[Proceedings of the Iowa Academy of Science](https://scholarworks.uni.edu/pias)

Volume 17 | Annual Issue Article 19

1910

Some Geological Aspects of Artificial Drainage in Iowa

G. G. Wheat

SOME GEOLOGICAL ASPECTS OF ARTIFICIAL DRAINAGE IN IOWA.

BY G. G. WHEAT.

Nature's unfinished work in the Wisconsin drift areas of Iowa has left the lands peculiarly subject to submergence in times of heavy precipitation. The magnitude of the drainage projects which would be required to carry out the incomplete work of Nature's young river systems, for a long time held back the development of drainage. Recent legislation, making possible the creation of drainage districts upon the petition of a reasonable number of land holders interested, has led to a most rapid growth in farm land drainage. Those who are familiar with the topography of the Wisconsin Drift area, in the counties of Cerro Gordo, Hancock, Palo Alto ,Eastern Clay, Humboldt, Pocahontas, Eastern Buena Vista, Calhoun, Webster, Hamilton, Worth, Winnebago, Kossuth, Emmet and Dickinson, are aware that the Des Moines, Iowa and Cedar rivers have developed very few tributaries; that these are not deeply eroded and that the headwaters of these branches frequently rise in a marsh. The second typical feature of this region is the saucer-like basins or upland ponds, which usually have no outlet, except that one side may be a little lower than the other by a few inches. Drainage districts in this area almost always show chains of these ponds, united by extremely shallow depressions, unworthy of the name of ravine, coulee, or even swale. Depressions so slight as to be invisible to any but the practiced eye, when the fields are uniform in color in winter.

The methods used at present in drainage, are those which first suggested themselves to the mind of man who has no other desire than to get rid of the water. Beginning at some point where an outlet can be secured, at the lower end of the drainage system, open ditches are constructed, leading toward the upper limits of the water-shed. Frequently other open ditches are branched from this in dendritic system, although sometimes a drainage plat makes me want to use another term and say, the branches are in hieroglyphic fashion. When the open ditch has been carried far enough so that a 30-inch diameter tile is sufficient to take care of waters from the remaining water-shed above, tile are then laid, the extreme limits of the drainage system being the last small branches laid by individual farmers, draining their acres.

The magnitude of some of these undertakings may have been overlooked by some members of the academy. Kossuth County has one drainage ditch costing in the neighborhood of $483,000 for the mains alone. The laterals which the land owners will lay will amount to fully four times the cost of the original ditch, making a total expenditure of approximately $2,500,000. This project is a logical extension of the East Branch of the Des Moines River and brings easily and quickly within the water-shed this acreage which formerly has had no outlet, except such outlet as was gained by overflow from the depressions, when rainfall became excessive, and the other outlet is straight up, by evaporation, which is, of course, too slow an outlet to render the land of agricultural value.

A second type of river improvement found necessary for the reclamation of lands, can be studied in the Harrison-Monona Ditch, which differs so widely from the one just mentioned that it might well become the subject of an entirely independent study, were it not for the fact that the problems involved are so intimately related to the problems and the work of the first type of reclamation that it is deemed permissable and wise to discuss it in relation to the former. In this second case of the improvement of the Little Sioux River in Harrison and Monona Counties, the project costs nearly the same, one-half million of dollars. It is there planned to straighten the native channel of the river, until three times the original carrying capacity is secured. Parallel to this new river channel an immense ditch is being dug that, in places, is eighteen feet deep, 90 feet from berm to berm on top and 30 feet across the bottom. The capacity of this dug ditch is estimated at four times the original carrying capacity of the native river channel, making an increased power of run-off fully seven times that of the native stream. The object sought in this case is to provide free run-off for the waters, which formerly have flooded the low flats of the river valley. Those of you who have examined the flood plains of the tributaries running into the Missouri River form Western Iowa, have discovered that, in many cases, if possibly not in all, the river has built levees for itself until it meanders through alluvial soil of its own deposit at a level considerably higher, sometimes as much as four or five feet, than the level at the foot of the bluffs some miles away.

A third feature sought for in the drainage of these Iowa lands is the reclamation of swamp, bog and shallow lake. These are, again, a separate problem in drainage engineering and are frequently so treated. Yet, to the hydrographer, whom we, unfortunately, have not had on our drainage work, these lakes and bogs at once appeal as being intimately related to the control of river flows and flood plain reclamation. Imagine observing from a balloon, Nature would show us an area, with many ponds and lakes, which catch and hold the rainfall within the water-shed. Only the overflow, and that which falls within the immediate water-shed of the river, contributes to the increase of river flood flow. In the times of the prairie, before the plow had broken the surface, rendering it more penetrable by the rain, floods were common, as evidenced by the deposits on the river flats and the meandering courses of these rivers. Deposits of soil eroded from the water-shed were, in these earlier days, comparatively small. Many of the rivers had clear water and pebbly bottoms. Since cultivation, conditions are so changed that more of the rainfall is absorbed directly by the soil. Floods have not been so frequent because the run-off is reduced, but those which do occur have been more destructive in their nature, carrying the loosened soil, to fill the channels and obstruct the flow, driving it out over the river flats.

The part played by these upland ponds and by the lakes, marshes and swamps, has been to catch and hold back much of the rainfall from causing floods in the river. Destructive floods, caused by rainfall alone, have been infrequent until within the past ten years, excepting within special sections. An illustration of these floods may be found in the year 1906. If dates are not mixed, the month of April was peculiarly dry. In May the rains early became excessive, lasting on until about the 10th of June. During the early part of May, it was frequently remarked by farmers and other observant men, that the ground took care of all the rainfall in excellent manner, the roads remaining good and drying rapidly within a few days. These conditions continued until the first week in June, when it was observed that ponds were beginning to fill, and the roads would no longer dry. During the first ten days of June, of almost continuous rainfall, all of the ponds and every depression rapidly filled to overflowing, and when, at last, one general rain came over the whole Des Moines River valley, these ponds, which were already filled to their utmost capacity, overflowed, flooding the river flat for miles in width, forest trees were drowned, bridges destroyed, crops inundated, heavy deposits of silt formed and everything growing was made profitless, except the late crop of hay, which practically formed after the flood. Let us still consider that we are in a balloon, watching the whole proceding. Had we been able, with our fingers, to trace some channels to conduct water from these depressions to the main river channel, enabling them to carry, from the water-shed, excess waters and thus prevent the great accumulation which finally overloaded the whole river to the flooding limit, this final disastrous flood, it is plain to be seen, could have been greatly reduced, if not entirely prevented. Then, again, had we been able to do this very thing, permitting the rapid escape of waters to the river, without any control, we might have produced floods of a no less serious nature, as will be observed from our former statement of how the final general rainfall brought flood. This sort of provision for rapid escape of waters, without any control, is what is being sought by the engineer in the constructon of miles of open ditches in one drainage district, and hundreds of these drainage systems as extensions of one river system. If you are still with us in the balloon, at that time, observing the whole face of the Des Moines River water-shed, you would see that every lake and pond and depression was carrying its full capacity of waters; that the grounds themselves, had you dug into these soils in this area, you would have found carrying their full load of absorbed water. This suggests to us the necessity for the better control of these waters, than the mere construction of open ditches, to allow the escape of superfluous rainfall—some means by which the waters can be caught and held back and slowly fed to the river channels, enabling them to work continuously, with an even, regular flow of waters. Let us still consider that we are observing this area from a balloon. An engineer, at your side and mine, looking into the flooded channel of the Des Moines River, suggests, ''We must straighten and deepen the channel of that river, enabling it to carry off these flood waters seven times faster than it now does. Then this flood would be prevented, these lands would be reclaimed and this loss would be stopped.'' This is what is being tried in Harrison and Monona counties, in that big ditch. At our side in the car of the balloon speaks up the forester friend, saying:

''But you must reforest large sections of the water-shed in the head waters of these rivers. Forest retards the run-off until it soaks into the soil, is given off in springs, feeding continuously and steadily into small streams, these, in turn, furnishing even feed for the main river channels, of clear, non-sediment-bearing water, and your troubles will be over.''

The suggestions of our friend the forester are excellent, as viewed from directly above the lands, but when you stand on the ground, observing the value of each acre, its importance as a part of the food-bearing acreage of America, observing also that there is but little necessity, at any place, for trees to retard erosion of soils, the rare exception being the hill-sides and the gullies which are extended slightly out from the Des Moines main river channel, and in but very few places; the additional fact, growing out of this, that the slope of lands is insufficient to provide a gravity outlet through the sub-soils into streams; the further fact that these streams do not exist, we are again thrown back upon the problem of creating an outlet for these waters and controlling them in their passage to the main river channels. The reclamation service engineer, whom we can imagine with us in the balloon car, hitherto silent, speaks up, with the suggestion:

"Save these waters and dam them in reservoirs, where they can be fed off to irriate your lands in times of drouth, can be utilized for water power, with electric transmission, to control rapid transit, your manufacturing and your domestic needs."

Drop again to earth, where you can see things on the level, and search for valleys in the mountains, deep river channels, great lakes or canyons where waters can be stored. They cannot be found. There is truth in the suggestions of the reclamation service engineer, which may be worked out, but it is so remote as a practical possibility that it is out of the question at this period of industrial and agricultural development in this new section of our country.

If we can secure the desired result of storing and feeding the waters gradually to the river, we have overcome the flood, we have gained the point the forester urges, we have accomplished the desires of the drainage engineer, provided we do not need to overflow or submerge valuable lands in order to do this. It may be well, for a moment, while we are still on earth, to examine a few peculiar looking spots which we noted from the balloon car. This black splotch over in Kossuth County is the unexpected result of one drainage ditch, running into Kossuth County from Winnebago County. This drainage ditch cost $86,000. Let me mention, in passing, that this $86,000 is approximately one-five hundredth part of the total probable public drainage which will be constructed in the twenty-five or thirty counties. This big black splotch upon the landscape we find, on close inspection, to be a deposit of fine, rich, black alluvial soil, washed from the surface of some of the richest land in Iowa, into an open drainage ditch and carried to the outlet, which fortunately happened to be upon an ancient river terrace, permitting the sedimentation of the ditch water load upon the river flats. According to the engineer's and the county supervisors' estimates, 160 acres of land have been covered with material carried by this one drainage ditch, to a depth averaging two feet, since the completion of the ditch in June of 1908. Let us arise again in the balloon car and look at these thirty counties and imagine 350 such splotches upon the surface of thirty counties—more than ten to a county. Ten quarter sections of the richest of Iowa lands being carried away annually. Industrially, could we endure the loss? Geographically, how long would it take to rob us of our richest heritage? Where these ditches run into rivers, the effects are not so readily observed, but they are none the less there. In one other region, where you look from our point of vantage over into the watershed of a neighboring river, you see an unusual flood following each more than ordinarily heavy rainfall, this flood covering but a short section of the river, measuring from head to mouth. Above and below, no floods. This strip of fifteen or twenty miles, being inundated after each heavy rain, is unfit for farming, but is dotted with excellent farm buildings and groves. The rest of the story, to explain, was told me by a legislator, at Des Moines, last winter:

''Five drainage ditches run into our little river within a short distance of each other. These drainage ditches are all open ditches and it seems that they have washed so much mud down into the river that the channel is choked for several miles. Now, every time a heavy rainfall comes, the lands below, for ten or fifteen miles, are flooded, whereas formerly, floods did not occur more frequently than once in fifteen or twenty years, and it was seldom then that these were destructive to crops. Now it is nearly impracticable to farm the lands in this section of the valley and my people are asking me to introduce a special bill to secure them relief.''

Before we finally alight from the balloon, to study these problems more closely, we must admit that our friend, the reclamation service engineer, has suggested something of great value to us. In the reclamation project of Harrison and Monona Counties, the Little Sioux River does meet some of the conditions to which his plan will apply. Numerous V-shaped valleys, carrying at their bottoms small streams of clear water, help to make the system of the Little Sioux River much different from that of the Des Moines, the Iowa or the Cedar headwaters. These V-shaped valleys are of small value, agriculturally, and when broken by the plow wash readily into the streams, choking them and destroying their value for drainage purposes, making marsh and swamp lands of the once beautiful valley floor. The lands that would be lost by the construction of reservoirs to hold back the water rushing down in flood times to overflow the channels, would be comparatively small. A half-million dollar program, such as has been carried out in the Harrison-Monona Ditch, had it been expended in constructing dams, creating reservoirs and protecting river channels against flood waters and providing an equable flow of water in the river channel would have enabled the engineers to calculate definitely what channel conditions could be maintained, by a certain given water flow, which could easily be determined.

In other words, channel conditions cannot be maintained, except the flow of water can be placed under control and lastly, the expensive program of large channel construction would have been rendered very largely unnecessary, so that by the correction of the major crooks of the native channel, it would have been rendered capable of doing all the work required. The additional advantages of such a program of reclamation and river control, need not be discussed. The possibilities of water-power, so valuable now as a means of extension of rapid transit facilities, are evident. The possibility of irrigation of the flat lands of our river valleys by constructing irrigation laterals on the two or three river terraces are so obvious that our reclamation service engineer need not mention them to us. Who among you is not willing to admit for a moment that Iowa has not seen the time when irrigation would have benefitted much of her acreage? Who among you is willing to admit that Iowa soil is not capable of producing as valuable and profitable crops as any lands? Those of you who are familiar with the sub-soils of these river flats, are aware that they will readily lend themselves to irrigation; that they are seldom underlaid with impervious sub-soils and, in nearly every case, have gravels which render these soils peculiarly subject to crop loss in times of drouth, this same condition being most favorable for absorbing and using all waters applied by irrigation methods. Lands underlain by impervious sub-soils frequently require artificial under drainage in order for irrigation methods to work most successfully.

The tile drainage of these lands is being carried on at a rate per acre which will total when all lands needing it are well drained, about $300,000,000. The effect which this tile drainage produces is to lower the ground water level to an average of about three feet or in wetter times 24 to 30 inches below the surface. This creates a porous soil cap which is capable of absorbing about 15 to 20 per cent of its bulk of water. This means that 30 inches of soil that is drained will absorb 4½ inches of rainfall in about 48 hours without erosive run-off or leaving standing water in the depressions.

What this means in the solution of the problems given before can merely be suggested. But certain facts we know. There can be no better reservoir than a soil capable of absorbing this rainfall. We know by guaging of ground water level in drained lands that a rainfall is absorbed quickly and fed slowly off to the river through a period of many days and often weeks before the original low ground water level is again reached.

The remarkably heavy snowfall reported variously at from 64 to 84 inches in the Wisconsin Drift area, winter of 1909-1910, thawed in about ten days since March 1st, 1910. The disappearance of snow was complete. The ground was but slightly frozen and practically all the water was absorbed. Another important fact the ground had been draining and the rivers had held at a reasonably high stage all winter. There was no trouble or danger at all from flood following the thaw of snow in March. These several phenomena present a very suggestive promise of what the result will be when the tile drainage is complete.

The peat marshes and the lakes may very safely be kept as reservoirs to help control the crest of floods, and it appears that the executive council has wisely been governed to deny many petitions which have come before it urging the drainage of meandered lakes.