearly square, one side of which was bounded by the main ditch from which the water was taken. The slight fall made the use of a weir out of the question. This determination, as well as Nos. 4, 5 and 6 were made under the Adams system.

8. Duty of water on 118 Acre Alfalfa Field Owned by Ankeny & Cantrell (free flooding). August 8-11. Measured with rectangular weirs without end contractions. Irrigated from two laterals, A, delivering 17.009 acre-feet, and B, delivering 31.448 acre-feet. Total supplied by both laterals, 48.457 acre-feet. Applied to 118 acres is equivalent to a depth of 4.92 inches. The apparently high duty of water on this field is aided by three conditions, viz., large volume of water used; plants had made considerable growth since cutting, thus lessening evaporation; considerable drainage water from an adjoining field had spread over this one but four or five days previously. And further, some of the higher spots in the field received no water on their surface. That part of the field nearest the main ditch was about one-fourth mile distant.

9. Duty of Water on 110 Acre Alfalfa Field, Owned by Ankeny & Cantrell (check system).—August 14-18, measured with rectangular weir without end contractions. 54.2 acre-feet applied to 110 acres, equivalent to a depth of 5.92 inches. The lower duty of water in this case as compared with No. 8 is doubtless due to the following conditions: (1) The application was made about a week later; (2) comparatively little plant growth covered the field; (3) no drainage from other fields had occurred; (4) a more uniform application of water was made by reason of the land being "checked." The two fields laid side by side for the greater part of their length, and were each about the same distance from the main ditch. The field of No. 8 had a less uniform surface, and a slightly lower average level.

10. Comparison of Labor Required in Nos. 8 and 9, and Opinions as to Relative Merits of the Two Systems Used.—In No. 8 (free flooding) two men and a team were required for one day, plowing furrows and otherwise preparing ditches for the distribution of the water. The



III. HEADGATE ANKENY CANAL.

services of two men for five days were required to apply the water. And the days were very long and very arduous. Allowing $2.50 per day for each man, and $2.00 for the team, the cost of spreading the water on the 118 acres amounts to $32.00 or about 27 cents per acre.

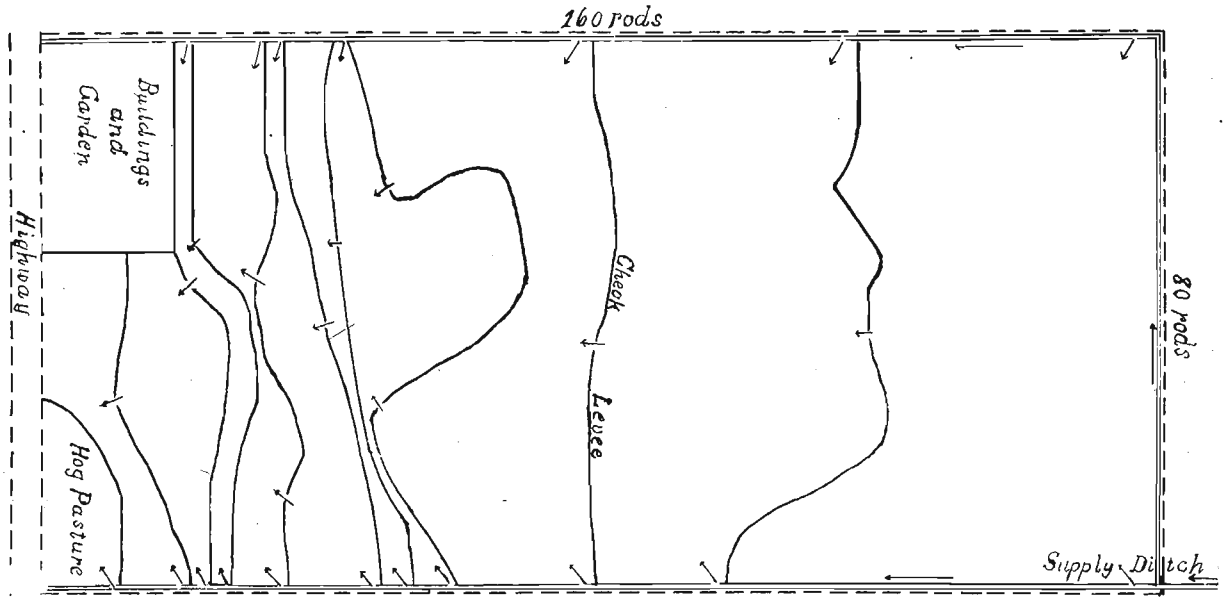
In No. 9 (check system) practically no preparation was required before turning on the water, and one man was easily able to attend to the handling of the water which required five days to supply the 110 acres. Making the same wage allowance as before, the cost would amount to $12.50 or a little more than 11 cents per acre.

The cost of preparing land for the application of the check system depends to a considerable extent upon the contour of the land. Mr. N. S. Merrill, who is a firm believer in the merits of the system, estimates that his checking has cost him about $10.00 per acre, but he has some land upon which the check levees are not more than one rod apart with a fall of one foot between checks.

Mr. J. F. Adams, who has superintended a large amount of check construction, says that one man with a "Fresno Buck Scraper," and a four-horse team can construct about one-fourth mile of checks per day for a three-inch fall, and such a working outfit is worth about $5.00 per day. On this basis, using as an example the 80 acre field of Mr. M. E. Robinson (a sketch of which accompanies this report), the cost of constructing the check levee would amount to about $60.00. The cost of locating the levees would probably amount to $20.00 additional, making the cost of putting in the checks about $80.00 or about $1.00 per acre in this particular case. This is an ideal field for the application of the checking system although there are other checked fields of equal area in the Lost River system which have a less amount of levee work. To the above estimate should be added the cost of putting in twenty gates, two for each levee, although in many cases canvas, manure or dirt dams are used in the laterals instead of gates. The manure or dirt dams are not to be recommended as they require too much labor.

A peculiar feature of the practice of water users under the Adams and the Ankeny ditches is their attitude toward the use or non-use of the checking system. Ankeny and Cantrell are practically the only users of checks under the Ankeny ditch, and they propose to decrease and perhaps eliminate their checked area, while practically all of the users under the Adams ditch follow the check method. The lands covered by these two ditches approach within less than ten miles of each other, and to a close observer there appears to be no particular difference in the character of the soils, except perhaps the presence of a little more sand, and and a trifle less clay in the region served by the Adams ditch.

11. Evaporation.—In the absence of a regular evaporation pan, a pan 13x9 inches, and 9 inches deep, enclosed in a wooden framework suitable for properly floating the pan, was placed in the



II. Eighty acre checked field of M. E. Robinson (Adams ditch system). Fall between checks, three inches. The arrows indicate inlets of water to checks. When applying water, temporary dams are placed in the supply ditches just below the inlets to the first check. When this check is properly filled, dams are placed at the inlets to the second check, and the first dams removed. This is repeated till all checks have been filled, each one except the first being partially supplied by the drainage from the check above. The long straight arrows indicate the direction of flow in the supply ditches.

Adams ditch on July 24 and filled to a depth of seven inches. The evaporation by seven-day periods was as follows: First period, 2.5 inches; second period, 3.125 inches; third period, 2.5 inches; fourth period, 2.0 inches; next three days, .875 inches. Total for 31 days, beginning July 24, 11.0 inches.

12. Collection of Samples of Soil and Irrigation Waters for Analysis.—(a) SOILS: Two samples of soil were taken to determine the effect upon the soil of the continued growing of alfalfa irrigated from the waters of the Adams ditch. The claim had been set up that the waters of this ditch carried a considerable amount of organic matter by reason of the water slowly passing through a considerable area of tule growth before reaching the ditch, hence its use would tend to build up the land irrigated therefrom. Sample A was taken from virgin soil which had never been irrigated. Sample B was taken from a field which had been growing alfalfa continuously for nine years, having grown just one grain crop prior to being seeded to alfalfa. The samples were taken about 150 feet apart and represented apparently exactly the same original soil conditions.

The results of the analyses are as follows:

	Sample A. (Virgin soil).	Sample B. (Nine years in alfalfa).
Potash, K_2O	.43 per cent.	.41 per cent.
Lime, CaO	1.56	.98
Magnesia, MgO	.11	.05
Phosphoric acid, P_2O_5	.19	.085
Nitrogen	.166	.177

(Determinations by F. E. Edwards, Oregon Agricultural College.)

These analyses indicate that the soil nitrogen is increased by the growing of alfalfa, under the irrigated conditions already described, but whether the increase in the nitrogen content is due to the character of the irrigation waters, or to the growing of the alfalfa on the land is not determinable in this case. The other essential elements of plant growth are seen to have considerably decreased.

(b) IRRIGATION WATERS: The waters of Lost River which are used at the F. J. Bowne pumping plant, come from a large number of springs. An analysis of this water with reference to its use both for boiler and irrigation purposes gave the following:

	Parts per million.	Grains per gallon.
NaCl	5.3	.31
Na_2SO_4	11.0	.64
Na_2CO_3	1.0	.06
K_2CO_3	3.7	.22
$MgCO_3$	93.0	5.43
$CaCO_3$	77.5	4.56
Fe_2O_3 } Al_2O_3 }	5.2	.30
SiO_2	22.9	2.24

(Determinations by F. E. Edwards, Oregon Experiment Station.)

The following analyses made by A. L. Knisely and F. E. Edwards of the Oregon Experiment Station, give an idea of the composition of the irrigating waters furnished by the Ankeny and the Adams ditches:

	Parts per Million.				
	1 Little Kl. Lake	2 Adams	3 Ankeny	4 Adams	5 Ankeny
Total solids (110°C)	307.0	467.0	128.0	369.6	174.4
Organic matter	76.0	93.0	.....	80.0	60.0
Silica (SiO_2)	34.0	16.0	37.0	46.0	40.0
Sodium chloride (NaCl)	50.9	75.4	50.9	23.0	12.5
Sodium carbonate (Na_2CO_3)	49.0	133.7	20.9	148.4	31.8
Sodium sulphate (Na_2SO_4)	10.5	5.5	5.5	35.5	42.5
Calcium carbonate ($CaCO_3$)	125.0	107.5	50.0	38.0	35.2
Magnesium carbonate ($MgCO_3$)	.....	21.7	.....	68.4	.....
Nitrogen (N)	8.4	9.3	6.2	2.6	2.1
Iron and alumina (Fe_2O_3+Al_2O_3)	.....	.....	----	.....	2.9

For grains per gallon use the divisor 17.12

Nos. 1, 2 and 3 are from samples taken in 1903, and 4 and 5, from samples taken in 1904. Nos. 2 and 4 were taken at practically the same points and season of the year, viz., about August 1st, at which time the ditches were carrying an average quantity of water and the same may be said of Nos. 3 and 5. No. 1 was taken for the purpose of determining whether any considerable change took place in the composition of the water used by the Adams ditch by reason of passing through the tule growth and White Lake. The results seem to indicate an increase in both organic matter and soluble salts, particularly sodium and magnesium carbonates.

Sodium chloride (common salt), and sodium carbonate (sal soda) are component parts of the so called "black alkali." Sodium sulphate (Glauber salts), and calcium carbonate (lime), enter into the composition of "white alkali." The above analyses indicate that the water from either of these sources would be considered perfectly safe for irrigation purposes.

13. Data Relative to Alfalfa Growing.—Several growers were interviewed under each of the two systems previously referred to, the results indicating that there was no essential difference in the methods followed under the two systems. In the matter of preparing the ground it is the practice to grow grain for two or more years after clearing away the sage brush, before sowing to alfalfa. The seeding is uniformly done with a drill, and as a rule no "nurse crop" is used. When such a crop is sown, barley seems to be preferred. 8 to 10 pounds of seed per acre is the amount usually sown, although one grower recommended 20 pounds, and another regarded 6 pounds, or even less, as being sufficient if it could be evenly applied. The time for seeding has quite a range, some preferring to sow early in April. Others consider June 1 to 15 as the proper season. One of the oldest and most successful growers says he has had excellent results from sowing during the latter part of February. If the seed is sown early, that is, prior to May 15, it will not as a rule require irrigation to start a vigorous growth. Two

irrigations are usually given the fields, but there is a growing sentiment in favor of three applications of water, and it is the opinion of the writer that the latter practice will soon become general. With three irrigations they would come about four weeks apart beginning usually about May 15.

The first cutting usually takes place about July 1, and yields 2 to 2½ tons of hay per acre. The second cutting usually takes place about September 15 and yields 1½ to 2 tons per acre. From four to six weeks fall pasture is usually obtained after the removal of the second cutting. The renewal of an alfalfa field is usually recommended after 7 to 9 years of growth, although some well cared for fields seemed to be in prime condition at 12 to 14 years of age. Treatment similar to that given new land is recommended before re-seeding to alfalfa.

In the opinion of some of the most successful growers, more damage is done by the use of too much water and imperfect drainage than from the use of too little water. Especially is this true under the checking system. It certainly does not take an experienced eye to see that there is much waste of water under each of the ditch systems which have been discussed.

SUMMARY.

The discussions in the foregoing pages seem to indicate:

1. That in the soils of the region considered the losses by seepage and evaporation are comparatively small, ranging between 10.24 per cent and 13.5 per cent in the three cases observed on main ditches.
2. That the percentage losses in laterals may be considerably greater than in the main ditches.
3. That the duty of water was rather high, a depth of only 4.92 to 6.27 inches being required to produce the desired moisture conditions for the second irrigation of alfalfa fields.
4. That the cost of applying water to checked fields, after the land is properly fitted, is less than one half the cost of application in free flooding.
5. That during the height of the growing season the evaporation from a water surface may amount to a depth of 11. inches in 31 days.
6. That chemical analyses show the waters of this region to be very desirable for irrigation purposes.
7. That while two irrigations are commonly given alfalfa fields each season, there is a growing tendency toward the use of three.

NOTE:—The writer desires to express his appreciation of the courteous treatment and liberal assistance given by the parties mentioned in this report, as well as by others in the vicinity.