I went to Colorado July 15, 1918, and took up with D. E. Carpenter the nature of the work which it was desired that I should do. Two lines of work were decided on - one, the securing of a personal knowledge of conditions along the South Platte below the mouth of the Cache la Poudre, and on the main Platte in Nebraska, in order to be able to testify as to these conditions; and, two, to compile all available information regarding conditions along the river, and regarding the ditches in Nebraska, particularly. The time put on the work was divided approximately evenly between these two lines of work.

For the purpose of obtaining personal knowledge of conditions along the rivers three trips were made, as follows:

July 31 to August 10, 1918 a party consisting of Delph E. Carpenter, Charles Colwell, R. G. Hoesa, R. P. Teele, Jr., and myself drove from Denver to Lincoln and return following the river from Denver to Grande Island, both going and coming.

August 14 to 26, 1918, a trip was made with R. G. Hoesa from Greeley to North Platte, measuring the discharge of the river at various places and the discharge of the canals taking water from the river in this section. The trip was continued alone to Lexington, Nebraska, to obtain information regarding ditches on the Platte River. I returned along the river as far as Ogallala, and returned to Denver.

September 9 to September 12, 1918 a trip was made with Delph E. Carpenter from Denver to Julesburg and return, principally for the purpose of looking over the lands brought under irrigation in recent years, to observe agricultural conditions and, particularly seepage conditions on these lands.
For the purpose of compiling information the following subjects were gone into:

1. The condition of the Platte and South Platte rivers before irrigation began, particularly with reference to low water and a dry river.

2. The history of irrigation development in both Colorado and Nebraska, with particular reference to the extent of use of water, priority of use, present use, and abandonment of use in Nebraska.

3. The water supply of the river both before and since irrigation began, with particular attention to the supply passing the Colorado-Nebraska line for use in Nebraska.

4. Return seepage to the river in Colorado, with reference to its effect on the past and future supply of water for Nebraska.

It is not the purpose to present in this report the data collected but rather to give an account of what was done and the impression gained. It seems better to combine all data collected by myself and others in a single report, by subjects, so that everything available on any point may be brought together for digesting and for ready reference. Everything has been considered from the standpoint of its bearing on the litigation now pending between the Western Irrigation District and alleged later appropriators in Colorado, and on possible future litigation between users of water from the South Platte in Colorado and users from the South Platte and Platte rivers in Nebraska.

The report on conditions on the South Platte prepared by myself in 1904, was taken as a starting point and it seems best to refer to the conclusions reached in that report, on the several points set out above as an introduction to the report of what has been done in the present investigation.

1. Condition of Platte and South Platte Rivers Before Irrigation Began.

In my previous report I presented a summary of such published reports of early travels and explorations along the Platte and South Platte as I was
then able to get, and also statements from living witnesses, as to conditions as they had observed them. (O. S. S. Bul. 157, pp. 43-46.) After giving the statements of these individuals, and analyzing them, I gave this as my conclusion: (p. 47.)

"It seems from these statements that there can be no question that from the time of the earliest travelers the river has been dry during the summer, in some years, at least, and that it has been very low in the late summer, and that in the summers of 1862 to 1866, before there were enough diversions in Colorado to have any effect upon the flow of the stream, the river went dry. In the early seventies, before the construction of most of the large canals in Colorado, there was another series of years when the river was dry. Since the building of the large canals in Colorado and the irrigation of large areas of land - that is, since 1865 and 1866 - the river is said to have gone dry practically every year."

"The fact that there never has been and are not now any irrigating ditches of any considerable size along the section of the river immediately above the state line and between that point and the junction of the branches of the Platte would also point to the conclusion that there never has been any reliable supply of water in this section of the South Platte River."

On the point under discussion, I have gone over a great many more published and unpublished accounts of travels, and many more personal statements have been collected.

Government reports of military expeditions, exploration, etc., in the state library in Denver, and the Denver public library were searched, and much material was collected. The same is true of the library of the University of Nebraska, at Lincoln.

I visited the Salt Lake public library and found there some reports of travels not found elsewhere. In the library of the Mormon Church access was obtained to unpublished journals of Mormon emigrants who followed the Platte in the late forties and early fifties.

In the Bancroft Library of Pacific Coast History, at the University of California, were found both published and unpublished journals of persons crossing the plains from the forties to the sixties.

Searches were made in the public library of Portland, Oregon, and the library of the Oregon Historical Society in Portland. In the latter library
I found several journals of parties who came up the Platte in the thirties.

Some effort was made to locate unpublished journals of travels on
the plains in the Library of Congress in Washington, D. C.

The searches in Salt Lake, Utah; Berkeley, Calif.; Portland, Oregon;
and Washington, D. C., were made when I was in those cities on other business,
and not on trips made at the expense of the Colorado parties.

While much additional material was accumulated, this will not modify
in any way but will corroborate and strengthen the conclusion previously reached
that "from the time of the earliest travelers the river has gone dry during the
summer, in some years at least, and that it has always been very low in late
summer".

One of the most striking statements found, in fiction, however, is
contained in J. Fenimore Cooper's book "The Prairie", written in 1827, showing
the reputation of the Platte at that early date. Cooper puts into the mouth
of one of his characters, "Old Trapper", these words, in reply to a question
as to whether the Platte, apparently in the vicinity of Kearney, was too deep
to ford; "When the mountains above feed it with their torrents, it is, as you
see, a swift and powerful stream. Yet have I crossed its sandy bed in my time,
without wetting a knee". (Chap. XXIV.)

After some of the party referred to had crossed the river this
dialogue takes place:

"'What may be the distance to the sources of this stream?' demanded Dr. Battins, whose eyes were rolling over the whirling eddies of the current,
with a very portentous expression of doubt. 'At what distance may its secret
springs be found?'"

"'That may be as the weather proves. I warrant me your legs would
be a-weary before you had followed its bed into the Rocky Mountains; but then
there are seasons when it might be done without wetting a foot.'"

"'And in what particular divisions of the year do these periodical
seasons occur?'"
"He that passes this spot a few months from this time will find that foaming water course a desert of drifting sand."

(Chapter I, p. 4, says: "many long and dreary miles in their rear, formed the swift and turbid waters of La Platte" showing that they had gone up that stream. See also Ch. XX, p. 245 for evidence that the stream mentioned was the Platte.)

While this is fiction, it indicates the reputation which the Platte had at that early date.

On the basis of a recognition of riparian rights in Nebraska, this showing would seem to be conclusive. The ownership of riparian land gives its owner no more than a right to have the river continue to flow as it "was wont to flow". The testimony collected shows conclusively that in the section of the river from the state line to the junction there never has been a reliable flow, that the river has gone dry in many years and has been extremely low every year. Under these conditions it will be practically impossible for a riparian proprietor along this section of the river to prove that any damage which he may suffer from shortage of water is due to the diversion of the water in Colorado.

The decision of the United States Supreme Court in the Kansas-Colorado case was based on an "equitable division" of the benefits from the use of the river water. The above showing seems to indicate that on the basis of an equitable division of benefits Nebraska could not claim the right to a better supply than she had in a state of nature, although all the records indicate that she has now, in fact, a better supply than before irrigation began.

2. History of Irrigation Development.

The suit of the Western Irrigation District is based on a recognition of priorities regardless of state lines, and the history of irrigation development in the two states may be predicated on the dates and amounts of water rights as determined by the courts in Colorado and the State Board of Irrigation in Nebraska. These were tabulated in my previous report, on the basis
of decrees rendered up to that time. On page 38 of that report the rights
to water from the South Platte in both states are given. This table shows that
the earliest rights to water from this stream in Nebraska is dated 1894, and
that prior to that date rights to 27,670.74 second feet had been acquired in
Colorado, and that rights to 2,691.40 second feet had been acquired in districts
1 and 64 in Colorado, the two districts next above the state line.

The right of the Western Irrigation District, is to 180 second feet,
dated June 14, 1897. Prior to this date there were in Colorado rights to
28,746.60 second feet and in Nebraska 301.93 second feet, and in districts 1
and 64 in Colorado there were rights to 3,273.40 second feet. These rights, if
fully exercised, would much more than exhaust the stream, except in flood
period, so that the Western District could not expect water at any other period.
The records of this district and the testimony of parties connected with the
organization of the district and the building of its canal indicate that, in
fact, the promoters of the district did not expect to get water except at
flood time. However, the suit is brought not against prior appropriators
in Colorado, but against junior appropriators, of which there are many.

In fact, the largest development on the lower part of the South
Platte in Colorado has taken place since the building of the Western District
Canal. This new development, however, depends very largely upon storage, which
takes place principally in winter, when Nebraska has no use for the water, and
in the flood season, when there is water enough for all. Speaking generally,
these later appropriators get no water from the stream when the Western Dis-
trict is entitled to any, because there are enough earlier rights in Colorado
to take all the water. It may have happened that at certain times some one of
these later appropriators may have taken water which should have gone to the
Western District. Tabulations to show whether this is the case, so far as it is possible to show it from existing records, are being made in the office of the State Engineer of Colorado.

Considered as a whole, there is no doubt that these later appropriations in Colorado would be of great benefit to the Nebraska canals if they had use for the water. These junior rights, which depend primarily on the storage of water that if not stored would flow unused down the stream, supply water to lands along that part of the South Platte in Colorado which is nearest the Nebraska line, and thus supply water to the stream in that section by return seepage at seasons when the river is naturally low or dry. Much of the land to be supplied by stored water is not yet irrigated, and that which is has been watered only a few years, so that the full effect of this use on the return to the stream is not yet felt. During the summer of 1918 I went over much of this land observing particularly the evidences of seepage. The land under the Riverside and North Sterling systems, particularly, is of a rolling topography that will tend toward a rapid return of surplus water to the stream.

While Colorado has shown such great progress in the storage and use of water on that part of the South Platte just above the Nebraska line, the history of irrigation below the line in Nebraska has been one of retrogression and failure to take advantage of natural opportunities.

The years from 1893 to 1897 were years of drought in the whole state of Nebraska, and during that period there was a great boom in irrigation construction in Nebraska. The greatest activity was in the section of the main Platte immediately below the junction of North and South branches, but the interest spread up the South Platte to the Colorado line. Prior to this time many canals had been built on the North Platte, but only two rights, and these both power rights, were acquired on the main stream prior to 1894, and on the South Platte no rights antedate 1894. The report of the Nebraska State Engineer for 1914
shows rights to 4,730 second feet of water from the main Platte initiated in
the years 1894 and 1895 by eighteen enterprises. On the basis of one second
foot to 70 acres, the legal limit in Nebraska, this would provide for the ir-
rigation of 305,900 acres. Only two rights initiated since that date are
shown and these provide for the irrigation of only about 4,000 acres.

I visited this section of the river on August 3, on August 6, and
8, and again on August 24 to 26, 1918, and found the following conditions:

Farmers Canal.

The Farmer's Canal, on the south side of the river not far below
North Platte is given by the reports of the State Engineer of Nebraska as
having a right to 280 second feet dated June 2, 1894 to supply water to
19,600 acres. On August 24, 1918 I interviewed the cashier of the First
National Bank of North Platte, Nebraska, regarding this canal. He informed
me that the Company controlling this canal had been defunct for many years,
and that the canal never had been finished. He stated that T. S. Blum, whose
address is Brady Island, was formerly treasurer of this company, and kept the
accounts of the company with the First National Bank of North Platte, but
this was about twenty years ago. On August 3, the party consisting of Mr.
Carpenter, Mr. Colwell, Mr. Hosea and myself crossed their old canal at several
places. We crossed it about 14 miles from the North Platte bridge over the
South Platte. At this point the road was graded across the canal, farmers were
cultivating right through the bed of the canal, and a large cottonwood tree
growing in the bed of the canal was observed. We crossed it again about a mile
east of the Plainview Cemetery. There were wheat shocks in the canal and corn
rows extended right through it. At the corner about one-half mile south of the
National Cemetery a section of the canal apparently had not been excavated, and
we learned afterward that this was the case.
On the evening of August 8, 1916, I got in conversation with the County Road Supervisor of Lincoln County, Nebraska, in North Platte. He stated that the canal had been excavated across or around the military reservation and later filled in. He stated that the farmers had plowed in parts of it, and that the canal failed because the farmers got to fighting among themselves. We crossed this canal again about 22 miles from North Platte, by the speedometer, and found both banks cut through and the road graded across the canal. It is very evident that this canal had not been used for years if ever, and the fact that it never was used seems to be unquestionable. Notwithstanding this the right to 280 second feet still stands as good on the records of the State Engineer of Nebraska.

Kearney Canal.

The Kearney Water and Electric Power Company is given as having a right to 125 second feet for irrigation and power purposes, or sufficient to irrigate 8,550 acres, dated September 1, 1866. On August 8, 1916, the same party mentioned above visited this power plant and canal. We found the canal taking water, the power plant running, and some water being used. We visited the head of the canal, or an auxiliary canal at the Platte River bridge south of Elm Creek station. The main heading is about a mile east of this point. At the north end of this bridge a canal has been excavated below the level of the river and water is taken into this canal by seepage and by means of a 30-inch siphon. While we were looking at this canal and siphon, the headgate man came up and gave us the following information. He said that there was an effective head of eleven feet on the siphon and that its capacity is 65 second feet; that this canal got about 33 second feet from seepage or underflow from the river. The headgate man estimated the discharge of the river at the bridge at 2,500 second feet, but said that they were unable to get 120 second feet into the canal, because their sand dam for diverting the water into the canal was washed out in places. He said that...
washed out in places. He said that the canal was supplying water to 3,500 acres, and that the company let the farmers have all the water they wanted, and used steam for power when there was not enough water for both irrigation and power. The situation here is that 32 years after the date of the right of this canal, it is irrigating less than one-half the area covered by rights in a season when crops were suffering for water and twenty times as much water as the canal was entitled to was flowing by its headgate unused.

Gothenburg Canal.

The Gothenburg Power and Irrigation Company is shown in the State Engineer's Report to have a right for power and irrigation to 200 second feet dating July 5, 1890, and a further right to 240 second feet dating September 22, 1894, for irrigation. This canal is so situated that water used for power can be used for irrigation so that its rights would provide for the irrigation of 30,000 acres. This canal has been in use continuously since it was built, but in 1917, that is 27 years after it was built, it watered 7,172 acres, or less than one-fourth of the acreage covered by its rights. On August 26, 1918, I visited the office of this canal, in Gothenburg, and obtained the above statement of acreage irrigated from Mr. W. T. Byron, who manages the canal. He stated also that the water supply had been sufficient for the last three years, and that this improvement in the river was due to storage in the Pathfinder Reservoir, and to the manner in which the river is controlled by Mr. Weise of the Reclamation Service. He stated that the Gothenburg Company never had depended on the South Platte for water as that stream did not supply any water when it was needed.

There was always plenty of water in the river when there was any in the South Platte. On this canal, then the situation is that after 27 years of effort, in a season when there was plenty of water in the river, and a marked deficiency of rainfall this canal is supplying less than one-fourth of the land covered by its rights.
The Farmers’ & Merchants’ Canal, which heads on the north side of the Platte, south of the town of Cozad is shown by the State Engineer’s report for 1914, to have a right to 1,142.86 second feet, dated June 26, 1894. This canal has been used to some extent continuously since that date. This right provides for the irrigation of 60,000 acres. On August 24, 1918, in Lexington, Nebraska, I visited the office of the Dawson County Irrigation Company, which was organized in 1913 and took over the Farmers’ and Merchants’ Canal. I interviewed the president, Mr. Roy Stuckey, who is also president of the Lexington State Bank.

Mr. Stuckey stated that the canal supplied water to 12,000 acres in 1917, and 20,000 acres in 1918. He stated that the ditch was getting water from the Pathfinder Reservoir, but there seems to be some difference of opinion as to this. He said that if they could continue to get summer water as they did in 1916 the ditch and the farmers would both succeed, but he did not feel very sure about this and was/pushing the sale of water rights; that farming in that section without irrigation means half crops; that farmers in that section are now appreciating the value of irrigation, and he expects to see a large increase in the acreage irrigated. He said that his company had a right to eleven hundred second feet of water from the river, but had not used over two hundred second feet and he supposed that their right would be cut down by the state board of irrigation to the amount required for the land to which the company is supplying water.

Mr. Stuckey stated that his canal was supplying water to land shown on the State Engineer’s map as lying under the Platte Valley Canal, between Lexington and the river, but that they had never received a permit for supplying this land. Mr. F. H. Scott who lives on land under the Platte Valley Canal told me the same thing regarding the irrigation of this land by the Farmers’ and Merchants’ Canal.

On August 26, 1918, I visited the head of the Farmers’ and Merchants’ Canal, south of Cozad. The headgate structure is of steel and concrete with
flashboards. There are twelve openings, five feet wide. The river had washed around the upper end of this structure, and this opening had been closed with boards. There were gates in the river channel at the head of the ditch with nine four-foot openings. At the time I visited it flashboards in these openings were holding the water up about two feet. A sand dam extended across a few river channels but not across the larger river channels. There was a large flow in the river, going past the head of this canal. There was a hydraulic dredge in the canal at the head for use in pumping water out of the canal. This was not operating when I visited it.

I had crossed this canal in several places on August 3, 1918, and found it carrying water. I crossed it again on August 6, 1918, south east of Lexington, and found several laterals supplying water to lands shown by the State Engineer's maps as supplied by the Platte Valley Canal. This confirms what was later told me by Mr. Stuckey and Mr. Scott, at Lexington. We (Carpenter, Colwell, Moses and Teels) crossed the main canal near its head on the same day, and found it carrying water.

From all information available this canal seems to have been used to some extent continuously since it was built in the nineties, but after 24 years is supplying water to only one-fourth of the land covered by its rights, and, according to its president, had never used more than 200 second feet of water, or less than one-fifth of its alleged appropriation. However, the company was reorganized in 1913, and the use of water was increasing. The president of this company, like the manager of the Gothenburg Canal, credited the water available to the U.S. Reclamation Service, and gave no indication of any belief that his canal was dependent in any way on the South Platte.
Maxwell Canal

The Maxwell Canal is shown by the same report of the Nebraska engineer to have a right of 27.14 second feet, dated July 5, 1894. In company with Mr. Carpenter, Colwell, and Hosea, I crossed this canal on August 8, 1918, south of Willow Island station on the Union Pacific. The canal was dry, and full of weeds, but looked as if it could be used, but had not been for some time.

Farmers Union Canal.

The Farmers Union Canal is given as having a right to 128.57 second feet, or sufficient water for 9,000 acres, dated August 10, 1894. On August 3, 1918, in company with Carpenter, Colwell, and Hosea, I crossed this canal on the Lincoln Highway, 16 miles west of Kearney (according to the signs along the highway). The canal line crosses the highway diagonally at the cross roads at the northeast corner of section 25, Township 9N, Range 19W. The canal had evidently been abandoned and was graded in at the highway and in the field to the south.

Platte Valley Canal.

The Platte Valley Canal is reported as having a right to 400 second feet, giving it a right to water 26,000 acres, dated September 15, 1894. This canal covered land southeast, and west and east of Lexington. I visited this section alone August 24 and 25, 1918. Mr. Roy Stuecky, president of the Lexington State Bank, told me that the canal had been abandoned many years and that the Farmers' and Merchants' Canal was now irrigating this land. On August 25, I interviewed Mr. F. H. Scott, of Lexington, regarding this canal. Mr. Scott stated that it was a natural channel which drained a large section, but had formerly been used for irrigation. This channel runs between Mr. Scott's house and his barns, crosses the main road running to the bridge south of Lexington,
and is bridged there. Mr. Scott stated that this channel carried drainage water a large part of the time; that it ran continuously in 1917, but not in 1918. He stated, as Mr. Stuckey had done, that the canal was now not used for irrigation, and that the land under it was supplied by the Farmers' and Merchants' canal. There seems to be no question that this canal has been abandoned for many years.

**Farmers Canal.**

No trace of the Farmers Canal, in Buffalo County, which is given in the Nebraska engineer's report as having a right to 160 second feet, or to water for 12,600 acres, dated September 24, 1894 was seen. Consequently I can say nothing of this canal. The same report of the engineer (p. 131) gives the cost of this canal as $15,000, and the acreage under it as 2,500 acres, but makes no mention of its having been used.

**McCullough Ditch.**

The McCullough Ditch, in Lincoln County, is given as having a right to 30 second feet, or enough for 2,100 acres, dated October 20, 1894, is not mentioned in the report of irrigation in Nebraska in the State Engineer's Report of Nebraska 1913-14, and this canal was not seen in any of the trips along the river.

**Six Mile Ditch.**

The Six Mile Ditch, in Lincoln County, is shown as having a right to 40 second feet, enough for 2,800 acres, dated October 22, 1894. On August 3, we (Colwell, Carpenter and Hosea) crossed the Six Mile Ditch near the southeast corner of Section 20, Township 11 N., Range 25W. It was carrying water estimated at 5 or 6 second feet. On August 26, 1918, in Gothenburg I called on the secretary of the Six Mile Ditch Company, Mr. Don F. Hinkley, who runs a drug
store in Gothenburg. Mr. Hinkley stated that this ditch was built about 20 years ago, was used for a short time and practically abandoned for about seven years, and that the present company had been operating it for eight years. The ditch is now irrigating about 1,400 acres; the exact acreage having been reported to the state engineer each year. He stated that the canal was practically abandoned before the new company took it. This canal seems to have been used sufficiently to prevent the loss of rights by abandonment, but after twenty years is irrigating only one-half the area for which it holds rights.

Gothenburg South Side Canal.

The Gothenburg South Side Canal, is shown as having a right to 357.16 second feet, enough for 25,000 acres, dated October 25, 1894. On August 3, 1916, in company with Carpenter, Colwell, and Hoxea, I crossed this canal line at several points. At the northeast corner of Section 8, Township 11N., Range 26W, the road is graded right through the ditch. There was a heavy growth of weeds in the canal on one side of the road, and corn rows extended across it on the other side. There were cottonwood trees about a foot in diameter in the canal a little way east of the road crossing. The road is graded right through the canal in the northeast quarter of Section 16 of the same township and range on the north and south road, and the same condition exists on the east line of Section 22 and on the south line of Section 23 just west of the concrete block church.

On August 6, 1916, in Lincoln, Nebraska, I called on A. G. Wolfenbarger, who now owns the Gothenburg South Side Canal, having taken it under foreclosure. He said that some parties were now (1916) trying to revive this enterprise. He admitted that the roads were graded across the canal, and that farmers had plowed it in, but said that only a few farmers would stand in the way of opening up the ditch. He said they were trying to get the farmers to buy water rights at $10 per acre to get funds to put the ditch in condition for use.

-15-
He stated that the original ditch cost $40,000; that after spending this the farmers refused to raise $1,600 to meet a bill for excavating machinery; that he bought this claim under an agreement with the farmers to pay him, but after he bought it the farmers refused to pay him and he came into possession of the ditch. He now claims to own the right of way and the ditch.

On August 26, 1916, I discussed the proposed revival of the Gothenburg South Side Canal with Mr. W. T. Byron, manager of the Gothenburg and Cogad Canals, in Gothenburg. He was of the opinion that the Nebraska State Board of Irrigation would permit of the reviving of the old rights of the canal, as the board was inclined to be lenient in such matters, to encourage development. He stated that the neighboring canals, which might object, were prior to the old South Side, and consequently had no grounds for objection. He doubted whether the efforts being made to revive this canal would be successful, as too many of the farmers under it did not wish to get water.

On the same day I discussed this canal with Don F. Hinkley of Gothenburg; Mr. Hinkley was much interested in the proposed revival of the ditch. Former State Engineer Donald D. Price and Mr. Carroll, who run a lumber yard and mill in Gothenburg were interested in it with him. Mr. Hinkley stated that the farmers under the canal are about evenly divided on the question of rebuilding the canal and that this situation prevents the forming of an irrigation district to do the rebuilding. Mr. Hinkley and Mr. Edwards, the engineer of the Gothenburg Canal, had made estimates of the cost four years ago. He stated that a considerable part of the old canal is above grade; that this is the case about two miles below the head where the canal was eighteen inches to two feet too high to get water from the river.

It appears, therefore, that this canal, with a right to water for 25,000 acres, dated in 1894, was never completed, and never used, but that an effort was being made in 1918 to open up and use the canal, on the old rights
acquired 24 years previously.

Booker Canal.

The Booker Canal, in Dawson County, is given as having a right to 100 second feet, enough for 7,000 acres, dated November 9, 1894. This same report (p. 131) gives the area under this ditch as 300 acres, and gives no record of the ditch having been used at any time. I saw nothing of this canal.

Cozad Canal.

The Cozad Canal is given as having a right to 614.29 second feet, or water for 43,000 acres, dated December 28, 1894. This canal has been in use to some extent since it was built. We crossed it August 3, 1916, and found it carrying water. Mr. W. T. Byron, of Gothenburg, manages this canal and the Gothenburg Canal. The Cozad Canal is so located that it can take the waste water from the Gothenburg power plant. This plant ordinarily uses about 200 second feet for water and discharges it into the Cozad Canal. In 1917, the Cozad Canal irrigated 5,499 acres, that is, twenty-three years after its beginning it was watering less than one-eighth of the acreage for which it was given a right.

Orchard and Alfalfa Canal.

The Orchard & Alfalfa Irrigation Company, is given as having a right to 300 second feet, for 21,000 acres, dated January 23, 1895. The same report (p. 131) gives the canal as covering 15,000 acres, and as having been last used in 1906. On August 16, 1916, in company with Carpenter, Colwell, and Hosea, I crossed this canal at the southwest corner of Section 5, Township 9N, Range 23W, just in front of the school house of District No. 66, Ringgold School. The ditch was carrying water at this point, estimated at 35 or 40 second feet. The ditch stops at the road between sections 5 and 8, in this township, and between
the two points mentioned wastes back to the river.

On August 26, 1918, I went to Cozad, and went south of the river to interview George M. Dillon, who runs the Orchard and Alfalfa Ditch. Mr. Dillon said that the company now controlling this ditch was organized four years ago to open up the old ditch. The company is composed of farmers, and is a corporation with the stock owned by the farmers. The company is run to pay expenses and not to make any money as a company. The promoters of the new organization supposed that the right of the old company had lapsed, and they made a new filing with the State Board of Irrigation. The Board, however, told them that the old right was still alive, or could be revived, and they secured a transfer of this old right and are operating under that. The old headworks were gone and much of the ditch had been graded in, and the right-of-way had reverted. The new company purchased the old rights, some land near the head of the ditch that belonged to the old company, repurchased the right-of-way, and rebuilt the ditch, but did not carry the new ditch as far as the old ditch had extended. Mr. Dillon stated that they could get the remainder of the ditch and open it up whenever the farmers under it wanted to get water. The new ditch ends at about the south line of Section 5, Township 9N, Range 23W, and a waste ditch runs from this point to the river. Mr. Dillon stated also that the promoters of the new company had a great deal of trouble in getting it to go since they had no funds. Ten of the farmers interested borrowed $500 each to secure the necessary funds and these farmers and others did the work and took their pay in stock in the company. They tried to organize a district but there were too many opposed to it, so they organized a company of those who were favorable to it. The acreage irrigated by the new canal has been reported to the State Engineer each year, and can be obtained from his records, but I did not get it from Mr. Dillon. The most interesting
point regarding this ditch is the manner in which the State Board of Irrigation
not only permitted, but forced the revival of the rights of a canal which had
been absolutely abandoned, so that the right-of-way had reverted and had to be
repurchased. This confirms the opinion of Mr. Byron of the Gothenburg Canal
(see p. 16) that the State Board will be lenient in such matters, and permit
the revival of old rights to water which never was used, or which had been
abandoned for many years.

Lincoln and Dawson Counties District.

The Lincoln and Dawson Counties Irrigation District, is given a
right to 642.86 second feet, for 45,000 acres, dated February 22, 1895. This
canal was never built, although the right still stands on the records 24 years
after the original date.

Lexington South Side Canal.

The Lexington South Side Canal is reported as having a right to 56
second feet, for 4,000 acres, dated September 26, 1900. The report of the
Nebraska State Engineer, 1913-14, gives the year 1906, as the last in which
this canal was used. On August 25, 1916, I inspected the section covered by
this canal, and found the channel graded in many places, so that there can be
no question of its having been abandoned. On the west line of Section 23, Town-
ship , Range , about a quarter of a mile north from the corner of the
section, the road is graded in; on Section 22 the ditch is still visible, but
is full of weeds. On Section 23 it is entirely graded in.

There are a few small ditches shown on the map and in the report of
the State Engineer referred to (1913-14), not discussed here, and not investigat-
ed, but the present situation on the Platte River from North Platte to Kearney,
so far as it relates to the large enterprises, is summarized as follows:
IRRIGATION PLATTE RIVER, NEBRASKA, 1918.

<table>
<thead>
<tr>
<th>NAME</th>
<th>WATERS RIGHTS</th>
<th>ACREAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
<td>Second-Foot</td>
</tr>
<tr>
<td>Kearny Electric &amp; Power Co.</td>
<td>125.00</td>
<td>6,950</td>
</tr>
<tr>
<td>Gothenburg Power &amp; Irrigation Canal</td>
<td>200.00</td>
<td>14,000</td>
</tr>
<tr>
<td>Farmers Canal Lincoln County</td>
<td>260.00</td>
<td>19,600</td>
</tr>
<tr>
<td>Farmers &amp; Merchants Canal</td>
<td>1,142.86</td>
<td>60,000</td>
</tr>
<tr>
<td>Farmers Union Canal</td>
<td>128.57</td>
<td>9,000</td>
</tr>
<tr>
<td>Platte Valley Canal</td>
<td>400.00</td>
<td>28,000</td>
</tr>
<tr>
<td>Farmers Canal, Buffalo Co.</td>
<td>160.00</td>
<td>13,600</td>
</tr>
<tr>
<td>Six Mile Ditch</td>
<td>40.00</td>
<td>2,800</td>
</tr>
<tr>
<td>Gothenburg South Side</td>
<td>357.14</td>
<td>25,000</td>
</tr>
<tr>
<td>Cozad Canal</td>
<td>614.29</td>
<td>43,000</td>
</tr>
<tr>
<td>Orchard &amp; Alfalfa Canal</td>
<td>300.00</td>
<td>21,000</td>
</tr>
<tr>
<td>Lincoln &amp; Dawson Counties Irrigation District</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lexington South Side</td>
<td>58.00</td>
<td>4,000</td>
</tr>
<tr>
<td>Total prior to 1894</td>
<td>325.00</td>
<td>22,950</td>
</tr>
<tr>
<td>Total 1894</td>
<td>3,382.86</td>
<td>237,600</td>
</tr>
<tr>
<td>Total 1895</td>
<td>942.86</td>
<td>66,000</td>
</tr>
<tr>
<td>Total since 1895</td>
<td>58.00</td>
<td>4,000</td>
</tr>
<tr>
<td>Grand total</td>
<td>4,706.72</td>
<td>330,750</td>
</tr>
</tbody>
</table>

The table shows that of the 22,950 acres covered by rights dating prior to 1894, 3,500 acres were irrigated in 1918. That is, after about thirty years 15% of the land covered by these rights is irrigated.

Of the 237,600 acres, covered by rights dated in 1894, only 33,071 acres were irrigated in 1918. Of the 9 canals holding these rights only 4 were in use in 1918 and 2 representing rights to 44,600 acres were never used. Thus after/
years more than one-half of the canals are unused, two never were used and the acreage irrigated is only 14% of the acreage originally provided for.

Of the three enterprises having rights dated since 1894, one never was used, one is now completely abandoned, and the third was abandoned, but has been partially revised.

Various reasons for this showing are advanced. Mr. A. C. Wolfenbarger, of Lincoln, whom I interviewed August 6, 1916, and who was interested in the original construction of the Gothenburg South Side Canal, attributed the slump in irrigation development in this section principally to two causes: First, poor engineering, particularly as regards estimates of costs of construction and of maintenance and operation - these were greatly underestimated; second, indifference of the part of the farmers who would not buy water rights but wanted to buy water only when they needed it.

On August 23, 1916, I discussed the same question with Mr. W. V. Hoagland, of North Platte. In his opinion the failure of these irrigation enterprises below North Platte is fundamentally due to the fact that the farmers in this section can raise crops without irrigation. This is only another way of stating the second cause given by Mr. Wolfenbarger - the indifference of the farmers. They can live without irrigation and don't think it worth the cost.

The same fact is shown by the statement of Mr. George M. Dillon, of the Orchard and Alfalfa Ditch, previously referred to (p. 17) - that the reorganizers of that enterprise tried to organize an irrigation district but could not because so many of the land owners objected to it (Notes Aug. 26, 1916).

Mr. W. T. Byron, manager of the Gothenburg and Cozad Canals expressed the same idea in discussing the proposed revival of the Gothenburg South Side Canal. He stated that he doubted whether the efforts to revive this canal would succeed as too many of the farmers under it did not wish to get water (Notes Aug. 26, 1916).
Similarly, Mr. Don F. Hinkley of Gothenburg, stated that the farmers under the old Gothenburg South Side Canal were about evenly divided as to whether they wanted irrigation, and consequently it was impossible to organize an irrigation district. (Notes Aug. 26, 1918).

There seems to be no doubt that the reason given - that more or less successful farming is carried on in this section without irrigation - is the real reason for the failure of these irrigation enterprises. So far as my information goes there has never been in the United States a successful irrigation enterprise under similar conditions. It may be possible to show experimentally that irrigation under such conditions pays, but farmers are unwilling to undertake the large expense involved when it can be avoided.

Occasionally there are found statements to the effect that the use of water above in Colorado and Wyoming and on the North Platte in Nebraska has decreased the water supply and that the failure is due to that cause. The newspapers of the time, as well as a great mass of other evidence, show that the promoters of these canals did not expect to get water in the late summer, but believed that irrigation in the fall and in flood season would mean success for them. Mr. Wolfenbarger, of Lincoln, referred to above, made this statement. Water at those seasons has always been available, and is still, so that it does not appear that the use of water above is in any way responsible for the failure of these Platte River enterprises.

So far as the interests of the Colorado users of the South Platte are concerned, the only questions of interest regarding these Platte River canals are whether they have rights which can be shown to be interfered with by the Colorado users; and whether there is danger of such an expansion under these old rights which have been used, and revival under those which have not, as to make a demand on the Colorado users for water.
Most of the Colorado rights are prior to these Nebraska rights, and most of those which are dated subsequent to the Nebraska Canals, are supplied principally by water stored during winter and flood seasons, so that the Colorado parties have little to fear from an enforcement of priorities.

Furthermore, the whole history of this section, and the difficulty being experienced by those who were trying to revive old enterprises, lead to the conclusion that there is little danger of any marked expansion or revival in this section.

In the Nebraska legislature enacted a law providing for a checking up of the rights on record and the cancelation of those which had been abandoned, and it seems likely that recent efforts at revival are due more to this law than to any real interest in irrigation. It seems true, also, that an honest enforcement of this law would lead to the cancelation of a large part of the rights on the Platte River. On the other hand, the action of the Nebraska State Board of Irrigation in the case of the Orchard and Alfalfa Canal, in permitting, or rather forcing, the revival of an old right, where even the right-of-way had reverted, would lead to the conclusion that this board has no intention of enforcing the law.

The opinion seems general in the section under discussion, that the storage of water in the Pathfinder Reservoir and return seepage from the large areas being irrigated on the North Platte from the Interstate Project will supply this section of the main Platte with all the water for which there is likely to be a demand. Mr. Hongland, of North Platte, expressed this opinion very positively (notes August 22, 1918). Mr. Byron, of Gothenburg, stated that the supply had been sufficient during the past three years, and that this improvement was due to the Pathfinder Reservoir and the way in which Mr. Weise, of the Reclamation Service, had been controlling the river (Notes August 26, 1918). Mr. Stuckey, of the Farmers' and Merchants' Canal, also stated that
his canal was getting water from the Pathfinder Reservoir.

The conclusion seems justified, therefore, that because of the improved supply of water in this section of the river, the fact that the South Platte never did supply water to the main stream except in flood season, and the lack of interest in irrigation on the part of the farmers in this section, the water users on the South Platte in Colorado have nothing to fear from the canals on the main stream in Nebraska. It appears further, that if there should be an attempt to enforce rights in this section against Colorado users, there is ample proof that the South Platte never did supply water to this section, and that a very large part of the rights in Nebraska has been abandoned.

Irrigation Along the South Platte in Nebraska.

All the rights to water from the South Platte in Nebraska, as shown in the report of the State Engineer of Nebraska for 1913-1914 (p. 286) are dated during the same years as those on the main stream and the years immediately following — that is from 1894 to 1896. The record shows no rights initiated prior to 1894 or since 1896. During the summer of 1918, I visited such of these canals as could be found. The history of these canals, as shown by an unpublished report by Professor O. V. F. Stout of the University of Nebraska dated 1906, and a report on irrigation in Nebraska, contained in the report of the State Engineer of Nebraska for 1913-14, and the conditions found in 1918, are shown in the following pages. The canals are taken up in the order of their priorities, or given in the report referred to.

Eaton & McGrath.

The report of the state engineer shows the canal to have a right to twenty second feet — 1,400 acres — dated April 3, 1894, and to have been used in 1904, but not since.

Professor Stout's report of this canal is as follows:

"Name of claimant — John J. Eaton.

Amount of

-24-
Amount of water granted - 20 cu.ft. per sec.
Date of priority - Apr. 3, 1894.
Source - South Platte River.

This ditch heads 5 1/2 miles east and one mile north of Big Springs.

The Home Irrigation Ditch heads 1/2 mile farther down stream from the same (south) bank. Eaton & McGrath in 1900 sold the ditch to James Gray (1/2 interest), Charles Douglas (1/2 interest), and J. J. Snedeker (1/2 interest). The ditch is 4 1/2 miles long and has a fall of from 3 1/2 to 2 ft. per mile. The seepage or overflow, whichever it may be, from the district (Western) ditch, combined with the rainfall, has been sufficient to mature the crops, and for this reason the ditch has not been used for the last three years. They are contemplating a development of the underflow provided it turns dry again. The seepage the last three years has filled their ditch. Mr. Gray irrigates (1906) 40 acres of hay and 40 acres of alfalfa. Mr. Douglas has 80 acres and Mr. Snedeker 160 acres under irrigation. This is in corn, wheat, oats, alfalfa and hay land. For the small grain the ground is irrigated before sowing the seed or when the crop begins to shade the ground. Corn receives one irrigation, and that in August, providing they have the water. Alfalfa is irrigated early in spring. Winter irrigation not only brings alkali to the surface but causes the alfalfa to freeze and die out. Alfalfa grows too rank to allow it to go to seed. Native hay yields 1 ton per acre. Alfalfa yields 3 to 4 tons per acre. Wheat yields about 20 and oats about 25 bushels per acre. The maintenance on the ditch is about $100 per year. Willows have started in the ditch and are causing considerable trouble. Irrigated land is worth $50 per acre, one-half of which is due to irrigation.

Data from claims.

The Ditch was begun June 2, 1894, and completed Jan 31, 1896.

It is 3.83 miles long. 21,517 cubic yards of loam, clay and sand were excavated at a cost of $1,300. The completed ditch cost $1,450. 80 acres were irrigated in 1895 and 260 acres in 1896.
John J. Eaton filed a proof of appropriation with The State Board of Irrigation on Aug. 13, 1900. In this he depicts a story of hail, grasshoppers and floods. The amount of land irrigated was not given."

I visited the head of this ditch with Mr. R. G. Hosea, August 20, 1918. Only a few old boards of the headgate structure remained, and the ditch had been filled in right at the head. Mr. Hosea took a picture of me sitting on this dam in the ditch. There was no dam or other structure to be seen in the river. He also took a picture of me standing in the ditch about 1,000 feet below the head, where the ditch is full of weeds and willows. We crossed the ditch on the line between ranges 40 and 41. There were large willow trees in the bottom of the ditch just east of the fence along this road. The fence is built across the ditch in such a way as to dam the ditch in case an attempt to use it is made. The ditch was full of weeds, willows and grass, and evidently it had not carried water for years.

We crossed this ditch again on the line between Sections 29 and 30, Township 13N., Range 40W. At this point the road is graded across the ditch. Mr. Hosea took a picture with the car standing on this road grade. East of the road the ditch is full of large willows. Between Sections 27 and 28, Township 13N., Range 40W., the road is graded across the ditch line.

From the reports quoted and the observations made in 1918 it appears that the land under this ditch is wet from seepage from the Western District Canal, and that the ditch has not been used since 1904. It seems to be completely abandoned.

Hollingsworth Ditch.

The State Engineer’s report gives this ditch as having a right to 30 second feet, sufficient for 2,100 acres, dated June 5, 1894, and shows 356 acres irrigated in 1914 (the date of the report). Professor Stout’s report of this ditch is as follows:
"Name of claimant - Hollingsworth & Son.
Amount of water granted - 30 cu. ft. per sec.
Date of priority - June 5, 1894.
Source - South Platte River.

The ditch heads on the south side of the (South) Platte about 1 mile
south west of Ogallala. It was started in 1894 and the work of extension and
excavating continued for three years. Underflow was excavated along the river
bank, but high water filled this with sand. This was abandoned and the under-
flow made farther from the river. The new underflow has never been under water.
The ditch is four miles long, only the first two miles are in use, however.
At its head the underflow ditch is 5 ft. below the bed of the river. Dr. Hol-
lingsworth intended to sell water rights for land covering the last two miles.
Water will run in the ditch all winter. A covering of ice is frozen and an air
space 6 to 8 inches deep is left between the ice and the flowing water. Dr.
Hollingsworth is an underflow enthusiast. He gives the following as the ad-
vantages of an underflow ditch:

1. Water can be obtained when there is no surface-flow in the stream.
2. Water can be used in winter.
3. No expense for headgate.
4. Flow increases when the surfaceflow in the stream increases.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acreage</th>
<th>Yield per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>60</td>
<td>30 bushels</td>
</tr>
<tr>
<td>Oats</td>
<td>30</td>
<td>60 - 70 bushels</td>
</tr>
<tr>
<td>Speltz</td>
<td>30</td>
<td>60 - 70 bushels</td>
</tr>
<tr>
<td>Potatoes</td>
<td>5</td>
<td>Never measured</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>45 or 50</td>
<td>4 - 5 tons</td>
</tr>
</tbody>
</table>

Alfalfa is worth $4 to $5 per ton in the stack. No proof of ap-
propriation was filed, although the date set for the completion of the ditch
was Sept. 1, 1902."

Mr. Moses and I visited the head of this canal August 2, 1916. We
crossed the canal immediately south of the south end of the Ogallala bridge.
The canal was carrying a very small stream of water, a part of which was going
down a waste way, and a part down the ditch. This is an underflow ditch, and it seems to have been used to some extent up to the present time.

Stebbins Canal.

This canal is given as having a right to 30 second feet - 2,100 acres - dated December 17, 1894. It is reported to have 500 acres under the ditch, and not to have been used for years.

Professor Stout makes no mention of it, and I saw no trace of it.

Riverside Ditch.

This ditch is given as having a right to 2.86 second feet - 200 acres - dated December 22, 1894. It is reported as covering 200 acres, and as having been last used in 1900.

Professor Stout's report is as follows:

"Name of applicant - E. M. Searle.
Amount of water granted - 2.86 cu.ft. per sec.
Date of priority - Dec. 22, 1894.
Source - South Platte.

This ditch heads on the north bank of the South Platte River 4 miles west and 1\frac{1}{2} miles south of Ogallala. It is 3 miles long and cost $1,000. The map locates the ditch as being mostly north of the U. P. track, but it is all south of the track. The ditch is built on a ridge near the river. The land irrigated is between the ditch and the track. By crossing the track as shown 400 acres more could be irrigated. The land irrigated was all hay land. The scarcity of water in the river when water was needed for irrigation led to the abandonment of the ditch in 1904.

From records;

The construction of the ditch was begun Feb. 15, 1895, and completed Jan. 15, 1896. 200 acres were irrigated in 1896. 12,000 cubic yards of sand and clay were excavated at a cost of $900. E. M. Searle filed a proof of ap-
propriation with the State Board of Irrigation on July 18, 1900. In this
proof the amount irrigated in 1899 was given as 265 acres, consisting of 250
acres hay and 15 acres alfalfa."

This canal was not visited in 1916. The reports quoted agree that it has been abandoned, but do not agree as to the date.

**Miller & Warren Ditch.**

This ditch is given as having a right to 53.86 second feet - 3,770
acres - dated January 5, 1895. It is reported as covering 3,000 acres, and as
having irrigated 1,800 acres in 1914.

Professor Stout’s report is as follows:

"Name of claimant - F. L. Miller.
Amount of water granted - 53 6/7 cu. ft. per sec.
Date of priority - Jan. 5, 1895.
Source - South Platte River.

This ditch heads on the south bank of the South Platte 4 miles west
and 2 3/4 mi. south of Big Springs. Stafford and Kimball obtained a grant of
water from the South Platte River, but failed to start the construction of the
ditch. Then George Warren and Freeman Miller obtained a water grant in the
spring of 1895. In Jan. 1896 John H. Abbott and Walter Kimball joined Mr.
Warren and Mr. Miller in the construction of a ditch. Mr. Kimball bought Mr.
Warren’s rights, the consideration being $500, and a perpetual water right to
80 acres. A few perpetual water rights were sold at $2.50 per acre, but they
are now valued at $5. It appears that if a guaranty were given that the ditch
would be kept in repair, perpetual water rights for at least 100 acres could
be disposed of at $5 per acre. After the ditch was first constructed any one
was allowed to divert water from it. Under these circumstances 1,900 acres
were irrigated, which decreased to 400 or 500 acres, when they began to charge
for water. The dam broke early in the spring of 1908 and has not been repaired.
30,000 cu. yds, were excavated at a cost of 6 $ per cu. yd. The headgate cost
§100. The ditch is burned out each spring. Irrigated land is worth §35 to §40, unirrigated §15 to §20 per acre.

Records:

This ditch is 5.68 miles long. Mr. Miller having 900 acres, Mr. Warren 160 acres and Mr. Abbott 650 susceptible of irrigation from this ditch (in 1895). Including lands not owned by the two named men the amount which can be irrigated from the ditch is given as 768 acres. F. L. Miller filed a proof of appropriation with the State Board of Irrigation on July 26, 1900. In this he gave the amount irrigated in 1899 as 1,790 acres. This consisted of 960 acres of hay, 630 acres of grain, 200 acres of alfalfa. The river is usually dry during May, June, July and August."

The report of the State Engineer of Nebraska, for 1913–14, contains the following statement regarding this ditch:

"A notice of appropriation was posted January 5, 1895, and construc-
tion of the ditch was begun. In all about 6½ miles of canal have been built at a cost of about §3,000.

"A mutual stock company has been organized and now controls the ditch. There are 3,000 acres under the canal and during 1914 about 1,000 acres were irrigated".

I visited the head of the Miller & Warren canal August 20, 1916, with R. G. Hosse.

There is a timber rating flume about one-third of a mile below the head of the ditch. This was in fair condition. It is 12 feet wide, and about six inches of water was flowing through, with very little velocity - not more than one-third of a foot per second.

A short distance above the rating flume there were the remains of a structure for carrying flash boards to shut the water out of the ditch, and just
above this a waste gate and bridge, but the waste channel below the bridge was filled in with an earth dam. The gate structure below the abandoned waste gates appeared not to have been used for a long time, and there were no boards in the vicinity to be used for closing the openings.

A short distance above the waste gate there was a sand and gravel fill apparently recently built across a break in the lower bank of the ditch. It appeared that an attempt had been made to put the canal in shape to be used.

We did not go up the canal to the river.

The rating flume described above is in Sec. 7, Township 12N., Range 42W.

We crossed the Miller & Warren canal again on the line between Sections 6 and 9, Township 12N., Range 42W. At that point it was carrying a very small stream of water - not more than 1 or 2 second feet.

*Home Irrigation Ditch.*

This canal is given as having a right to 3.14 second feet - 220 acres - dated March 2, 1895, and as having been used in 1909.

Professor Stout's statement regarding this ditch is as follows:

- Name of claimant - J. T. Ryan.
- Amount of water granted - 3 1/7 cu. ft. per sec.
- Date of priority - Mar. 2, 1895.
- Source - South Platte.

This ditch heads on the south side of the South Platte River, 6 miles east and one mile north of Big Springs. It was built by J. T. Ryan in 1894. Water was used from it that year. The bottom width at the headgate is 6 ft.

The ditch is 2 miles long and cost $250. There is a fall of 2 ft. for the first 1/2 mile, and the remainder of the ditch has a fall of 2'6" per mile. The fall is not sufficient. A board 6" wide is kept in the bottom of the headgate to keep sand from being washed into the ditch. This device apparently keeps con-
siderable sand from the ditch for it has needed cleaning only twice. This ditch has not been used during the last two years on account of an increase in the rainfall, and subirrigation from the district ditch. (Western Irr. Dist.) Mr. Ryan has irrigated 145 acres of hay land and 15 acres of alfalfa. When irrigating some one attends to the spreading of the water. 3 crops of alfalfa are raised unless one crop is let go to seed, then only two crops are harvested. In this case the first crop is let go to seed. It yields from 2 to 6 bushels per acre. The first crop is better than the second crop for seed because the second crop grows too rank and does not fill good, and is damaged by the grasshoppers. Alfalfa yields 1 ton per acre without irrigation and 1 2 tons with it. Native hay yields 2 1 ton per acre. Hay is worth $4. per ton in the stack. The yield of hay is doubled by irrigation. Water is used, if available, when the crops are needing moisture. Mr. Ryan filed a proof of appropriation with the State Board of Irrigation on July 30, 1900. In this the amount given as irrigated in 1899 being 259 acres hay, 20 acres alfalfa. In 1896 and 1898 the river was dry during a period extending from July 15 to Dec. In 1897 and 1899 the river was low from Apr. 15 to July 15. It was dry the remainder of the irrigating season. In 1900 the supply was sufficient up to July 15."

I visited this canal with Mr. Hoes August 20, 1916. There were left a few old rotten timbers of the headworks on this canal, and a bank of earth in the head of the ditch, apparently put there to keep the river water out of the ditch. Just down stream from this bank of earth there are willows up to four inches in diameter growing on the bottom of the ditch. Below this the ditch is intact, but full of grass and weeds. There was not enough left of the old structure to show what it had been, but it was about 9 feet between the posts on the sides of it.
South Side Plano Ditch.

This ditch is given as having a right to 1.43 second feet - 100 acres - dated April 27, 1895 (p. 286). The same report (p. 115) states that no water was ever diverted. We saw no trace of this ditch. This ditch shows the same condition that was found on the main stream - a right still on record as good, where the report of the State Engineer 19 years later, shows that no water ever had been used.

Big Springs Canal.

The State Engineer's report for 1913-14, shows the ditch as having a right to 6.93 second feet - 625 acres - and as being used in 1914, and as irrigating 200 acres in 1912. We did not visit the canal in 1918.

Professor Stout's report contains the following statement regarding this canal:

"Name of claimant - C. W. Kimball, et al.
Amount of water granted - 6 13/14 cu.ft. per sec.
Date of priority - Apr. 27, 1895.
Source - South Platte.

This ditch heads on the north bank of South Platte 1/2 mi. S.W. of Big Springs. The construction was started by G. (?E. Thompson, John H. Abbott, and Walter Kimball in 1893. It was completed and used in the same year. In 1896 it was deepened 1 1/2 ft. and also widened. The bottom width at the headgate is now 7 ft. The ditch cost $500, and the headgate $50. The headgate is built on piles driven into the sand. A small temporary sand dam is used to divert the water. The maintenance is about $20 per year. Mr. Thompson bought out Abbott's and Kimball's interest in 1902. They had school land but stopped payment on it. 500 acres, all hayland, were irrigated at first but the lapsing of the school lands reduced this to 300 acres. The land is not irrigated in the fall or winter on account of haymaking being left on the field during the winter. It has not
been irrigated this year (1906) for the same reason. The water supply is good until August. The ditch is burned out each year. Hayland yields 1 ton per acre. Hay is worth $6 per ton in the stack. Irrigated land is worth $50 per acre, $20 of which is due to irrigation.

From records:

The construction on the ditch was begun Mar. 5, 1895, and completed far enough to allow the irrigation of 200 acres that year. 7,000 cu. yards of loam, gumbo, clay and sand were excavated at a cost of $400. The ditch when completed cost $600. J. (?) E. Thompson filed a proof of appropriation with the State Board of Irrigation, on July 21, 1900. In this the land irrigated was given as 150 acres, all of which was in hay.

Paxton Southern Ditch.

The State Engineer's report shows this ditch as having a right to 1.43 second feet - 100 acres - dated Oct. 17, 1895, as having been built in 1896, and as last operated in 1902.

Professor Stout's report is as follows:

Name of applicant - David Stafford.
Amount of water granted - 1 3/7 cu. ft. per sec.
Date of priority - Oct. 17, 1895.
Source - South Platte.

This ditch heads on the north bank of the South Platte River about 3 miles west of Paxton. It was constructed and irrigated from in 1894 or 1895. The completed ditch is 4 miles long and cost $300. David Stafford, Fred Crook and Mr. Laughlin started this ditch. Laughlin sold his interest to R. E. McComb and his brother, 150 or 200 acres of hay land and 100 acres of alfalfa were irrigated for a few years, but the ditch has not been used for the last 5 years. The river is usually dry during the summer and the rainfall has increased. A proof of appropriation was filed with the State Board of Irrigation on Nov. 9, 1906, by David Stafford. In this the amount irrigated in 1906 was given as 60 acres alfalfa, 20 acres hay, 20 acres grain.
On August 21, 1916, what was supposed to be this canal was visited with R. C. House. The ditch runs at the base of the hills and cross drainage from the hills had washed it out in many places and the road crossings were graded in. It was very evidently abandoned.

Late and Sheridan Ditch.

The State Engineer's report gives this ditch as having a right to 13,43 second feet - 940 acres - dated February 17, 1896, and as having been last used in 1902.

Professor Stout's report is as follows:

"Name of claimants - Late and Sheridan.
Amount of water granted - 13 3/7 cu.ft. per sec.
Date of priority - Feb. 17, 1896.
Source - South Platte River."

This ditch heads on the south bank of the South Platte 1 mile S.E. of Roscoe. The ditch was constructed and water used from it in 1896 (proof gives 1896), by Late and Sheridan. It is now (1907) owned by Guyser, Hilliard and Late. It was to extend to Paxton, but only 3 miles were constructed. It seems that this was a speculative scheme. A large spring near the headgate was to have furnished considerable of the flow. The ditch has not been used since 1896. At the crossings it has been filled in. Fred Lute filed a proof of appropriation with the State Board of Irrigation in which the amount irrigated was given as 160 acres, all hayland."

Mr. House and I visited the locality of this ditch August 21, 1916. We found what appeared to be the head of a ditch about one-half mile east of the south end of the Roscoe bridge. This ditch was full of weeds, willows and locust brush and evidently had not been used for years. A little further east the ditch was well defined but full of weeds, grass and brush. I noted one tree five or six inches in diameter in the bottom of the ditch. Mr. House took a picture of me standing by this tree. The State Engineer's map shows this ditch heading
west of the road leading south from Roscoe, but there is no evidence of a ditch crossing this road. Above the head of this ditch there is an old ditch running up an old river channel apparently dry for the purpose of developing underflow. The ditch runs up this channel for a few hundred feet but has no connection with the present river. There was no evidence of any structure connected with this ditch at any point.

**Meyer Canal.**

The State Engineer's report gives this canal as having a right to 1.46 second feet - 102 acres - dated April 14, 1896, and as having been last used in 1911.

Professor Stout's statement follows:

"Name of applicant - Hemery Meyer.  
Amount of water granted - 1 32/70 cu.ft. per sec.  
Date of priority - Apr. 14, 1896.  
Source - South Platte."

This ditch heads on the south side of the South Platte, 1\(\frac{1}{4}\) miles southwest of Brule. It was built by Henery Meyer, its present owner, in 1891 and 1892. Water was used from it in 1892. The ditch is \(\frac{3}{8}\) mile long. The bottom width at the headgate is 7 ft. The ditch cost $400 and the headgate $40. This is a high ditch, that is the bottom of the ditch is above the bottom of the nearby channel in the river. This is to prevent sand from being washed into the ditch. No diversion dam is used. The water was not high enough in the river this spring 1906 to enter the ditch. Sweet clover and weeds grow in the ditch. These are plowed up, and thrown out in the fall or moved with a scythe.

Mr. Meyer claims that winter irrigation does not cause weeds unless flood water is used. The latter usually carries weed seeds. Hay land yields \(\frac{1}{2}\) to 1 ton per acre. Hay is worth $3 to $4 per ton in the stack. Hemery Meyer filed a proof of appropriation with the State Board of Irrigation on Dec. 28, 1900.
In this the amount irrigated is given as 172 acres. The amount conditionally granted was 2.86 cu.ft. per sec."

This canal was not visited in 1918.

**Cereal Irrigation Ditch.**

The State Engineer's report gives this ditch as having a right to 4.86 second feet - 340 acres - dated July 10, 1896, and as not having been used for years.

Professor Stout's report is as follows:

"Name of applicants - H. C. Carnahan and C. Reed.
Amount of water granted - 4 6/7 cu.ft. per sec.
Date of priority - July 10, 1896.
Source - South Platte.

This ditch diverts water from the south bank of the South Platte River at a point nearly opposite Plano. Carnahan and Reed started this ditch in 1895. Reed sold his interest to Carnahan before construction was begun, and he to Bradford and Kennedy, and they to McKeag and Spangler in 1907. The ditch has both an overflow and an underflow source, but the latter develops very little water. The overflow ditch is too high at the headgate to obtain water at low stages of the river. Only 3 of the 5½ miles of ditch are used. The slope of the last 2½ miles is not great enough. The estimated cost of the ditch is $5,000. 70 acres of corn and alfalfa are irrigated. They obtained their proof of appropriation this year (1907) for 400 acres. Alfalfa yields 4 tons per acre, and is worth $6 per ton in the stack. It is irrigated in the fall and spring and after each cutting. A proof of appropriation filed with the State Board of Irrigation Apr. 7, 1904 by H. Carnahan ... In 1903 300 acres of hay and alfalfa, 60 acres of corn, 20 acres of oats and 20 acres of wheat were irrigated. Water is used in Feb., Mar., Apr., May, and June."

Mr. Hosea and I visited this ditch August 20, 1918. We visited the head of the ditch a short distance above the wasteway of the Western District canal. There were no works of any kind at the head of the Cereal ditch. It
heads in an old river channel which is, however, only a few feet from an old channel now carrying water, and a cut had been made into this larger channel. The bottom of the ditch was about two feet above the water level at the time of this visit, although the river was carrying a large stream. The ditch was full of brush and weeds. About a half a mile below this there is another channel with the remains of an old headgate with three 4-foot openings with flashboards. There was sand and earth in the channel about two feet above the water in the river channel nearby. The ditch was full of willows. Mr. Hoesa took some pictures of this heading. The old structure is rotted and fallen in, and there was no dam in the river. The river channel at this point was carrying a good flow, but neither of the ditches just described was carrying any water. Waste from the Western District Canal crosses the line of this canal about one-half mile below its head, the water being carried over in a semi-circular galvanized flume about five feet wide. The waste was discharging on the flat ground below the Cereal ditch and a considerable part of it ran back into this ditch and flowed on down. The ditch, however, was dry at the road crossing a short distance below. Provision has been made for carrying the Cereal ditch across the roads, good concrete culverts being installed in several places. There is one of these near the corner of Sections 11, 12, 13 and 14, in Township 15W, Range 39W., and one on the line between Sections 12 and 13. The State Engineer’s map seems to be incorrect at this point.

The ditch had not the appearance of being used in 1916, and the reports referred to indicate that it has not been used for years, but there was some evidence of an intention to use it, indicating that there may be an attempt to maintain its right to 4.56 second feet.

Allen Ditch.

The State Engineer’s report gives this ditch as having a right to 6.56 second feet - 460 acres - dated Dec. 15, 1896, and as having been used in 1910.
Professor Stout's report is as follows:

"Name of applicant - W. F. Allen.
Amount of water granted - 9 cu.ft. per second.
Date of priority - Dec. 15, 1896.
Source - South Platte River.

This ditch was started and completed by Allen in 1897. The first irrigation was in the following year. This ditch is three and one-third miles long. The cost of the ditch and the headgate was about $700. The present owners are W. H. Shireman, one-half; John Halligan, one-sixth; Mr. Bates, one-third. 160 acres of hay land and forty acres of cultivated land are irrigated. Hay yields three-fourths ton per acre. On account of the intermittent supply Mr. Shireman thinks that the ditch is not a financial success."

In company with Mr. Hosea, I visited the head of this ditch August 20, 1916, and found the remains of an old headgate structure at the bank of an old river channel. It was about 350 feet to the nearest river channel that was carrying any water. There was a board fence crossing the head of the ditch, and the ditch was full of grass and weeds. About 150 feet down stream from the head the ditch was full of locust brush. The line of the Allen ditch crosses the waste way from the end of the Western District canal just below a washed out drop on this waste way, and there was no provision for carrying water in the Allen ditch across this waste way.

Western Irrigation District Canal.

The report of the State Engineer gives this canal as having a right to 160 second feet - 12,600 acres - dated June 14, 1897, and contains the following history of the ditch:

"A petition praying for the organization of an irrigation district was presented to the board of county commissioners of Keith county, who approved the petition on August 24, 1895, and called an election for September 21. On September 30, the commissioners met as a canvassing board and finding the vote favorable to the district, declared it duly organized. Bonds in the sum of $25,000, which amount was based upon the estimates made from the surveys, were voted in 1896. No bonds were sold for cash, as no bids could be obtained and
no contractor could be interested sufficiently in the work even to submit a bid for the construction. Final surveys reduced the estimated cost, and construction was begun in 1897, farmers within the district doing the work and taking their pay in bonds at the rate of 5 cents per cubic yard. The system was completed in 1899. The state board of irrigation granted a water right of 160 second-feet, issuing a certificate to the application under date of June 14, 1897.

Owing to the shortgage of water in the river, due to diversions in Colorado under subsequent rights, all of the land within the district is seldom irrigated in a single season. The district has an area of 14,992 acres and in 1914 water was applied to 6,000 acres. Lands within the district, for district purposes, are assessed upon a valuation of $10 per acre. The levy for maintenance and operation in 1914 was 50 mills, and that for bonds, 25 mills, making the cost per acre for maintenance and operation 50 cents, and to cover bonds and interest, 25 cents, making a total of 75 cents.

The district has installed a reinforced concrete spillway, which cost $2,000, and it is the intention to install weirs in all of the laterals and to measure the water used by each water user."

Professor Stout's report is as follows:

"Name of applicant - Western Irrigation District.
Amount of water granted - 160 cu.ft. per sec.
Date of priority - June 14, 1897.
Source - South Platte River.

Water filing was made and the district organized. Among the signers of the petition were W. F. Stafford, Martin Anderson, Peter Peterson, William Vale, E. W. Harrison, Henry Shireman and Frank Richmond. All votes were for a district. 20 year bonds drawing 6% were issued Jan. 1, 1897. The bond issue was $25,000. 6% of the bond was to be paid the 11th year, 6% of the remainder the 12th year, after which the percentage was to increase 1% each year. The 20th year the remainder was to be paid. Most of the bonds were exchanged for work upon the ditch. They were valued at 50 ¢ on the $1. The work of excavation cost about 98¢ per cu. yd. It was paid in bonds at their face value. A board of directors is elected annually, and they select their officers. The present (1907) officers are: Moderator, McSufford; President, Harry Shireman; and a Third Member, John Stewart. The Treasurer, S. J. Holden, is not a member of the board of directors. An assessor is elected each spring. The present (1907) assessor is E. M. Harrison. The directors receive $3.50 per day and mileage. The latter amounts to 50¢ per mile. The treasurer received $75 per year. A Supt. is appointed, who attends to the maintenance of the ditch and the division of the water. The present (1907) superintendent receives $100 per month. He also superintends, instructs and supervises all workers. His instructions are the minutes and bylaws. A meeting can be called upon a written request signed by ten voters. This meeting has power to discharge the superintendent, regardless of the contract the superintendent has with the board of directors. Construction was begun on the ditch in 1897, and completed in about three years. A delay of one year was caused by their awaiting the outcome of the testing of the district law in the Supreme Court. The headgate is located within a few rods of the Nebraska-Colorado State line. Headgate and wasteway cost $1,000. The latter is located within 12 mile of the former. The wasteway is 4 ft. below grade. By means of this several thousand cu. yds. of sand can be readily removed. The ditch is cleaned out in the winter, and will work satisfactorily without another cleaning until another winter. The ditch is 50 ft. wide at the headgate and tapers to 30 ft. at the end of the first two miles. The fall of
2.11 ft. per mile when the ditch is carrying a full head of water makes the velocity considerable too high. The ditch has become enlarged by erosion of the water until now it is 30 ft. wide. A box 1 ft. high, and 2 ft. wide is used for 160 acres or less. For a larger area the width of the box is increased in proportion. When water is plentiful no limit is placed on the amount they can divert. During a shortage of water they allow the diversion of water 48 hours per 160 A. They have two funds, a general fund, and a bond fund. The latter includes the interest for the first ten years on the bonds, and after that the percentage payment of the bonds. The heaviest levy was in 1897. This amounted to $120 for 160 acres. In 1906 the levy was about $85 per quarter. The first five years 5,000 acres were irrigated. At the present time (1907) this has been increased to 14,900 acres. 160 acres have been added to the district since it was formed. They are contemplating the addition of more land. They had water nearly all summer in 1907. In 1908 the supply was sufficient until June. They have had several "runs" since then. A ditch 10 miles in length was constructed to drain the land which had become flooded by seepage from the ditch. 1,000 acres were drained. The ditch cost $2 per rod, and was paid for by the men owning the land which was drained. Land was worth $5 to $5 when the ditch was started. It is now worth $40 to $50 per acre. During this length of time the value of table land has increased from $2 to $15 per acre."

The canal of the Western Irrigation District heads just below the State line on the south side of the South Platte river.

The records of the county commissioners of Keith County, Nebraska, show that the commissioners approved the petition for the organization of this district August 24, 1895 (Record of County Commissioners, Book B, pp. 306 and 309) and set September 21, 1895, as the date for the organization election. The commissioners canvassed the vote at this election on September 30, 1895, and found all votes favorable and declared the district organized. The directors elected were: E. D. Harrison, W. T. Vail, and W. H. Shireman; F. M. Richman, treasurer, and W. J. Cooney, assessor. (Record of Co. Comrs. Book B, p. 313). See Teple's notes, August 27, 1916; see also Nebr. State Engineer's Report 1913-14, p. 113).

Bonds in the sum of $25,000 were voted in 1896, but could not be sold. Work was begun in 1897, farmers in the district doing the work and taking their pay in bonds. The system was completed in 1899. (See Nebr. Eng. Report, 1913-1914, p. 113).

The State Board of Irrigation granted a certificate for 160 cubic feet per second, dated June 14, 1897. (See Nebr. Eng. Report 1913-14, p. 113,
I visited the head of the ditch in company with Delph E. Carpenter, Charles Colwell and R. D. Hosea, August 2, 1916. The water of the river is turned to the head of the canal by a brush and sand dam. At the head of the canal there is a timber structure, with gates in the river channel but no gates in the head of the canal. When visited on August 2, the canal was taking a small stream, estimated at 25 cubic feet per second. Much more than this amount was being passed down the river, estimated at 75 cubic feet per second. There was a gage rod on the gate structure in the river, and the water stood at 1.5 feet on this gage.

The gates in the river consisted of wooden gates set in an old wooden structure, and operated by rack and pinion. There are ten openings each six feet wide.

Waste gates are installed a short distance below the head of the canal. These waste gates are radial gates set in concrete. The gates appeared to be closed, but considerable water was leaking through them. This leakage was not measured.

Below the waste gates, there is a rating flume, consisting of a short concrete-lined section. The water stood at 1.5 on the gage rod at this flume, and the discharge was estimated, not measured at 15 cubic feet per second.

A short distance below the head of the canal, and below the line of the canal we passed ponds of water. A depression seemed to lead from these to the river.

We crossed the canal about five miles below the head and found the canal dry.

About seven or eight miles below the head of the canal we passed large swamped areas under the canal, and one lake covering several acres. This is evidently a permanent lake as there was a boat on it, and signs warning
against shooting.

We passed an old waste ditch near the end of the canal. This was washed very deep, but was not in use. Also passed the waste ditch at the extreme end of the canal, on the south side of the river a mile or two west of Ogallala.

I visited the Western Canal again August 9, 1918, on return trip from Lincoln with the same parties. We crossed from the north side of river at Brule, and crossed the Western Canal several times between that point and the head of the canal. The canal was carrying water where crossed, but we saw corn which was suffering for water but not being irrigated.

We visited the head works on the same date. The waste gates were closed, but were leaking considerably—several cubic feet per second. Water stood at 1.1 feet on the gage at the rating flume. The discharge was not measured, but was estimated at 75 cubic feet per second.

At the gates in the river water stood at 1.95 feet. Eight of the gates were closed and two were open about one foot. Mr. Hosea estimated the discharge passing down the river at 75 cubic feet per second.

At Julesburg, I met Ed. Lowe, auto liveryman, who stated that the Western District had been wasting water down the river all summer. Mr. White of Julesburg said the same thing.

I visited the Western Canal head again on August 19, 1918, with Mr. Hosea. Before going to the head of the canal we measured the discharge of the river at the Julesburg bridge, and found it to be about 575 cubic feet per second.

At the head of the Western Canal, all of the gates in the river were wide open, and the water stood at 1.6 feet on the gage. Water was passing down the canal without obstruction. The water stood at 1.1 feet on the gage rod at the rating flume, and some water was leaking through the waste gates.
We visited the head of the canal again the next morning - August 20, 1918, and measured the discharge. The gage reading was 1.2 feet, and the discharge was 73,87 cubic feet per second. We did not measure the discharge passing down the river.

We went on down the river inspecting the lands and ditches. We visited the head of the Miller & Warren ditch, and examined the land between the two ditches. This land was in fairly good condition. There were some small ponds of standing water, but generally the land was not too wet to use. There was some good alfalfa.

In the afternoon of the same day we crossed the wasteway at the end of the Western Canal. This was carrying some water - estimated at from 3 to 5 cubic feet per second. This wasteway runs down quite a slope, and contains several concrete drops. One of these was washed out, and the ditch was cutting back to the next drop.

I visited the head of the Western Canal again September 11, 1918, in company with Delph E. Carpenter. At the Julesburg bridge the river was carrying considerable water, estimated roughly at 200 second feet. At the head of the Western Canal the gates in the river were all wide open, permitting whatever water was in the river to flow past the head of the ditch. We did not go down to the canal to see whether any water was running down the canal.

It is evident that this canal has been used to some extent every season since it was completed, and that it has, therefore, maintained its right to water from the river. There may be a question as to its having maintained its right to the full 160 second feet allowed it by the State Board of Irrigation, as under the Nebraska law rights are granted for the irrigation of certain specified areas, and are limited to the needs of those areas, not exceeding one-second foot to 70 acres - the amount granted by the State Board. A large part of the land within this district is swamped - other reports estimate this - and
other land has never been irrigated, so that it is probable that the right can
be cut down if attacked in the courts.

A further consideration is that this district cannot claim in-
fringement by junior Colorado ditches whenever it can be shown that they were
drawing water and the Western Canal was not getting 100 second feet. In my
opinion the district can be compelled to show that it had need of water for
its entire area — which it is impossible for it to show, since probably one-
half the area is not at present irrigated when water is available — as it was
throughout the season of 1918.

**Kimball's Underflow Ditch.**

The State Engineer's report gives this ditch as having a right to
3.57 second feet - 250 acres - dated Nov. 8, 1898, and as having been last
operated in 1912.

Professor Stout's report on this canal is as follows:

"Name of applicant - E. E. Leech et al.
Amount of water granted - 3 1/7 cu. ft. per sec.
Date of priority - Nov. 8, 1898.
Source - South Platte River.

This ditch heads on the south side of the South Platte, 1 1/2 mi. south
and 3 miles west of Big Springs. It was started in March 1898, and completed by
Sept. 1898 by E.E. Leech and Walter Kimball. It is 5 miles long. Two men with
four teams and two buck scrapers completed the surface ditch in two months.
The headgate was made and the water then diverted from the river which became
nearly dry, then work was begun on the underflow part. It took the same force
4 months to complete the underflow portion. 15,000 cu. yards of dirt and sand,
most of which was from the underflow, were moved at a cost of $1,000. 95 acres
were irrigated until 1906, when the underflow was filled up during high water
and has not been excavated since. This part of the ditch is 5/8 mile long and 6
ft. deep at the head. More water was obtained than they could use. They in-
tended to sell water but this never materialized. At the end of the second mile
of the ditch there is a spillway back to the river. The water would run through this during the coldest weather in the winter without freezing. The fall of one foot per mile has been found to be insufficient. Alfalfa is irrigated in the fall, spring and after each cutting. It yields 3 tons per acre, and sells for $5 per ton in the stack. Hay land is irrigated in the spring and summer. It yielded 1 ton per acre and is sold for $4 per ton in the stack. A proof of appropriation filed with the State Board of Irrigation by Walter Kimball Nov. 9, 1901 gives the amount irrigated in 1901 as 50 acres of alfalfa and 200 acres of hay land."

I visited this canal with R. G. Hosea, on August 20, 1918. It was very evidently not used. It had grown up with weeds and brush and the bottom was a foot above the water in the river channel at its head. This is in Section 3, Township 12N, Range 42W.

We crossed the old ditch again on the line between Sections 2 and 3, in the same township. At that point it was full of weeds and brush, with high brush just west of the section line. There was a large break in the lower bank of the ditch a short distance below this crossing. There is no sign of the ditch crossing the north and south road leading to the bridge at Big Springs.

The canals described above are all that are given in the report of the State Engineer, above referred to, (1913-14, p. 266) as having rights to water from the South Platte River. It will be observed that these rights all date in the years 1894 to 1896 inclusive.

The following table shows the rights on the South Platte, as given in the report referred to, and the condition found in 1918, and shown by the reports referred to above.
<table>
<thead>
<tr>
<th>NAME</th>
<th>WATER RIGHTS</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount : Acreage : Date : 1918</td>
<td></td>
</tr>
<tr>
<td>Second-feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eaton &amp; McGrath</td>
<td>20.00 : 1,400 : Apr. 3, 1894 : Not used.</td>
<td></td>
</tr>
<tr>
<td>Hollingsworth</td>
<td>30.00 : 2,100 : June 5, 1894 : Used</td>
<td></td>
</tr>
<tr>
<td>Stebbins</td>
<td>30.00 : 2,100 : Dec. 17, 1894 : Not used.</td>
<td></td>
</tr>
<tr>
<td>Miller &amp; Warren</td>
<td>53.66 : 3,770 : Jan. 5, 1895 : Not used</td>
<td></td>
</tr>
<tr>
<td>South Side Plano</td>
<td>1.43 : 100 : Apr. 27, 1895 : Not used.</td>
<td></td>
</tr>
<tr>
<td>Big Springs</td>
<td>6.93 : 625 : Apr. 27, 1895 : Used (?)</td>
<td></td>
</tr>
<tr>
<td>Paxton Southern</td>
<td>1.43 : 100 : Oct. 17, 1895 : Not used.</td>
<td></td>
</tr>
<tr>
<td>Western District</td>
<td>180.00 : 12,600 : June 14, 1897 : Used.</td>
<td></td>
</tr>
<tr>
<td>Kimball Underflow</td>
<td>3.57 : 250 : Nov. 8, 1898 : Not used.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>361.55 : 25,307 :</td>
<td></td>
</tr>
</tbody>
</table>

-47-
It appears from the table and reports that the Western District is the only going enterprise taking water from the South Platte in 1918, the Hollingsworth ditch, the only other one in use, being an underflow ditch unless it is shown that the Big Springs Canal was in use. The acreage actually irrigated by the Western District was not ascertained, but can be obtained from the reports to the state engineer. An inspection indicated that not to exceed one-half the land was irrigated.

The Western Canal represents almost exactly one-half the acreage covered by rights on the South Platte, and most of the other half has been abandoned. The ditches discussed do not fully represent, however, the enterprises launched in the nineties for irrigating lands in the South Platte Valley. These other enterprises are discussed in the following pages.

The records of the county commissioners of Keith County, Nebraska, show that the Western District was only one of many large schemes which were proposed for the South Platte Valley, from 1895 to 1897. On October 13, 1895, the County Commissioners passed a resolution submitting to a vote of the residents of the county a proposition to issue bonds for fifteen thousand dollars to aid the South Platte Land & Irrigation Company to build a canal heading on the south bank of the South Platte River, two miles west from Big Springs, running in an easterly direction for about twenty-three miles to the center of Twp. 15 W., R. 36 W. The County retained the option of purchasing this ditch after its completion or of permitting an irrigation district to purchase it in case one should be organized. The agreement fixed a number of conditions, among which was one that the company should sell water rights for eight dollars per acre.

On the same date provision was made for submitting another bond issue of fifteen thousand dollars to aid the Keith County Canal Company to build a canal on the south side of the South Platte and not farther east than the center line of R. 39 W., and running easterly about twenty-seven miles to the east line of Keith County. This contained the same conditions as the other proposition approved the same day. It contained also a provision that no contract for more
than one mile should be let to any one person, the evident intention being that the residents should take small contracts.

On the same day still another submission of a bond issue of fifteen thousand dollars was approved. This one was to be an aid to the Keith County Irrigation and Power Company. A canal was to take water from the North Platte River at the line between Keith and Deuel Counties.

August 31, 1895, petition was received for the Platte Valley Irrigation District. The canal was to commence on the south bank of the South Platte River in Keith County where the section line between Sections 21 and 22, in Twp. 13N., R. 40W. intersect the river.

County Comrs. Book B, pp. 310 and 311.
The organization of this district was voted down at the election.
The petition of the Paxton Irrigation District was considered October 8, 1895, and election ordered for December 28, 1895.

January 6, 1896, the Commissioners canvassed the vote and declared this district organized.

On February 27, 1897, the Commissioners considered a petition for a district south of Ogallala, but disapproved this petition.

On April 7, 1897, Commissioners considered a petition for a district embracing the territory adjacent to the South Platte River extending through Ranges 39 and parts of 38 and 40.

On May 4, 1897, the Commissioners rejected this petition.
Paxton Irrigation District.

One of these enterprises, the Paxton Irrigation District, reached the construction stage, but was never completed. The report of the State Engineer of Nebraska for 1913-1914 contains the following statement regarding this district:

"This enterprise is now dead and the district has been abolished, yet a short synopsis of the court records covering the organization will illustrate the era of speculation that attended early irrigation development.

On August 24, 1896, an application was made by an individual for a water right. Immediately following this the Paxton Irrigation District was organized, a favorable vote being cast October 6, 1895. This election was held without the notice prescribed by law being given. The district employed no engineer, no surveys were made upon which to base estimates of the cost of construction, yet on February 25, 1896, the board of directors held a special meeting and ordered an election to be held April 4, for the purpose of voting bonds in the sum of $27,000. The election was held and the board of directors declared that the bonds had carried. No legal notice of this bond election was ever issued. About $11,000 of the bonds were used in paying for the construction of twenty miles of canal.

The district court of Keith county has held that the bonds were illegally issued and that they had been used in making payment upon illegal contracts. Some valid claims were found to exist and these had to be paid before the district was allowed to dissolve.

Approximately 5,000 acres could have been irrigated from this canal, but it never was opened up to the river. The state board of irrigation has cancelled the water right."

On August 9, 1816, in company with Carpenter, Colwell and Hosea, I passed along the line of this ditch on the highway between Paxton and Ogallala. We crossed the line of the canal in several places, and saw it beside the road. The banks were broken in many places, and there seemed to be many places where it had not been excavated. East of Ogallala many draws cross the canal line, but there were no canal crossings. The canal was very evidently abandoned.

On August 21, 1916, I passed over this road again in company with Hosea, and noted again the same conditions described above.

Ogallala Power Canal.

Another abandoned enterprise on which some work was done was the Ogallala Power Canal, which headed on the north side of the South Platte. It

-50-
was to develop power at Ogallala. Professor Stout's report contains the following statement regarding it:

"Source - South Platte, north side.

The precinct voted $35,000.00 in bonds to help construct the ditch. S. F. Wiley of Omaha took the contract at $2,600.00 per mile. They were to put in a 50 horse power plant at Ogallala. The machinery for the water power was to cost about $5,000.00. The ditch was put through but never was used to any extent.

The flow was obtained from wells sunk in the bed of the river and connected by a pipe line.

Water was carried to Bruel a distance of 3 miles in the ditch."

The report of the Nebraska State Engineer for 1913-14 (p. 115) shows that the right of this company has been canceled.

On August 9, 1918, I crossed the line of this canal several times in company with Carpenter, Colwell and Hosca. The road is graded across the canal in many places, showing that it is completely abandoned.

South Side Canal.

Another enterprise, which has taken some water from the South Platte, and consequently should be considered in any report on that stream is the South Side Canal, which took water from the North Platte across the land between the two branches of the Platte, and across the South Platte to be used on land south of the latter stream. The history of this enterprise is given in the report of the State Engineer of Nebraska for 1913-14 (pp. 63-64) as follows:

"This canal had its beginning in the latter part of the eighties, at which time it was proposed to build a canal from the South Platte river upon almost the same line that later was occupied.

Early in 1894 an enterprise was promoted for the purpose of diverting water from the North Platte river to irrigate lands to the south side of the South Platte river just south of the town of North Platte. The first plan of this enterprise would have left a large acreage southwest of the town of
North Platte and south of the South Platte river above the canal. After investigation, it was found to be feasible to locate the canal between the rivers farther west at a higher elevation, and a notice of appropriation was posted on the south bank of the North Platte river. This right afterwards was transferred to the company.

The South Side Irrigation and Land Company, with a capital stock of $75,000, was organized on June 17, 1894. Very few contracts for construction were let, almost all the work being done by the farmers themselves. They either were allowed a certain wage per day or were given credit for the number of yards excavated. With the exception of some few cases where money had to be advanced to supply the necessities or for feed for teams, all work was paid for in stock of the company at a rate of 5 cents per cubic yard. Where cash was advanced, only four cents per cubic yard was paid.

A contract was let for the construction of 6½ miles of canal lying between the two rivers, payment to be made in stock of the company. The contractors furnished bond for $20,000 to guarantee the completion of the work and the company agreed to furnish the right of way. The work was begun simultaneously at the banks of the South Platte River, the farmers working down the canal on the south side of the river, and the contractors working up the canal between the rivers. The company became involved in litigation over some right of way between the rivers, and the contractors ceased work after two miles of canal had been completed. The winter of 1894-5 was an open one and the farmers worked throughout the entire winter. During the years 1894-95, 41 miles of canal were completed.

As no stock was sold for cash, the landowners formed an improvement district and voted $10,000 in improvement bonds to pay for the material used in the construction of an inverted siphon across the South Platte River. This structure was a double box section, containing over 250,000 feet B.H., of lumber, and cost $12,000. The total cost of the canal was $85,000.

Water was run through the entire length of the canal for several years. Better weather conditions and dissatisfaction among the water users because of the non-delivery of water, led many either to sell their landholdings or quit using water, and resulted in the canal falling into disuse, and no water being carried south of the river for some 12 or 14 years. The abandoned canal was sold under foreclosure to satisfy a debt of $5,000, and no further attempt was made to operate it. More than 25,000 acres lie below the canal, the greater portion of the land being located upon the second bench."

The same report (p. 279) shows this canal as having a right to 270 second feet - 16,900 acres - dated June 6, 1894, from the North Platte River.

It is not shown as having any right to water from the South Platte, although it has a headin in that stream. There have been many attempts to revive this enterprise, and since the report referred to above, a small amount of water from the South Platte has been run in the canal at times.

On August 2, 1918, in company with Carpenter, Colwell and Rosea, I crossed the line of this canal south of the river and west of North Platte. It had every appearance of being abandoned. On August 3 we continued east on the
south side of the Platte, and noted sections of the South Side Canal for several miles east from North Platte.

On August 9, 1916, with the same parties, I crossed the line of this canal on the highway west of North Platte between the two rivers. The highway and the railroad both are graded across the canal, and it was full of weeds showing that it could not carry water from the North Platte. We visited the inverted siphon which had carried the water of this canal beneath the South Platte. The top and parts of the sides of this siphon had rotted off and it was full of sand, the top being on a level with the bed of the river. We waded several small channels along the line of the siphon, and went to the north bank of the extreme south channel, which was carrying quite a stream of water, estimated at 100 second feet, but not measured. We could see on the south side of this channel the remains of old headworks in the South Platte. We did not go to them at that time.

On August 21, 1916, in company with Mr. Hosea, I visited these old headworks on the south side of the South Platte. A channel had been excavated from these headworks to the canal coming from the siphon, a distance of about 200 feet. The opening in the river bank between the bulkheads was about 40 feet wide. There was no evidence of any gates in this opening, to keep the river water out. There was a small grass and sand dam, fifteen to eighteen inches high across the nearest channel of the river to turn water into this heading. At the time of our visit a small stream, possibly one second foot, was entering the canal. This water flowed down to the end of the old siphon, and ran back into the river. About 100 feet below this point a bridge crosses the canal and at this bridge the canal has been filled with hay to keep the water from going on down the canal. The channel from the South Platte is large enough to carry water to fill the canal below the junction, but the bottom was too high to take water, except as noted, although the river was carrying about 500 second feet.
Other reports show the details of the use of this South Platte diversion in recent years.

On August 23, 1918, in North Platte, I discussed the attempts to revive this enterprise with W. V. Hoagland, and with County Agricultural Agent Bert Barber. Both believed very strongly in the feasibility of reviving the enterprise; that the company which last tried to do anything with it was defunct; that Mr. Keith had bought the ditch under foreclosure proceedings; and that the ditch had been abandoned so long that nobody owned it, as a ditch. Mr. Hoagland said that in his opinion its old priority could not be revived, that the right of way had reverted, and that the ditch could not be used without again securing a right of way from the farmers through whose land it passed. Both Hoagland and Barber stated that there were parties under the canal who opposed irrigation, and that it was impossible to revive the enterprise until these parties die or move. Mr. Hoagland stated that the parties who made the heading in the South Platte had filed an application for this diversion with the State Board of Irrigation — that he himself had made this application for them.

In North Platte I attempted to find a report on the rebuilding of this canal, which had been prepared by R. H. Willis, in 1914(?). Mr. Barber, the county agricultural agent knew of this report, as other parties interviewed, but no one knew where it could be found. So far as I was able to learn, none of the plans for revival contemplated the taking of water from the South Platte, and if this were done, it would have to be under a new appropriation which would be subsequent to all Colorado appropriations.

From the above statements it appears that there is little danger from the revival of defunct enterprises along the South Platte in Nebraska. The only defunct enterprises of any size on this section of the river are the Paxton Irrigation District and the Ogallala Power Canal, and the rights of both of these have been canceled by the State Board of Irrigation. The South Side Canal has

-54-
only late rights, if any, in the South Platte, and would not seem to be a menace to present Colorado users.

While it is my conclusion from a study of the records and an inspection of the country and the canals in the Platte and South Platte valleys, that the users of water from the South Platte in Colorado have little to fear from expansion under existing canals, or from the revival of abandoned enterprises, these Nebraska canals are always a possible source of trouble through litigation, which may be annoying and expensive, however it may be decided. If it is possible, some way should be found to force the Nebraska State Board of Irrigation to enforce the law of that state, and cancel the rights of abandoned enterprises, and cut down the rights of those partially abandoned to the amounts which are reasonably required for the lands irrigated. Theoretically rights on the main Platte are superior to later rights on the South Platte, and these old rights that still stand as good on the records of the State of Nebraska, are a theoretical cloud on the title of water users in Colorado, although, as I have stated, they are not, in my opinion, an actual menace.

Possible Future Development in the South Platte Valley in Nebraska.

As pointed out in the preceding pages, there has been no attempt at new development of irrigation enterprises in the South Platte Valley in Nebraska since 1896, a period of more than twenty years, while most of the enterprises initiated in the nineties have been abandoned. It would be natural to conclude from this that there is not likely to be any such development in the future. However, other considerations particularly the history of development in Colorado, make such a conclusion doubtful.

On the south side of the river, from the Colorado-Nebraska line east to far below the junction of the two forks of the Platte, there is a very fine body of valley land, and it is physically possible to carry water from the South Platte onto the high table lands where there is an unlimited area which it is
possible to irrigate. On the north side of the South Platte there is only a limited area which can be irrigated, while the level land between the two forks is served by the North Platte. There is, therefore, plenty of land available for future development. The limiting factors are the lack of desire on the part of the land owners to irrigate their lands, and the water supply.

As indicated above, the absence of any attempt to develop irrigation enterprises along the South Platte in Nebraska for more than twenty years past indicates a lack of desire on the part of land owners to use water for irrigation. It has been shown that further east, along the Platte, this indifference or opposition is strong enough to prevent the organization of irrigation districts. My observations in the valley in 1916 point the same way.

At the various times when the Western District Canal was observed there was water flowing past the head of the canal in the river, and there was water in the canal while crops under it were suffering for water. Further, it was evident that much of the land had never been prepared for the application of water, although it is in the district and the owners had to pay for water whether they used it or not. These conditions strengthen the impression there is at present little desire to irrigate in the valley of the South Platte in Nebraska.

It may be contended that this condition is due to the unsatisfactory character of the water supply. There is abundant evidence that the promoters of the unsuccessful enterprises on the South Platte and the Platte expected to get water only in flood season, and in the fall, and water has usually been available at those seasons, so that irrigation of that type has been possible through all the years since these enterprises were launched. Furthermore, there are in the hills south of the South Platte accessible and easily developed sites for reservoirs for storing winter and flood flows, with a dependable water supply in the river at those seasons for storage. On August 2, 1916, in com-
pany with Carpenter, Colwell and Hosea I visited several of these sites, and saw many of the basins holding water from rainfall, indicating that the soil is of such a character that the basin would hold stored water. It appears, therefore, that a water supply is available, if proper effort to conserve it is made. Other reports will show the streamflow available for storage as well as for direct use, and the report on return seepage will show that this supply is increasing, and is likely to continue to increase, as the use of water - mostly stored in winter and used in summer - along the river in Colorado increases. It appears, therefore, that the lack of desire to irrigate is the only serious limitation on the development in the South Platte Valley.

However, it is my opinion that this desire will come, and that eventually the whole valley will be irrigated. This belief is based on the history of development in Colorado. Agricultural development in the South Platte Valley in Colorado began on the tributaries above the mouth of the Cache la Poudre. The river below that point was not dependable, and storage was not then common. These tributaries were largely utilized and their surplus water stored before large development took place on the main stream. On the tributaries a very high type of agriculture has been developed - probably the highest type in the United States. When this had taken place, the same type of agriculture began to progress down the main stream. Return waters in the tributaries and storage along the main stream improved the water supply and made this development possible. This expansion has reached the Colorado-Nebraska line, in fact it has crossed the line at Julesburg. It is a common expression that the Julesburg District has the best water right on the river, although it is among the latest. Return water and adequate storage facilities insure a supply, where earlier rights higher up, without storage are insecure.

This favorable situation at the state line and below is likely to improve rather than deteriorate. The Riverside and North Sterling districts,
together covering acres, extending along the river for
are just fairly getting to using water – principally stored water. These lands
are rolling and will produce large seepage returns or direct return flow, in the
river below their points of diversion. Similarly, the Julesburg District, im-
mediately above the state line, is new, and will make larger contributions to
the river in the future.

The character of the water supply in this section of the river –
direct flow in flood season and stored water for late summer use – makes pos-
sible the highest type of agriculture. This development has reached the state
line, as stated, and there is no reason to suppose it will stop there. If the
present owners of the land in Nebraska are not progressive enough to make use
of their opportunities, it is probable that more progressive people will acquire
the land and water supply, and put it to use, as has been done in Colorado.

In my previous report already referred to (Office of Experiment
Station Bulletin 157, pp. 56-58) I reached the following conclusions regarding
the use of the South Platte for irrigation:

"The general conclusion regarding the effect of irrigation in Colo-
rado upon the supply of water in Nebraska is that the use of the water of the
Platte in Colorado has reduced the size of the spring floods, and also to a less
extent the flow in the late summer, but this summer flow has always been very
unreliable. At present the improvement in the flow of the stream during the
late summer due to return seepage has reached the state line and may be expect-
ed to continue down the stream. In that case the conditions along the stream
in Nebraska will be better than they have ever been before. The flood will
be less, but the supply after the floods have subsided will be more reliable.
Under the present arrangements there are irrigated from the South Platte and
tributaries in Colorado about 750,000 acres of land yielding annual crops worth
from $15 to $1,000 per acre,² supporting a large population in comfort, not only
²Mr. Adams collected complete crop returns for 24,329 acres, showing annual
returns of $19.84 per acre. This land was not in the most highly productive
section of the valley. The area planted to sugar beets in 1903 was 15,973
acres, with an average production of 13.46 tons per acre. At $4.50 per ton,
the usual price, this is $60.57 per acre, a total of $967,464 for the whole area.
Raspberries yielded as high as $1,018 per acre, potatoes $30 to $55 per acre,
and alfalfa $15 per acre. The acreages of these various crops are not avail-
able, hence no statement of total crop returns can be made.

without working any lasting harm to the farmers in Nebraska, but actually im-
proving their water supply. Stopping the use of the water in Colorado might
increase the supply in Nebraska for a few years, until the water supplied to the soil by years of irrigation had drained out, but there is every reason to believe that eventually the river would return to its former condition, and Nebraska would receive no lasting benefit, while Colorado would suffer the loss due to the return of 750,000 acres from intensively cultivated and highly productive farms to their original desert condition or worse, because the natural grasses have been destroyed. This would involve the loss of the capital invested in irrigation works, in railroads, in sugar factories, in farm buildings and implements, and in all the industries and business enterprises which are supported by a prosperous agricultural community. It would mean the ruin of other industries which now run on a narrow margin of profit, because of the increased cost of living due to the stopping of the local production of a food supply.

Even assuming that the natural flow of the stream would reach Nebraska if it were not used in Colorado, its use in Nebraska would necessitate the construction of new canals, farm buildings, grain elevators, mills, sugar factories, business houses, and residences. All over the United States the development of new sections by irrigation has been attended with financial losses and misunderstandings and recriminations between investors and irrigation works and the settlers under these works. The South Platte Valley in Colorado has passed through this period. At present 65 per cent of the land in the valley is watered by ditches owned by the farmers, and a satisfactory and economical system of ditch management has been worked out. This condition has been reached only after years of trouble between investors and settlers.

Under present conditions the water used on the lands near the headwaters returns in part to the streams to be used again farther down along their courses. This process continues down to the State line and will probably extend on into Nebraska. Supposing the use in Colorado is stopped and supposing the water reaches Nebraska, the return seepage, which will not be as great as it is in Colorado will reach the stream below where water is needed for irrigation, and there will be but one use of water where now it is used over and over.

Considered from an economic standpoint, the maintenance of the present status means the largest possible use of the water supply, since irrigation begins where the streams issue from their canyons, allowing the fullest opportunity for seepage return to the streams. It means the preservation of the homes and industries of the South Platte Valley in Colorado and the maintenance of the institutions which are the outgrowth of nearly a half century's experience, while Nebraska will receive a gradually increasing supply of water, which will eventually be better than would result from the stopping of irrigation in Colorado.

The present study serves merely to emphasize these conclusions. Since the previous report was written, development in Colorado has been marked—but right in line with my conclusions. Nebraska has not yet waked up to her opportunities, but will do so.

It is not believed that Nebraska has anything to gain from the present litigation. It is a suit to enforce priorities, regardless of state lines. The only Colorado canals having later rights than the Western District get little if any water in the low-water season, because of prior rights in Colorado. If they have infringed the rights of the Western District this has
happened only on isolated occasions, and the closing of these ditches at such times would not result in any general improvement in the water supply for the Western District. It might give it water on an occasional day when it would not otherwise get water, but that would be of little if any value to the district. What is needed is storage of water that now goes to waste. That would give the district the same dependable supply that the Colorado lands now have, and make possible the same high type of agriculture.

R. P. Beele
Probability of Loss of Water from the South Platte in Nebraska.

In my previous report reference was made (page 56) to a more or less common belief that water from the South Platte escapes to the southward into the tributaries of the Republican, and that, therefore, return seepage in the section of the river in Nebraska will not increase the flow to the same extent that it has done further up stream. In discussing this point the report of W. W. Follett, of measurements made in 1891, was cited. Since that time, other investigations bearing on this point have been made, and the reports of Mr. Follett, and of these other investigations are summarized below:

The following notes on Mr. Follett's report are based on the report as found in Senate Executive Document No. 41, Fifty-Second Congress, First Session, Part II, page 19+. During the summer of 1891, Mr. Follett ran lines of levels across the South Platte Valley at various points and determined the depth to water in existing wells along these lines.

What was termed the Sterling line extended from Akron, Colorado, northward to Lodge Pole Creek in Nebraska, striking it about ten miles west of Sidney, Nebraska, and crossing the South Platte at Sterling, Colorado. On this line, such water as was found in the wells was higher than the water in the river, except in Cedar Draw - about seven miles north of Sterling - where the water was at the same level as that in the river. Mr. Follett's conclusion regarding this line is as follows (p. 22):

"Like the Cheyenne line this one is negative in its results. It lies at about what may be called the northwestern limit of the Great Plains. The plateau country both north and south of the Platte is so high above the river that a deep hole would probably encounter rock in place far above the river's level."

The fact that the results along this line, and along others to be described later were not conclusive led to the running of a line east from Sterling to the headwaters of the Frenchman, known as the Frenchman
The reasons for running this line are stated by Mr. Follett as follows (p. 22):

"It is generally believed that these plains streams (the branches of the Republican on the north side, the Frenchman, Stinking Water, Red Willow, Medicine and Muddy Creeks) derive their water from the mountains through gravel strata, and it is locally supposed by all that the branches of the Republican on its north side derive their water from the Platte River. The data obtained from the Big Spring and North Platte lines (described further on in this report) was not such as to settle this question, and so you instructed me to run a line from Sterling, Colorado, eastward to the headwaters of Frenchman Creek".

Since the question under discussion is the condition in the South Platte Valley in Nebraska, the details of the results along this line will not be given. Mr. Follett's conclusion, however, is as follows (p. 23):

"Careful study of this line gives almost absolute conviction that the source of this water is not the Platte, and as the river cuts down far below the westward projection of the water bearing stratum it can not be from the mountains. The only inference is that the source is local and is the rainfall along near the crest of the divide".

Mr. Follett's report on a line crossing the river at Big Spring, and on another line crossing at North Platte, is quoted in full:

"The Big Spring line runs from the North Platte, 18 miles north of Big Spring, 33 miles south to the headwaters of Frenchman Creek at the east end of the Frenchman line, crossing the South Platte at Big Spring. The country between the two Plattes is a high table land broken up into ragged bluffs on the north. On the higher portion of the plateau the water supply is derived from a deep-lying gravel stratum under thin rock whose waters are artesian in character. The water in well No. 4 rose about 100 feet above the point where it was struck. It is locally believed that this vein is continuous with the two rivers. Examination of the profile shows this assumption erroneous. The North River is 50 feet lower than the South and the water in well No. 4 rises to a point 160 feet above the North Platte. Near the southern edge of the table land water is found in sand or in sandy clay in good quantity, but not rising very far in the well. Well No. 10 (not shown on the profile) lies in the bluffs just north of the South Platte, some 8 miles northeast of Big Spring. A large supply of water, rising 6 feet in the well, was struck in gravel under sandstone. The bottom of this well is a few feet above the Platte. The big spring at the station of that name comes out of the bluffs some 15 feet above the river. It comes out of or from under cemented gravel, and is probably from the vein supplying well 10.

South of Big Spring the country traversed is typical of the Great Plains. The line lies 1 mile east of the Colorado-Nebraska State line and strikes Venango on the Burlington railroad. At the northeast corner of Colorado the line strikes what is known as the State corner spring. There are several other good springs southwest of this one on the same or higher level. It flows about 5 gallons per minute and is 160 feet above the Platte. It comes out of
sandy clay in a long sandy arroyo, which furnishes water below the spring within a few feet of the surface. This group of springs is probably fed by local rainfall and has no value in the study of the "sheet water" of the locality.

Well 23 is the first one struck by the line south of the Platte Valley. Its water supply comes from a layer of gravel under cemented gravel 25 feet below the level of the Platte, but the water rises over 70 feet in the well. This is typical of the wells in the neighborhood.

At Venango well 23 is put down to what is locally called the third vein. As it is overlaid with a thin layer of rock and as its water rises some 40 feet above that of the second vein, it is undoubtedly a separate stratum. The well has been pumped 60 gallons per minute for one hour without materially lowering the water in the 5-inch hole.

From Venango south the water-bearing stratum rises, its level in well 23 being 3,350 feet above the sea level and the south end of the line (see well 263) 3,492. This elevation of 3,472 is 110 feet above the South Platte at Big Spring and is on the vein which supplies the Frenchman, the water of the latter stream coming to the surface about a mile and a half southeast of well 263. The wells on the south end of this line and on the Frenchman are undoubtedly in the same vein or veins and show that the line of greatest dip of the strata is north of east."

North Platte Line.

"This line runs from the head of the South Loup, 23 miles north of North Platte, 52 miles south to Medicine Creek, 3 miles east of Wellfleet. Owing to detours, the line run was 60 miles long.

The Loup rivers and their tributaries are plain streams rising in the eastern part of an extensive sand-hill country northwest of North Platte. At the point where this line strikes the South Loup Valley, water stands in pools and just begins to run. After reaching the table-land south of the Loup, the country is rolling prairie for 10 miles. Then the sand hills are entered and they continue to the Platte Valley. The water in the Loup is 160 feet above that of the Platte. Nearly all the wells examined reach water not artesian in character in sand or gravely sand about level with or slightly below the Loup. Wells 47 and 51 go down to a deeper vein and get water from gravel (under clay in 47 and sandstone in 51), which rises to the same level as the upper vein.

The town of North Platte lies between the two rivers about 3 miles above their junction. The valley is six miles wide. The channel of the south river is 10 feet above that of the North, and in November, 1890, when this line was run, was dry, the water level being 4 feet below the river bed. This valley is all a deposit of river sand and gravel and, if water moved freely in sand, it would be found on the same level across this valley. Such was not the case. The first water struck on the North side of the valley was in White Horse Creek. Its elevation was 2,788 feet above sea level, but it was crossed three-fourths of a mile east of the crossing of the rivers. The water in the North Platte was at elevation 2,760. That of the water in the wells at North Platte and in the South Platte was 2,792, and in Fremont Slough, 2,797, thus showing a difference of level of 9 feet in less than 4 miles square across the drainage.

South of North Platte the line strikes a high table-land over 200 feet above the Platte Valley. The soil is sandy, becoming hard, fine sand (loess) at the south end, where deep canons are cut into it, with almost vertical sides. Some of them are over 100 feet deep. Water on the plateau is generally found under cemented gravel in fine sand changing to gravel, and, except in 1 or 2 wells, is not artesian in character. Immediately south of the valley, the level
of the water-bearing stratum is practically that of the Platte, gradually
falling to the south. The south end of the line on Medicine Creek is 110
feet lower than the Platte. As stated before Medicine Creek has here a mini-
imum flow of about 30 cubic feet per second. This water comes out of the fine
sand near the head of the creek, and from stratum of cemented gravel lower
down. The stream is similar to the Frenchman."

Mr. Pollett draws no conclusion from his investigations for the
obvious reason that they are not conclusive.

Professor Robert Hay, Chief Geologist, Office of Irrigation Inquiry,
U. S. Dept. of Agriculture, engaged on the same general inquiry with which Mr.
Pollett was connected, in Part III, of the report referred to, discusses the
general subject of underground waters on the plains, and, after pointing out
that the ground water in the wells on the divides between the streams is higher
than the streams and that it comes from local precipitation, concludes as fol-
lows, regarding the flow of water from one stream to another (p. 33).

"But the trenches of the great rivers, Platte and Arkansas, cut
down also to bed rock; so that for the sub-plains waters north of the Platte
and between the Platte and the Platte, and between the Platte and the Arkansas, there is ab-
solutely no connection, and the plains of Texas are again separate from these.
That is, each region of the Great Plains are separated by the mountain rivers
is an independent area as to the source of its sub-waters. That source is in
each case the rainfall of the region itself."

In the summer of 1905, Charles S. Slichter and Henry C. Wolff, of
the U. S. Geological Survey, made an investigation of the underflow of the South
Platte Valley. (U.S. G.S. Water Supply and Irrigation Paper No. 184)."The pur-
pose of the survey was to determine what resources, if any, existed in the
underflow waters of the valley and whether it was practicable to make use of
such waters, if they were found to exist in suitable quantities, for purposes
of irrigation". (p. 5).

The greater part of the work was done at Ogallala, Nebraska, but
some was done near Sterling, Colorado. The essential features of the investiga-
tion were to determine the volume of the water-bearing materials and the rate
at which water moves through them. On page 7, this statement regarding the
volume of water-bearing material is made:
"From fig. 1 (p. 10) it will be seen that the river gravels are not very deep or extensive at Ogallala; all of the test wells, with one exception, were driven completely through the deposit. At station 1, two hundred feet south of the north bank of the river, good water-bearing gravel was found at a depth of 65 feet, where driving ceased. The average depth of the gravel between stations 9 and 4 (approximately one-third mile north and south of the river channel) was found to be about 40 feet. At the edges of the valley, beyond these stations, the gravels probably thin out very abruptly, for at the section line shown at the right of the figure and in the bluffs shown at the left appears the undisturbed formation within which the valley is cut".

In this same discussion, on page 8, it is stated, referring to the same gravels:

"The gravels in all cases where test wells were put down have a sharply defined lower limit, resting upon a soft formation of sand (usually very fine) and calcareous grit. In places, however, the material is so firmly cemented that it offered considerable resistance to the driving of the test wells. This underlying material is practically impervious, as in only a few cases was it possible to draw water from it, and even then only with great difficulty."

And again (p. 12)

"The total cross section of gravels capable of transmitting water is less than 330,000 square feet. The average velocity of the ground water in this material does not exceed seven feet per twenty-four hours. From this it can be readily concluded that the total amount of ground water passing between the river bluffs at Ogallala does not exceed 10 second feet."

In 1914 and 1915 the Irrigation Division of the Bureau of Public Roads of the U.S. Dept. of Agriculture made an investigation of ground water conditions in the Platte River Valley, but did not extend this work west of North Platte. The condition found at North Platte was as follows:

"At North Platte, Nebraska, the water table forms a gradient sloping down from the hills bordering each side of the valley toward the river beds of the North and South Platte rivers and reaches the lowest point at well No. 5, which is about one-half mile north of the North Platte River and about 2 miles north of the South Platte River, thus forming a "U" or trough shaped surface." (Unpublished report by H. C. Diesen).

Reviewing the reports referred to, it appears that Mellett's results were not conclusive; Hay is quite positive that the water in any valley remains in that valley; Slichter and Wolff, are even more positive that, at Ogallala, at least, the water will be confined within the valley, and in a very small section, too. Diesen indicates that somewhat the same condition exists at North Platte.
From all of these investigations, it appears that any water entering this portion of the valley, and not lost by evaporation or plant transpiration will remain in the valley, and that the supply in the stream will be increased by return seepage as more water is used immediately above the state line in Colorado, or in Nebraska.

Sligher and Wolff included in their work a determination of the velocity and direction of the movement of the ground water at Ogallala. It was found that the greatest velocity was down stream, this velocity varying from 2.3 to 15.6 feet per twenty-four hours, and the average 5.4 feet per twenty-four hours. The direction of the flow within the river channel was down stream (p.11).

At station 10, located 550 feet north of the north bank of the river, there was a flow toward the river at the rate of .76 foot per twenty-four hours; at station 9, located 1,600 north of the North bank of the river, there was a movement toward the river at the rate of 3.2 feet per day; and at station 4, located 1,400 feet south of the south bank of the river, the rate of flow toward the river was 2 feet per twenty-four hours. This rate would, of course, vary with the relative heights of the water in the river and the surface of the ground water at the sides of the channel, as well as with the character of the material through which the flow is taking place. The material here was river gravel. Seepage toward the river through soil, back from the stream would tend to be slower, although the slopes might be greater, tending to offset the greater fineness of the materials.

The rate of movement of water toward the stream has an important bearing upon the situation on the South Platte, with reference to return seepage. So far as the writer knows there is no direct data showing how long a time is required for seepage water from canals or irrigated land to reach the main drainage channel of the valley in which the land lies, and at best data from one section would only be of general value in predicting returns from any other section,
on account of the variation in conditions. The rate of movement of return waters would vary with the texture of the soil, the slope toward the drainage channel, the occurrence of impervious strata preventing downward percolation, the height of the water table, the quantities of water used, and other factors. Yet the results of the measurements of Slichter and Wolff do throw valuable light on the subject.
Duplicate pages not scanned

See originals in folder