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The Irrigation of Our Plains.

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- Kansas and the underflow.

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Wherever the art of irrigation originated, among what people, or at whatever period of time, never was there at any other age, a more wide spread interest in this work than that felt today. This feeling has been growing until the interest now manifest in the United States gives promise, especially in that portion west of the Mississippi, of results that will exceed in extent any work yet accomplished by those eastern nations which have had centuries of experience.

It is only since 1888 that our government has taken a real active interest in the investigation or, in aiding in the development of our resources for this work—a work that promises so great an increase in our national wealth.

Of the extensive work that has been carried on of late years, Kansas, as a state, should be especially interested in the investigation of the underflow water, and that this may be well understood, the importance of some knowledge of the geological formations of the state is apparent.

In the eastern portion of the state,

we have the upper Coal Measures extending as far west as Cowley county on the south and as Marshall county on the north. West of this we have the permian formation extending almost straight across the state and, is about two counties in width at the south, narrowing to about one on the north. Next, we have the Dakota sand-stone district extending south west from the state line north of Washington county, passing through the counties Ottawa, Saline, McPherson, Rice and portions of others. Again, west of this lies another strip of country, similar in its size and in its general direction, known as the Fort Benton formation. South of these, extending west from Reno county, is the Tertiary; while still farther south the Triassic ("red beds") extend along the line of the state next the Indian Territory. The Tertiary includes almost all of that portion of the state west of the one-hundredth meridian. Add to these a rather small area of Niobrara skirting the Fort Benton and Tertiary, a smaller portion of Comanche, between the Tertiary and red-beds, and a district, somewhat smaller than the last described, of the lower

Coal measures in the south east, and we have most of the surface formation Kansas. Now the question is- how will these different formations effect the undertaking of different irrigational enterprises?

The work that is being carried on by the State University, when completed, will be an aid in determining our natural resources for irrigational purposes. The first volume of their report was issued from the press but a few weeks since. This portion of their report gives us no information of the stratigraphy west of Abilene and, If we may rely on a statement in a Governmental Report of 1892 only that portion of the state which lies west of the one-hundredth meridian is in danger of being entirely abandoned to the herder- a portion where the Tertiary formation is most abundant.

The Governmental Reports have been examined to some extent but, they are generally quite bulky and difficult to do anything with in a reasonable length of time. The following obtained from a Geological Report of 1892 will be of some interest.

"Plain's marl,

Tertiary grit,
Yellow chalk,
Blue shale, } Niobrara."

This was taken from an exposure in Norton county near the fortieth parallel on the one-hundredth meridian, in the Prairie Dog Valley.

"Farther west toward the Colorado line, the section is about this:

The plain's marl,
Tertiary grit,
Carbonaceous and clay shales (Fox Hill or Pierre).

On the White Woman, farther south, as also on the Smoky, in Kansas, the order runs—

Plain's marl,
Tertiary grit,
Chalk,
Blue shale, } Niobrara.

On the Arkansas the section is—

Plain's marl,
Tertiary grit,
Benton ledges.

On Bear Creek it is—

Plain's marl,
Tertiary grit,
Dakota.

On the Cimarron we get-
Plains' marl,
Tertiary grit,
Trinity sands."

(Geological Report 1892 p. 20)

It will be noticed, that in the description of the surface geology given above, the term "Plains' marl" was not mentioned. In that description, my authority is a map found in The University Geological Report of Kansas Vol. I — just issued. There is another formation not indicated on this map, that of the drift which is found to cross the north east corner of the state. As to "Plains' marl," it seems to be a new geological term employed by the government geologist and applied to a late surface formation. Of these formations, the Dakota, Tertiary grit, Trinity sands and the drift, are of the greatest importance on account of their porous condition and water holding qualities.

The streams which cross the western portion of the state, that still have their beds above the Tertiary grit, are apt to be found without running water, it having sank

down into the grit beneath. In places where the streams have cut clear through the grit, water may be found and such streams will have a tendency to drain the underflow from the adjoining country.

As to the general topography of the state, "The elevation above the sea level from Kansas City to Denver is steadily progressive; at the former place it is 681 feet, and at Denver 5170 feet." (Government Report on Irrigation 1892 Part I, p. 301). The different strata through this region lie very nearly horizontal, dipping slightly to the east. A dip of from only 5 to 10 feet per mile is very common. In fact, a dip of from 100 to 200 feet per mile is rarely found any where in the Great Plains.

After sufficient data concerning the geological formation have been gathered, the next question is an investigation of our water supply. Originally this all comes from precipitation, but, for our purpose this may be divided as follows: (1) rainfall that enters the soil, (2) stream and surface water, (3) under ground water.

The rainfall of the state varies with

the year, seasons and locality. In speaking of the rainfall, Kansas is often divided into the following sections: eastern, middle and western Kansas. The divisions are purely arbitrary, however, and the division lines very indefinite. As to the rainfall of eastern Kansas, she usually receives enough to make her crops average as well as almost any locality in the United States. Yet, we are usually placed in that list of states called the subhumid states. This is due to the insufficient rainfall in middle and western Kansas. In the central portion of the state, we quite often have average crops and if the water that falls could be rightly distributed there is probably no portion of the state, if we except the strip west of the one-hundredth meridian, but that could raise sufficient crops any year to at least support the population and keep their stock in good condition. Following are some figures on the monthly precipitation of 1887, calculated from a diagram found in the Irrigation Census for 1890: At Independence for Jan. and Nov. a little below 2 in., for Feb., March and Dec. 2 in. or a little above, for April, August, Sept. and Oct. 3 in. and over, for May and July a little over 4 in. and for June 5 in.

at Ft. Riley it ranges from ½ in. in Jan. to 4 in. in July; at Allison the variation was from 4½ in. July to almost ¼ in. in Nov.; and at Monument from 3½ in. in April to ¼ in. in Dec.

The lowest annual rainfall at Ft Riley, between 1860 and 1889, was that of 1874 which was about 14 in.; while at Lawrence, for the same year, it was about 30 in. The heaviest annual rainfall recorded at Ft. Riley in the period named was about 38 in. in 1876. The rainfall on the one-hundredth meridian varies from 18 to 20 in., gradually growing less as we go west until, at the 105th, in Colorado, it is 12 or 14 in.

These last figures stand as an index to a knowledge of the source of water supply for our western streams and, as seems quite likely, for a large portion of our underflow water. As to the streams of the state, our geography is well known; but our knowledge of the underground water is more meagre.

The phenomena of this phreatic water, of our own state especially, has been a matter of much discussion. The following promises relief to those who are anxious to form more definite and correct opinions on this matter. I quote from the Governmental Report of

1892 (p. 288) on Irrigation: "The final reports of the field staff of the artesian and underflow investigation are a full presentation of the physical conditions of irrigation possibilities of the Great Plains region, rendering any further effort a work of supererogation." The same authority is responsible for these statements:

"The points that follow may be regarded as established facts:

(1) Every Union Pacific Railway well between Kansas City and Denver can be pumped dry

(2) The elevation does not have much to do with access to water, showing that the water-bearing strata are not of uniform deposition.

(3) The water is generally good and is used by the residents for many miles around the wells in the more unsettled portions.

(4) Where the water is bad inorganic matter is in solution, and this varies in quantity and quality.

(5) A fairly uniform depth may be expected for well on same general plateau.

(6) Failure to find water is rare.

(7) No engineering difficulties present themselves, that is, none which are insurmountable.

(8) The difference in elevation between the eastern and western well test is 2,927 ft.

(9) The average fall from west to east is about 9 5-4 feet per. mile for distance covered

(10) In places penetration of the fresh-water strata results in securing salt water." (p. 305).

Although, as stated above, these wells can be pumped dry, this statement should not be allowed to mislead the reader to think the supply of water insufficient for irrigation. These some Reports contain statements infering that it is quite certain the water supply is sufficiently abundant for this work.

The government, at last account, was still investigating, making attempts to accurately determin the source of this phreatic water. Whatever the source, this will matter little if the supply remains constant. I have before indicated that the great extent of this underflow water, is due to the Tertiary and drift formations which absorb and hold the moisture until they become supersaturated, when it percolates through their grit or gravel structure to portions less moist, or, sometimes appears in the forms of springs and seeps where their lower formations crop out. When we remember that a large area of the Tertiary formation which extends west from Kansas into

Colorado and is there exposed at a considerably higher elevation to an annual precipitation of from 12 to 14 in., our hopes for a good water supply are encouraging.

Under certain conditions, this underflow water will produce artesian wells and, in a few counties, our state is favored with these conditions. The largest area thus favored is in the south west in the Tertiary formations. Another portion, due to the drift formation is found in the north east.

With the data at hand in the form of Governmental and State Reports and with the addition of that which will soon be available, every one who is interested may easily obtain a knowledge of our natural resources; and the more widely these are known the greater the prospects for irrigation. Farmers are asking themselves everyday how we can utilize our resources?

The proper cultivation of the soil will aid in utilizing the moisture. But in the greater portion of the state we can do better than to stop here. Over the eastern half of the state, a great amount of good would result from a damming of certain streams and then properly ditching their waters over large and fertile bottoms.

Take our Blue valley for example. Here we have a very constant flow for this country and a sufficient fall - the flow for 1895 averaging 5.20 cu. ft. per. second. Engineers say the stream can be dammed and the water ditched at a comparatively low figure and the value of the land raised, thereby, to about $300.00 per. acre. The same is true of other streams and localities.

Perhaps our greatest attempts to ditch a streams have resulted in the construction of the canals along the Arkansas from about Syracuse down to and below Dodge City. These canals are owned by companies that furnish water to the farmers for from $1 to $2 per. acre, per. acre irrigated, or some will sell canal rights for $15 per. acre. Although their water supply is sometimes cut short, the river being ditched in Colorado, much aid is rendered these farmers.

A method known as subirrigation has according to the Irrigation Census of 1890, been successfully carried on in places along the Republican and other streams.

The possibility of utilizing the phreatic water is a problem nearly solved and the demonstration of this has begun to effect our own state. In the case of artesian wells, when the water

is of the right quality, it is simply a question of being able to put down the well and ditch the surface. Valuable information, regarding these wells, may be obtained by examining tables found in the Irrigation Census for 1890 and in Governmental Reports especially that of 1892 on Engineering.

Where the water has to be raised to the surface, the irrigation problem is a little more complex. It is not only the question of putting down the wells and ditching the ground but also one of raising the underflow water. Reliable tables giving figures on cost, area irrigated, and on other points of interest will be found in the Census named above.

Various means have been employed for furnishing power to raise this water. Engines are sometimes used; in some countries animal power is the source of energy; but to the Kansan, the promising expectations of the mechanical engineer to improve the wind mill, are likewise promising of cheaper means of irrigation. At present, the difficulty in using wind power is that either the wheels are too small to utilize low winds, or too large and heavy for the high winds and are apt to be broken. To

improve on these, engineers are investigating automatic methods of loading the mill, or varying the load, and means of holding the wheel square in the wind until it is dangerous to do so longer, when, the mill, through its own mechanism, will be enabled to get entirely out of the way. These improvements are said to be possible and thus the use of larger wheels may become general. Then, with the aid of reservoirs for storage water, the western farmer may have many of his anxieties removed.

But are we entirely dependent upon these improvements? In one of the quotations given above, we have good authority for saying that, with our present means, the engineering difficulties are not insurmountable. But the pioneer farmers of western Kansas are not capitalists by any means. The aid of corporations and the aid the state can give to develop great undertakings are needed. Again I quote from the Governmental Report on Irrigation for 1892 (p. 8-087): "The results, if successful, would be bewildering. Where the bare, brown plains stretch away in the distance, the home of the prairie dog and the antelope, no reach of imagination is required to see a mental photograph of the tree-

lined village, the garden with enormous vegitables, the town about the central water supply and the green and growing crops as far as the eye can reach. It is a beautiful picture, every color of which inheres in the water underlying the scene." The work begun by the government may result in great good if carried to success by the state.

The possibility of making small reservoirs to store surface water has not been mentioned. Many localities that favor such irrigation plants, may be found as the future will doubtless demonstrate. It is only when Kansas learns to use all her resources that her water supply will be found sufficient, When this has been accomplished her early struggles with drought will have resulted in placing her in the first rank of agricultural states.