A RECONNOISSANCE IN THE CACHE A LA POUDRE VALLEY, COLORADO.

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SOILS AND ALKALI.

The Cache a la Poudre Valley, or the Greeley country, as it is sometimes called, is one of the oldest as it is one of the most prosperous irrigation districts of the West.

One month was spent in a reconnoissance of this valley in the summer of 1899, and as the conditions there are unique in a way the results of the investigations may be of more than mere local interest.

The Cache a la Poudre Valley, or at least that part of it which lies east of the foothills of the Rocky Mountains, is cut from a series of nearly horizontal strata of cretaceous rocks. That portion of these strata which is exposed in the irrigated parts of the valley is largely sandstone or sandy shale, though at some places a bed of heavy blue shale is exposed. From these shales and sandstones the soils of the valley are formed, modified in a measure by the mixture of materials brought down from the mountains by the streams. The farming lands are situated on a more or less perfect system of terraces extending back from the stream and merging indefinitely into the upland, which consists of hills rounded by erosion. The lateral valleys, which extend back from the main Poudre Valley, are the result of flood erosion, no water flowing through any of them before irrigation was practiced except during times of heavy rains.

The soils of the bottom lands are generally sandy or gravelly, with coarse, gravelly subsoils. Such soils, where well drained, furnish excellent truck lands; but the greater part of this low land is wet from the seepage from the upper irrigated lands, and at present is used for pasturage and hay crops.

The second and third bottoms consist of heavier soils, becoming in some places a heavy clay. This clay land, on account of its impervious nature, acts as an obstruction to the flow of seepage waters from the uplands, and is in consequence often wet or alkaline. This type of land abuts directly against the upland soils, and extends around the mouths of the draws and lateral valleys. The same type

of heavy soil is found in the bottoms of the draws, where the natural moisture has collected the fine particles of soil from the hillsides and promoted the disintegration of the large grains.

The greater part of the farming lands of the valley lies upon the rounded hills of the uplands. The soil on these hills is a sandy loam in nearly all cases, varying slightly in texture. Immediately north of Greeley it contains about 7 per cent of clay, while north of New Windsor it contains 12 per cent, and around Fort Collins the soils are as a rule still heavier.

Many inclosed basins are found throughout the country, in the bottoms of which the soil is heavy and impervious. In these natural basins the water collects after each rain, and when they are irrigated the waste water collects in the lowest parts, forming swamps. The bottom lands were the first to be irrigated, and as the country became more thickly settled new canals were built covering the higher lands. In this way the irrigated land has extended back from the river to a distance in some places of more than 10 miles. The construction of one canal above another in this way has opened a wide field for inquiry into the possibilities of damage from seepage water, and in the present investigation special attention was given to the damage already done and to the possible remedies for this damage.

Since the time allotted to the field work was too short to warrant a complete study of the district, two townships were selected, comprising a strip of land from the Poudre to the desert land above the uppermost canal, the Larimer County Canal. This section was studied in detail, and the areas of wet or alkali soil were outlined in the field on a map. In this way a definite idea was obtained of the amount of wet land which at present exists, and the best means for removing this excess of water were considered.

It was found that the amount of wet land under the Larimer County Canal is small and confined to the bottoms of draws and land immediately adjoining the canal. The whole of the area under the Larimer County Canal is not farmed at present, but when all the land is farmed this area of wet land will be likely to increase. The seepage water, however, seems to originate in the losses from the canals and constantly running laterals rather than in seepage from the irrigated fields.

Professor Carpenter, of the Colorado Experiment Station, has investigated the question of the origin of the seepage waters, and, in his opinion, the greater part comes from the canals and laterals.

The material through which the canals run is largely loose in character, and the water is clear, carrying very little material which would clog the interstitial spaces of the soil. There can be no question, however, but that over irrigation, through ignorance or neglect, is also the cause of much seepage. The effect of over irrigation is very noticeable in some districts, and the careless use of water can not be too strongly condemned. It not only injures the land to which it is applied, but it

also largely increases the seepage water to the destruction of lower lands.

Under the Larimer and Weld Canal the amount of actual damage is greater than under the Larimer County Canal. The lands have been under irrigation longer and the subsoil has had more opportunity to fill up; besides, the amount of land irrigated is larger. This land also receives the seepage from the lands under the Larimer County Canal.

Under No. 2 canal the amount of wet land is still larger than under either of the canals above mentioned. It receives the seepage from all the land above, as well as the seepage from several reservoirs situated at a higher elevation. The soils under No. 2 canal are heavier than the upland soils, the land is more level, and the natural drainage is poorer. In the district mapped several large areas of wet land under this canal are shown. This area receives the direct seepage from all the upland, and since the underlying beds of gravel are not contiguous to give adequate drainage, the water tends to rise to the surface in places and swamps are formed.

One of the first questions which should be considered in the opening of new farming lands is the drainage. If the natural drainage is good—that is, if the excess of water is quickly removed from the subsoil—the installation of drains is not necessary, but if the water at any time stands within the subsoil or if the excess of water, applied through irrigation or falling as rain, does not quickly pass away through the underground drainage the crops grown upon the land will suffer and the farmer will not obtain the best results from his efforts. The wet land of an irrigated country should be immediately drained when the level of water rises closer than within 3 feet of the surface of the ground. It may be that the water rises near the surface only during a limited period of the year, but this may be long enough to injure a crop.

The underground waters of an irrigated district situated within the arid regions of the West are never free from salts in solution. When this water is allowed to approach the surface of the ground it evaporates, leaving its burden of salt on or near the surface. The salt continues to accumulate in this manner unless the surface water is drained away. Usually such a quantity of salt accumulates that nothing useful will grow upon the land. When reclamation is attempted both the water and salt have to be removed, thus making the work of reclamation very difficult and costly. From the standpoint of economy, therefore, it is much better to install drains before or at least as soon as the ground becomes wet. This will not only remove the excess of water, but will insure the land against ever becoming alkaline.

In the Greeley district the process has as yet gone in most places only far enough to damage the ground from water. If the water is not removed much more damage is probable from alkali. A wet piece of ground is valuable in some cases as pasture, but a piece of badly alkaline land is practically worthless. The underground waters are not

highly charged with salts and the evolution of an alkali flat is slow, but none the less sure. In the shales of the underlying rocks quantities of alkali are stored, and where the seepage water passes through this shale and appears again the accumulation of alkali at the surface is much more rapid.

Repeated tests were made for sodium carbonate, but none was found. This was to be expected, since all of the soils contain small quantities of gypsum, which is the chemical antidote for black alkali.

There is no chemical preparation known which would render the alkali of the Poudre Valley harmless, consequently in order to redeem the lands already damaged these salts must be removed from the soils and removed so far that there can be no possibility of their ever coming back again. There is but one known way of effectively removing these alkali salts, and that is by underdrainage. In the Poudre Valley at present only the lower lands are in need of drainage. The lower lands along the Poudre River and the immediate bottoms of the draws extending back into the hills should be drained at once. In some cases a simple line of drains up the center of the draw would suffice for the present and would insure much of the bottom land from damage. By drawing off the water from the hill land through proper drains in the bottom of the draws, much less water would reach the Poudre bottoms as seepage. The larger tracts of land in the draws and Poudre bottoms should be thoroughly tiled. The shallow basins and sinks offer the most serious difficulties in the construction of drains. Where the basin has a shallow depth the expense of cutting an outlet for the water may be slight, but where the basin is deep the expense of cutting an outlet is liable to be great.

SUMMARY.

Considerable damage has been felt in parts of the Poudre Valley from wet or alkali soils. Such wet or alkali tracts are the natural result of poor drainage. Tile drains should be installed in all the lower lands both to remove the excess of water and to prevent the accumulation of alkali. With continued irrigation of the uplands the amount of possible damage to the lower lands is very great and to insure against this damage the drainage should be commenced at once.

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