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PIONEER PLANTS ON A NEW LEVEE.

FRANK E. A. THONE.

A year ago this spring the city of Des Moines cut a new channel and mouth for the Raccoon river, causing it to change its course for a distance of about half a mile and to empty into the Des Moines river a little more than half that distance below its old mouth. The bulk of the excavated material was piled upon the south bank of the new channel to form a levee about fifteen feet high, sixty feet wide at the base, and twelve feet wide at the top, with a space of twelve feet intervening between the foot of the embankment and the river. The material first excavated, part sand and part a very sandy, silty alluvium, was dumped into place by the steam-shovel and worked over into permanent shape by grading shovels; the material from the bottom of the cut, practically pure sand, was dumped on the opposite bank and left there in long, irregular heaps. The western end of the levee was also left more or less unshapen, and is in consequence some six or seven feet higher than the rest of the embankment; it also has a larger proportion of sand in its makeup than the levee proper, though it is not so nearly pure sand as the heaps on the opposite bank.

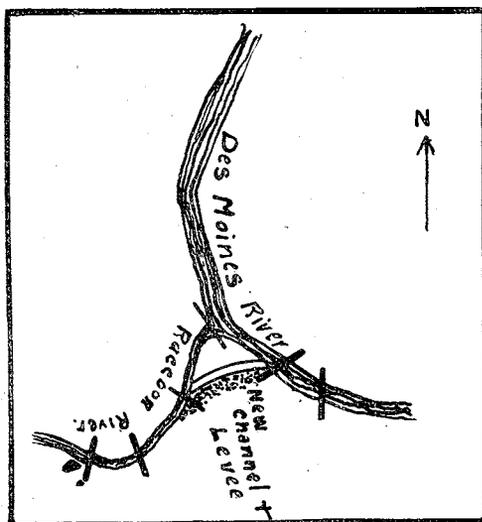


FIG. 3.—Diagram of area studied. Heavy lines indicate bridges.

The area first came to my attention during a visit to Des Moines about the middle of May, 1914. At that time the work of excavation and grading was just being finished, and though the growing season was, of course, well begun, there was little or no sign of vegetation on any part of the embankment. The sandy loam of the levee proper, the half-and-half mixture of its western end, and the sand hills on the opposite shore were alike as bare and lifeless as a desert.

A month later I returned to Des Moines, this time to stay all summer. I was struck with the remarkably changed appearance presented by the surface which had been so devoid of anything green only a few weeks before. A vigorous stand of wild grasses and of those hardy pioneer plants that most people contemptuously term weeds had made its appearance and like an army was overrunning the territory. On the parts of the work which had been finished first the plants stood close and dense, pushing ahead vigorously to overcome their handicap of a late start, and, young as they were, already beginning the eternal struggle for a place in the sun. On the sandy western end of the levee where the ground was poorer and where the steam shovel had longest postponed the start there was a straggling advance guard, but the sand heaps on the opposite shore remained bare and unattacked. Only here and there, where a chance streak of loam in the matrix of sterile sand had received a chance seed did any green leaves show themselves; here they were mostly pigweed, *Amaranthus retroflexus*.

As the summer advanced these relative densities of vegetation maintained themselves much as they were in the beginning: on the sand dunes there was little growth, on the ungraded western end of the levee there was a fairly well-developed flora, and on the levee proper the growth was thick and rank. I took occasion to visit the place frequently during the summer, and from time to time carried home a handful of specimens, so that by the time the first frosts began to take their toll of my weed garden I had botanized the whole area pretty thoroughly.

From an ecological viewpoint, the area falls naturally into three rough divisions, along the lines indicated above. First, there are the sand heaps of the north shore; then the ungraded, sandier part of the levee toward the west, and finally the graded levee composed of rather better soil than either of the two preceding portions.

The sand heaps, as has been stated already, represent for the most part the last of the material thrown up by the steam shovel, a coarse, gritty sand from the bottom of the ancient river bed. Due partly to the natural sterility of this material, partly to its inability to hold any amount of water, and partly also doubtless, to the fact that the lateness of the completion of the heaps delayed the development of any vegetation they might have had, these artificial dunes did not present much in the way of plant life. A thin sprinkling of annuals, mostly *Amaranthus retroflexus*, *Chenopodium album*, and *Abutilon theophrasti*, together with a few tufts of wild grasses, told the whole story.

The shapeless western end of the embankment presents several interesting peculiarities in soil formation. The sand heaps opposite this part of the work are smaller than elsewhere, for the steam shovel dumped a good part of the sand from the bottom of the cut right on top of the soil from nearer the surface, instead of on the opposite bank. The result is that in places the top of the levee here is as sterile as the sand-heaps of the north bank, and the soil in general is sandier than it is on the levee proper. Even where the top is covered with sterile sand, however, the soil on the level space between the embankment and the channel is a sandy loam much like that of the levee proper, and it is on this table that most of the vegetation of this part of the area is concentrated. Here, and on the more fertile parts of the slopes, the vegetation is of the same general character as that of the eastern end of the levee, described below, while on the sandier parts it is more like that of the sand heaps of the opposite bank, though perhaps a little denser. One or two species were found here that were not found elsewhere: the *Cynodon dactylon*, and most of the *Eragrostis megastachya*.

But it was on what I have already mentioned several times as the eastern end of the levee that the weeds flourished in all their glory. Here the better soil from near the surface of the cut had been piled up and shaped into the real prism of the levee, and the sterile sand had been dumped out of the way on the far shore. In consequence the seeds that alighted here fell upon good ground, with only a few sterile streaks, and the tree-stumps and root-scrapings of perennial plants had a chance here to take up anew the struggle for existence. Moreover, this portion had been completed before the less favorable western end, and of course the plants here had a couple of weeks' start. And

they utilized it to good advantage. They climbed over the whole eastern portion of the levee, concealed its slopes with a thick, rank growth, and carpeted the top with green. They struck their roots into the fresh, virgin soil that the steam shovel had given them and prospered wonderfully. There were tall ragweed and wild sunflowers as high as my head, thick sods of wild grass, patches of a *Cyperus* that burrowed in the streaks of sand that lay here and there upon the surface, Jimson-weeds as high as my waist and with stalks as thick as my wrist at the base, single plants of the sprawling amaranth making mats six feet or more in diameter, and pigweed, pigweed everywhere.

The pigweed was the dominant plant. It was ubiquitous. It led the forlorn hope against the forbidding strongholds of the sand on the far shore; together with its near relative, the goose-foot, it constituted the bulk of the first line of advance into the unfavorable western end of the levee; back where the plants stood thicker it asserted itself powerfully. In one or two limited spots it was outnumbered by other plants: on the reverse slope of the levee at its extreme eastern end, for instance, the tall ragweed was the dominant, but the tall ragweed was practically limited to just this narrow area, and you could scarcely walk ten feet anywhere on the whole embankment without brushing shoulders with a pigweed, and here and there, especially toward the western end, it would appropriate whole stretches of the terrain unto itself.

And it rejoiced in its supremacy in true kingly fashion. It built up tall, slender spires, and it spread itself out in thick, round bushes. It disported in half a score of interesting varieties: in shape from stiff and stocky to slender and graceful; in color from green to red; on leaves, or stem, or seed-head. There were stout, green pigweeds, and slender, green pigweeds; and there were stout, red pigweeds; and slender, red pigweeds; and there were pigweeds, both stout and slender, that were gorgeously variegated and pied.

In pitiful contrast to the sleek and prosperous condition of the weeds was the losing fight that the few stray cultivated plants were carrying on. Formerly part of the area where the channel and levee now are was inhabited, and some of the houses had vegetable and flower gardens attached. When the steam shovel's wrecking revolution swept through, most of these pampered, man-served vegetable aristocrats perished, but by chance

the seeds of a few were left close enough to the surface to sprout and grow and try their luck against the bourgeoisie of weeds. The tomato plant that I found was probably of this origin, also the watermelon. The solitary cultivated sunflower that stood majestically towering above a jostling crowd of pig-weed may have come with the tomato and the watermelon, or perhaps from a seed dropped by a bird. The two varieties of morning-glory that I found competing with the wild bindweed were probably wind-sown. The two specimens of corn were very likely remnants of a meal of one of the workhorses; one of them was a half-sized runt with a nubbin, abortive ear, and the other I picked up in mid-October, a mere starveling sprout with its half-devoured seed still among its roots. Oddly enough, there was little bluegrass on the levee—not enough, I should judge, to fill a peck measure; and when I lost the one specimen of white clover I had, I could not, for the life of me, find another.

So much for the cultivated species and their sources. Now how did the new possessors of the land make their appearance? Various. A few of them were there to begin with. At the eastern extremity of the levee the level space between the embankment and the channel had been covered rather thinly with debris, and through this new layer of soil a few perennials, like the goldenrod and the aster, managed to fight their way. To this class also, I suppose, must be added the cottonwood shoots that appeared down on the slopes of the channel itself, on the ends of the roots that the steam shovel had severed.

Again, some of the plants must have come from fragments cast up by the steam shovel. To this class must be relegated the shoots that I found sprouting from stumps and root fragments at various points on the slopes and bottom of the embankment: willow, catalpa, cottonwood, maple, and box-elder. Some of the perennial herbs, like the burdock and the dandelion, may have had this origin. Certainly the *Oenothera biennis* that I found in full bloom must have come from a previous foothold somewhere else. And, of course, it is highly probable that a good many seeds were sown in this fashion, along with the root fragments and the seeds of the cultivated plants.

Finally, much, if not most, of the vegetation must have originated from wind-blown seeds. The seedlings of the maple and the cottonwood could have come from no other source, for these are pre-eminently flying seeds, and moreover must germinate

within a few hours after they leave the tree, or else perish. Again, the seeds of many of the weeds, like the Amaranths, Chenopodium, Oxalis, Datura, the grasses, and in fact most of the plants on the levee, if not winged are at least small and light and could be carried through the air like grains of dust or sand. Some of the plants, like Amaranthus, Chenopodium, Abutilon, and Datura, hold a goodly portion of their seeds in the previous year's seed-head until well into the following season. And the universal distribution of the vegetation over the surface of the levee, and even on the heaps of sand from the deeper parts of the excavation, must argue for some impartial distributor like the wind.

In brief summary, then, we have the following facts: (1) On the sand heaps of the north shore and on the sandier portions of the western end of the levee, which presented poor opportunities for vegetation on account of the lateness of their exposure to seeding, their natural sterility, and the fact that they came from the deeper portions of the cut and hence had in themselves no seeds or root fragments, there were few plants, and these exclusively from seeds presumably sown by the wind. (2) On the more loamy patches at the western end of the levee the conditions of vegetation approached more nearly those of the eastern portion, or levee proper, though the vegetation was still practically exclusively in its first year from seed, that is, annuals and seeding perennials. (3) On the best soil of the whole area, that of the eastern portion of the levee, the vegetation reached its best maturity, and here it consisted not only of annuals and seeding perennials, but also of growths of perennials in their original position, or from tree stumps or root scraps, and included as well one biennial in its second year of growth and a number of cultivated plants and a few natives whose seed probably had been sown by agencies other than the wind.

Of the fifty-six species collected over the whole area, six (seven, if *Andropogon halepensis* be an escape) were cultivated plants recently escaped, and the balance native or naturalized. Of the cultivated plants, *Zea mais* and *Andropogon halepensis* probably were from feed dropped by horses, *Ipomoea purpurea* possibly was wind-sown, though possibly also of a common origin with the other four cultivated species, namely *Lycopersicum esculentum*, *Petunia* sp., *Citrullus vulgaris*, and *Helianthus*

annuus, which apparently were remnants of former cultivations cast up by the steam shovel.

Of the native and naturalized species six were trees and one a liane; the rest were herbs. The liane and five of the trees sprang from fragments of previous vegetation; two of the trees also appeared as wind-sown seedlings, and one tree only appeared exclusively as a seedling, presumably also wind-sown. Of the wild herbs one was a biennial in its second year, and the balance annuals and (apparently) seedling perennials. Of these the biennial must have been deposited with excavated material, and some of the seeds probably also came from the same source; most of the seeds, however, probably were wind-sown.

I have appended a list of all plants that I found on the area, giving also in tabular form such information as I have been able to extract from them regarding their age, past history and present condition. The classifications were made originally from Britton and Brown and afterward checked over and corrected from Gray's Manual. I wish to acknowledge with thanks the assistance of Professor Pammel of Ames and of Doctor Conard of Grinnell in classifying the collection, the latter especially also for his valuable suggestions and encouragement in the preparation of this paper. The following will serve as a key to the symbols tabulated at the right of the list. In the first column the symbols refer to the position of the plant on the embankment. "A" signifies that it was found exclusively on the top or slopes of the levee, "B" that it was found exclusively on the flat space at the base, and "C" that it grew indiscriminately over top, slopes, and base. In the next column the figure "1" indicates an origin from seed. I have listed most of the perennial herbs I found under this heading, for though some of them may have sprung from fragments of root or stem I have no positive evidence that any of them did. "2" indicates that the plant in question grew from a stump or root fragment, and "3" indicates that some specimens were from seeds and others from stumps or roots. In the last column "X" indicates that the plant was a recent escape from cultivation, and "Y" that it was a native or naturalized species.

Andropogon halepensis (Sorghum halepense)	A	1	X
Digitaria sanguinalis.....	C	1	Y
Panicum dichotomiflorum.....	C	1	Y
Setaria glauca.....	C	1	Y
Muhlenbergia mexicana.....	C	1	Y
Cynodon dactylon (?).....	C	1	Y
Eragrostis megastachya.....	C	1	Y
Poa pratensis.....	A	1?	Y?
Zea mais.....	A	1	X
Cyperus esculentus.....	A	1	Y
Salix sp. (alba?).....	C	2	Y
Populus deltoides.....	C	3	Y
Cannabis sativa.....	C	1	Y
Rumex crispus.....	A	1?	Y
Polygonum pennsylvanicum.....	C	1	Y
Polygonum persicaria.....	C	1	Y
Polygonum convolvulus.....	C	1	Y
Chenopodium album.....	C	1	Y
Amaranthus retroflexus.....	C	1	Y
Amaranthus blitoides.....	C	1	Y
Mollugo verticillata.....	C	1	Y
Stellaria media.....	C	1	Y
Brassica nigra.....	C	1	Y
Radicula armoracia.....	B	2	Y
Polanisia graveolens.....	A	1	Y
Gleditsia triacanthus.....	A	1	Y
Trifolium pratense.....	A	1	X?
Melilotus sp. (alba or officinalis):.....	A	1	Y
Strophostyles angulosa.....	A	1	Y
Oxalis stricta.....	A	1	Y
Acer saccharinum.....	B	2	Y
Acer negundo.....	C	1	Y
Vitis vulpina.....	B	2	Y
Abutilon theophrasti.....	C	1	Y
Hibiscus trionum.....	A	1	Y
Oenothera biennis.....	A	2	Y
Asclepias syriaca.....	C	1	Y
Ipomoea purpurea (2 vars.).....	A	1	X
Convolvulus arvensis.....	A	1	Y
Teucrium canadense.....	C	1	Y
Petunia sp. (?).....	A	1	Y
Lycopersicum esculentum.....	B	1	X
Solanum nigrum.....	A	1	Y
Datura stramonium.....	A	1	Y
Verbascum thapsus.....	C	1	Y
Catalpa sp. (bignonioides?).....	B	2	Y
Plantago major.....	A	1	Y
Citrullus vulgaris.....	B	1	X
Solidago canadensis.....	C	3	Y
Aster ericoides (?).....	C	3	Y
Ambrosia trifida.....	C	1	Y
Ambrosia artemisiifolia.....	C	1	Y
Xanthium commune.....	C	1	Y
Helianthus annuus.....	C	1	Y
Helianthus scaberrimus.....	C	1	Y
Arctium minus.....	C	3	Y
Taraxacum officinalis.....	A	1	Y

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