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CREATING NATURAL DISASTERS IN SOUTHEASTERN NEBRASKA

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In May 1950 the Little Nemaha River valley in the southeastern quadrant of Nebraska suffered a record-breaking flood. For a short time at the town of Syracuse, the Little Nemaha River, which drained a watershed of 218 square miles, had an estimated discharge of 225,000 cubic feet per second. This was larger than any flood recorded since 1928 on the Missouri River at Omaha, which drained a watershed of 322,000 square miles.[1] During this storm and flood twenty-three people lost their lives, fourteen in the Little Nemaha Valley. As night came on, floodwaters swept a commercial bus off a highway northwest of Syracuse; only three of nine in the bus would survive. A young mother and father had their two infant sons torn from their arms as they abandoned their automobile on a nearby minor tributary. At daybreak, sixty miles downriver at Auburn, a family of four on their way to a funeral in Kansas had their car stall out on an approach to a bridge over the Little Nemaha. Witnesses saw the waters take them one by one. These deaths were only the most visible manifestations of the disaster. Homes, businesses, vehicles, and domestic livestock were lost. Sloping fields on uplands lost topsoil in depths "up to the plow sole"; fields down on the flood plain would be covered at places by five feet of this topsoil. Railroads, bridges, and roads suffered severe damage. People were stranded in attics as their houses floated downstream; some spent horrifying hours lodged high up in trees, hoping floating debris would miss them. One family between Syracuse and Auburn was barely able to remain safe for seven hours on the tiny island that was the roof of their pickup truck.[2] It was a situation way beyond human control. Most people would consider it a clear example of natural disaster.

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Here I examine the history of flooding on the Little Nemaha as a case study of human relationships to a common form of natural hazard. Through the history of human responses to a particular river in flood, I also seek understanding of the variety of human roles in creating natural disaster out of this common hazard of flooding. Natural hazards exist when humans have made themselves vulnerable to nature's forces. As I am using the term, "natural disaster" refers to the situation after the hazard has fulfilled its potentiality, that is, after natural forces have negatively impacted humans. The Little Nemaha affords a useful vehicle for studying these relationships because of its history of repeated flooding. The record-breaking 1950 flood is not important simply as a case of an extreme natural event. It derives part of its instructive power for us (and for Syracuse residents) because people expended such effort protecting themselves from flooding. The lesson residents might have taken from the event was that they could ill afford to ignore a river's natural propensity to flood. Had they considered this carefully, it might have challenged their confidence in the adequacy of using technology to re-engineer natural processes.

Natural Disasters

Human complicity in a natural hazard, while being a cause, is also a result; it arises from something else. I argue that one type of natural disaster followed from basic human perceptions toward, and use of, nature. Floods do not start without unusually intense or prolonged precipitation (discounting dam breaks). The record-breaking 1950 Syracuse flood followed from extraordinary (though not record) rainfall amounts on two watersheds that converged on Syracuse at the same time. Other floods on this river also began with good rains, and, in fact, some storms on the river have had greater total amounts, and higher rates of precipitation, than during this flood. While southeast Nebraska is primarily rural without large centers of population, the people who do live in the Little Nemaha Valley have made themselves particularly vulnerable. They have done so through both their settlement patterns (living in a flood plain) and land usage (farming row crops on marginal prairie land).

Unfortunately, in arriving at causation for natural disaster, a model of natural disaster as an extreme environmental event meeting a vulnerable human population (as a function of size or usage) is not quite complete. An entry here may be through the phrase "nature is neutral." Is it not the point that *for humans* nature is not neutral? It is not neutral on two sides of our event. Nature created conditions which humans found attractive: rich farmland on flood plains and amenable transportation route possibilities. This is not a perceived neutral nature, it is a beneficent nature. And what of the event itself? During or after a flood, nature is anything but neutral. Humans often perceive it as a malevolent force. Nature is an entity divorced from its beneficent aspect in human perception. It calls for responses both immediate and long term. And the repeated experience of flooding in Southeastern Nebraska brought changes in human responses. But the responses also fell within carefully circumscribed limits. I would contend that the inhabitants' responses flowed from their basic perceptions toward, and use of, nature.

Simply put, nature was a commodity to be used for human purposes. Euro-American settlers' use of the land for commercial agriculture led to worse flooding. This view is in stark contrast to eastern Nebraska's Native American land usage patterns. Euro-Americans built their towns along the river's edge to service the railroad (as entrepôts for farm produce). They made roads and bridges that linked farms, towns, railroads, and eventually world markets. It was a system designed for efficiency. The locations chosen discounted nature in two aspects: the nature of the land and the nature of the river. The land-use practices of the settlers all too often were nonsustainable, creating conditions which led to soil loss through sheet erosion, and incidentally, increased severity of flooding. Their actions on the land thus changed the river. The river was not a static entity; it did not always stay in its channel—it never had. But the roads, railroads, and towns were built as though it did. And when it came up, and came up faster and higher due to human land-use practices, the valley's residents were swimming in consequences.

The first solution was to make a "better" river, a more efficient river. If valley residents had too much water in their towns, the solution was to get rid of it faster than it came in. They straightened and shortened the river through channelization. This worked, after a fashion, but led to its own consequences. Channelization provided a measure of false security, encouraging further development subject to flooding; it also led to unintended channel dynamics. Eventually channelization created increased damage downstream. But the commercial agricultural system was so profitable they would not seriously consider removing themselves from danger; people kept trying to engineer safety.

Cultural perceptions of nature guided human choices on both sides of the disaster: first, by perceiving that nature was amenable to human exploitation, with little regard for the consequences, then attempting solutions divorced from what had created the disaster in the first place. Valley residents unwittingly designed a relationship to nature that made themselves particularly vulnerable to natural hazard.

Structure and Historical Development of the Little Nemaha Valley

By the twentieth century, Euro-American settlers had formed the essential structure of their built environment in relationship to the river that still exists today. The major road systems formed a "T," with Syracuse lying at the juncture. Turning right on State Highway 2 (the top of the T) took residents to the grain elevators in Nebraska City, twenty miles to the east. There prodigious quantities of agricultural produce could be moved efficiently down the Missouri. Turning left, State Highway 2 took them the thirty-three miles to Lincoln, the state capital. On the way they passed through other towns carrying names some of their forebears brought with them from New York: Unadilla, then Palmyra. The railroad, which had preceded the state highway and was so important to the development of the upper Little Nemaha Valley, also followed the top of the T.

But before there was a T there was the river itself. From its headwaters near Bennett in this approximately sixty-mile-long valley, the river meandered along eastward, nearing the railroad and highway at Palmyra, and again at Unadilla, there turning southeastward on its way to Syracuse. Below Syracuse it flowed fourteen miles to the town of Talmage, then Brock, and Auburn (Nemaha County seat), where it usually flowed underneath another railroad, the Missouri-Pacific, down an ever-widening floodplain turned to fields, finally entering the Missouri River near Nemaha.

The Otoe-Missourian peoples who resided in southeastern Nebraska before the arrival of the Euro-Americans did not leave us with a clear picture of their relationship to rivers in flood. Like the Euro-Americans who would replace them on the land, the Otoe-Missourias were presumably drawn to the enriched spoils and moisture afforded by seasonal flooding of rivers and creeks. Their subsistence base, unlike that of the Euro-American farmer's, was not tied to a specific plot of land; it spread over space. During the late spring three or four women would go down to the creek bottoms and plant their corn, pumpkins, squash, beans, and melons. The word "Nemaha," in fact, comes from Otoe words "ne," water, and "maha," planting or cultivating.[3] In June, when corn reached chest height, the entire village might be abandoned as the tribe went on an extended summer bison hunt in central Kansas. The tribe would return to the village in time to harvest the corn. By 1800 a majority of their diet came from the spring and fall-winter bison hunts.[4] In addition to horticulture and twice-yearly bison hunts, they also gathered roots and hunted for small game and deer nearer home. As David J. Wishart notes, "the combined hunting, farming and gathering cycle spread their subsistence base over a wide area and was a successful ecological adaptation to the transitional tall-grass and mixed-grass environments of the Great Plains."[5]

Adaptation is the key here, made necessary because the Otoe-Missourias had come to southeastern Nebraska in relatively recent times. During the seventeenth century the Dakota had pushed the Otoes (a Siouian people) from their original homeland near the Great Lakes. They generally migrated southwest under the pressure of stronger tribes, until by 1714 they had lodged against the Salt Creek tributary of the Platte near its juncture with the Missouri River. Here they would control a part of southeastern Nebraska that contained the Little Nemaha, but they were prevented from further expansion by the Omaha to the north, the Pawnee to the west, and the Kansa to the south. At the turn of the century, the Otoe were joined by their relatives, the Missouria, in a somewhat uncomfortable union. After being weakened by smallpox and under the onslaught of the Sauk and Fox, the Missouria had fled from their homeland in Missouri.[6]

Wishart notes how quickly the Otoe-Missouria (and other Indian peoples) adapted to their new home. What is important for us is that they practiced subsistence patterns that did not perforce set them at odds with a river's natural propensity to flood. They built their villages conservatively on secondary terraces–expressly to remain above floodstage, locating them close to timber and water.[7] If their patterns of movement about the landscape were inconvenienced at times by the river's rise (as during the spring runoff), they would have found this a natural, regular occurrence and a part of their pattern of living. Flooding was a benefit to the Otoe-Missouria—it provided moisture and enrichment for the soils they farmed on the living floodplain. This is not to say that the Otoe-Missouria never experienced the negative effects of flooding. For example, widespread flooding in the summer of 1844, which took streams from Colorado's foothills to the Mississippi River to record heights, destroyed Otoe corn crops along the Platte. The point is that their subsistence base was broader than relying on their horticultural economy.[8]

By the time the Kansas-Nebraska Act opened southeastern Nebraska to Euro-American settlement in 1854, the Otoe-Missouria had been forced to cede their lands in southeastern Nebraska through a series of treaties and incremental land cessations. In the treaty of March 1854 they agreed to move southwest to a rectangular parcel of land in the Blue River Valley.[9]

By this time what would become Otoe County was a corridor well-traveled by settlers headed west (roughly following the top of our T). Euro-American settlers came to the rolling, hilly country of southeastern Nebraska under two impulses: first, to exploit the rich agricultural potential, of the prairie, and second, to exploit the settlers heading west—to service a human traffic pattern. The sloping, loess-covered hills, once the thick prairie sod was removed, had rich agricultural potential, and this quadrant of Nebraska did not require irrigation, as it received an average of over thirty inches of rain per year (70 percent of which fell in the growing season April through September).[10] Yet some of the earliest Euro-Americans hoped the land might yield profits without going through the enormous work it took to make a farm. The territorial legislature allowed speculators and squatters to form "claim clubs," and by 1856 settlers (many of whom would pay for land using their warrants from the Mexican War) were having to move into central and western Otoe County to find unclaimed land not held by speculators. Syracuse, in fact, originated—at least as a name—due to one group of speculators. After finding salt marshes in the area (six miles west of present-day Syracuse), these speculators hoped to cash in on the connection of the name with Syracuse, New York, which was known as a salt center. As Nebraska was laid out on the township grid system, these speculators filed in 1856 as the "Syracuse Town Company." Although they advertised their lands back East, the effort proved unsuccessful.[11] The real town of Syracuse would follow from another impulse, as a transportation-route service point.

Nebraska City was incorporated in 1855 at a ferry point that had been established the year before on the Missouri. It was near the site of the old Fort Kearny, which had been abandoned in 1848. New Fort Kearny was now situated at the southernmost bend of the Platte, 250 miles away; and the route between the two was called the Overland Trail. Within twenty years the railroad would follow a nearly identical route between Nebraska City and Lincoln. The route would be shortened in 1860, saving seventy-five miles and becoming known as the Nebraska City-Fort Kearny Cutoff. The first town west of Nebraska City on this route was Nursery Hill; it lay on the Little Nemaha two miles west of what would become Syracuse. It was the location of a floral nursery (serving a New York company), several stores, and the area's first grist mill (1868). This was a heavily traveled route—one settler claimed he had seen a hundred wagons pass before eight o'clock one morning.

The new settlers of the Little Nemaha Valley showed clear patterns of both cluster and chain migration. Many came from the Midwest: first Ohio, later Wisconsin and Illinois. There was an early and continuing pattern of migration from New York State, reflected in town names across Otoe County, not just in the Little Nemaha Valley, e.g., Syracuse, Unadilla, Palymra. There was a strong presence of German immigrants spread out across Otoe County; the 1870 census would show 1,173 German-born residents out of the county's 12,345. By 1900 this had grown to 2,250 out of 15,727. More than half of the German immigrants would arrive by steamer up the Missouri, disembarking at Nebraska City. Palmyra Township had a very strong British presence, with over a third of its population in 1870 born in England and 10 percent born in Ireland. It would take time for these new immigrants, with cultural preferences for growing particular crops, and from climates having different patterns of precipitation, to adjust to a new environmental context. Whether they actually adjusted to the physical constraints of the prairie environment is a deeper question. I argue that the valley's natural disasters were ultimately a factor of its inhabitants' nonadjustment to natural limits.[12]

Both Syracuse and Unadilla were creations of settlers who saw the railroad coming and took active measures to be sure it came their way. A group of five settlers residing in the Syracuse Township saw the possibility of making a town via the development of the railroad that was to be built between Nebraska City and Lincoln. In 1870 they donated 240 acres to the Midland Pacific Railroad to bring it through section sixteen of the township.[13] Syracuse prospered and Nursery Hill slowly withered. A land agent originally from Unadilla, New York, having relatives who worked for the Midland Pacific and had "inside information" about the future railroad route, platted Unadilla, Nebraska, in May 1871. Presumably his efforts paid off. Main Street soon followed the curved line of the railroad tracks.[14] The railroad was drawn both by the subsidy of humans (free land) and, perhaps of equal importance, by nature's provision. Gilbert White described this latter factor in 1945. In rough terrain railroads followed "the easiest possible grades for the longest possible distances."[15] Not only were grades of import for the railroad engineers but wide floodplains allowed the possibility of low curvature. D. W. Washburn, a locating engineer for the Jay Gould lines in the southwest instructed, "drainage, *drainage*, DRAINAGE. The drainage and location of the drainage is the framework on which you must hang your location."[16] Dry and gentle floodplains do not stay that way, of course; it is not in the nature of a river to do so.

The Midland Pacific followed the earlier traffic patterns through the area, ones that humans used for the same physical reasons. White described a typical result of railroad presence: "Highways and urban occupance have developed flood-plain locations in many instances in order to be near some railway rather than because of any other advantages of the flood plain."[17] And this describes succinctly the development of Syracuse, Unadilla, and Auburn—these towns grew up around the depot. The railroads (certainly prior to hard-surfaced highways) were their outlets to the world. The towns suffered from the same problem that beset the railroad from time to time—the river acted in its nature, but not for a while, and not until humans had made real efforts to aid it on its way.

The river appears somewhat abstract in the early accounts, possibly because it had a restricted value as commodity. As it was not used for irrigation or as a source of drinking water, perhaps it lay outside of the purview of farmers who were settling the area. Its utility as power for grist and flour mills was restricted to a few proprietors (although the larger community certainly benefited, and some had grandiose plans for water-generated power). But most of the farm produce was soon heading out of the valley into a world market. The river as hindrance steadily diminished as the railroad became important for transportation and as bridges replaced fords (the big iron bridge right below Unadilla dated from 1874; it remained until the Big Flood took it in 1950).[18] Residents appreciated the river as a place to swim, particularly in the pools created behind the mill dams. This river was fun and useful, but it was not so much fun or so useful as to loom large in the new natives' field of view.

Oldtimers remembered prairie grasses as high as six to eight feet in the Nemaha Valley. Probably apocryphal were the stories of chasing deer into the thick grass and catching them when they became tangled.[19] The land, once plowed, made good farms. The history here, as in so many places on the Great Plains, may be telescoped into the telling phrase provided by Donald Worster: "The sod had been destroyed to make farms to grow wheat to get cash."[20] It was an effective transformation, as the land produced vast quantities of corn and wheat.

Census records depict both the population growth and the expansion of agricultural production in southeast Nebraska between 1860 and 1890 (Table 1). The rapid expansion of corn production in Otoe County between 1870 and 1880, from roughly 600,000 to 3.5 million bushels, illustrates the rapidity with which the prairie was being turned to make cropland. It also shows why the floodplain dwellers (such as those in Syracuse) suffered from increased severity of flooding. The decline in wheat production between 1880 and 1890 was a factor not only of higher profitability for corn per acre but an attenuation of cultural preferences for growing wheat rather than corn (which some immigrants, such as British and Germans, brought with them from the Old Country).[21] The existence of the mill at Nursery Hill by 1868 and one soon established upriver at Unadilla in 1875 give additional evidence that the land was being settled thickly enough that there was need for them. The Syracuse Milling Company would arrive in the late 1890s, replacing the Unadilla mill.[22]

In 1878, 350 carloads of grain and 100 carloads of stock left Syracuse. Three years later, in a relatively poor year for farming, the total had increased to 641 carloads: corn, 323; swine, 130; cattle, 94; wheat, 54; barley, 34; and rye, 11.[24] The tendency was to expand production with little regard for the long-term consequences. This would come back to haunt them, as it did so graphically in the 1950 flood, when freshly tilled soil on unterraced, sloping land in the very beginning of the growing season ended up deposited thickly on floodplains. But as we have seen, the removal of the thick thatch of sod altered hydrologic characteristics of the land.[25]

Floods and Responses, 1883–1950

As farmers in Little Nemaha Valley put more and more land to crops in the 1870s and 1880s, the people of the valley started having increasingly severe problems with flooding. When general rains struck southeast Nebraska in June 1883, which the *Syracuse Journal* headlined as "The Heaviest Rain Ever Known in this Section," the Little Nemaha near Syracuse "overflowed and spread about a mile over the valley." Families had to evacuate homes; the floodwaters on the south of Syracuse came up to Third Street. Several people nearly drowned riding horses across water, and a team of horses mired, proving ineffective in one rescue. Five townsmen had apparently just built a boat, christened the *Billy Powell*. It was used to good effect in rescuing a number of people. One of the men, a Mr. Beesley, found it so handy, in fact, he bought it the next week "so as to be prepared for floods in the future." The Burlington and Missouri Railroad (which had purchased the Midland Pacific in 1877) lost bridges, had whole sections wrecked, and lost ten thousand feet of track at Syracuse. Towns downriver such as Brock, Talmage, and Nemaha City suffered flood damage. The local news column in the Syracuse paper, always hoping to strike a lighter note, reported, "On account of the almost incessant rains of late, the beautiful (?) weeds are flourishing."[26]

During the next week railroad crews began patching up the line. Then, a storm of even greater intensity hit Syracuse and vicinity. The *Syracuse Journal* reported the result of one night's six and a half inches of rain: "When morning came the streams and valleys were one wide seething sea, bridges were swept away in all directions, and communications and travel both by horse and rail rendered nearly impossible." Railroad track that had just been "patched up" washed away, the train could not get past Unadilla, and the area lost more bridges: "The wooden bridge on the road to Nursery Hill, broke in the middle and dropped into the creek a sorry wreck."[27] There was no report if Mr. Beesley used his new *Billy Powell*.

Damage was not confined to the built environment; it hit farmland as well. But, again, the local paper chose to give the story a positive spin:

> In many places in the valley the damage to crops was great, but strange to say in some instances the gain exceeded the loss. On the Van Riper farm, though 100 acres of grain was more or less damaged, yet the sediment that settled in the low places did his farm more good than the loss to his crops, so that on the whole he is better off than before the floods.[28]

This passage indicates two things: obviously, some recognized that a normally functioning nature did produce benefits for humans, but in comparison with later flood sediment damage, it indicates that a good bit of the prairie had not yet been turned to cropland (else Mr. Van Riper probably would have gained too much for his own good). This is also in line with the census data, showing a rise in Otoe County's corn production between 1880 and 1890 from 3.5 million to 5.3 million bushels (Table 1). The second point of interest is that the writer apparently gave little thought to where that rich sediment might be coming from—his focus was on crop loss, not topsoil loss. Two Nebraska scientists may have recently given us an indication as to why: "Soil loss is especially tragic because, at least in Nebraska, it is very nearly invisible. In general, erosion in our state does not take the form of gullies, as it does, for example, in the South. Much of it is result of sheet or ephemeral erosion where one pass with a field cultivator can completely mask it."[29]

By 1906 the residents along the upper river had enough experience with a series of minor floods that they convinced the owner of Unadilla Roller Mills that his dam was to blame. As he had stopped using water power to run his mill in 1897 when he purchased a gasoline engine, he acceded to their demands and blew up the dam.[30] It did not stop the floods.

Two years after the dam's destruction another big flood hit Unadilla; this time the damage was more serious than ever. It had started raining heavily Sunday night, 5 July 1908, hard

TABLE 1

GROWTH OF THE LITTLE NEMAHA VALLEY 1860-1890[23]

	1860	1870	1880	1890
Otoe County population	4,211	12,345	15,727	25,403
Syracuse [Township] population		[640]	510 [1,138]	728 [1,495]
Corn (in bushels)		632,160	3,591,019	5,315,708
Wheat (in bushels)		175,058	248,364	178,625
Nemaha County Population	3,139	7,593	10,451	12,930
Corn (in bushels)		224,659	2,942,770	4,084,020
Wheat (in bushels)		33,790	273,708	161,528

Note: In 1860, only township population was recorded. By 1870, both town and the larger township was recorded in the census.

enough, in fact, that members of the Christian Church canceled services and headed home or stayed with friends in town. It rained heavily all night long. The next morning, John Doyle was with a group of people at the lumberyard when he received a telephone call at about six o'clock. Someone warned him that he had better get his family out of his house, which was between the railroad tracks and the river (as were six or seven other homes). He was apparently still arguing over the relative danger of the situation (maintaining that his house had survived several floods), when someone arrived at the yard with the news that Doyle's house was floating down the river. Mr. Doyle ran down the railroad tracks, chasing his home, "trying to shout instructions and encouragement to his family." This lasted about three-quarters of a mile. Then his house came apart, and he dove in to save them. All six in the house died. A number of other homes situated too near the river were also destroyed.[31] This time water rose as far as Main Street in Syracuse.[32] The learning curve on the nature of this river was proving very steep.

By the mid-teens, some of the valley's residents judged they had suffered enough from the river and it was time for more direct action. They formed drainage districts with the purview of reducing floods. For several years these districts worked on ambitious channelization projects on two sections of the Little Nemaha, a fourteen-mile stretch between Syracuse and Talmage, and a forty-mile stretch from the Nemaha County line to the Missouri River at Nemaha. Neither project was met with enthusiasm from those whose property the ditches traversed. Some landowners sold out when they found the ditch might come their way and others refused to let the ditch cross their property. Huge land- and boat-based dredges were used to create these nearly straight channels.[33] Syracusans hoped that this would improve the river's dilatory behavior in draining the upper river. The problem as they saw it was in all that senseless weaving, meandering time the river took in getting rid of excess water. If this solution seems Herculean for such a small neck of the river, presumably it was a natural bit of reverse engineering from their broader water experience. Nebraskans had been constructing ambitious ditches farther northwest for several decades to bring irrigation water to fields that had none.[34] Why not make a ditch to take water away from where they had too much? Of course, in doing so, as we have seen, the valley's residents were opening themselves to increased danger in the future.

This began a new phase in the valley residents' relationship to their river in flood: from now on most of their efforts would be directed toward engineering a safe river. After a storm in the summer of 1917, shortly after the Syracuse "Ditch" was completed, the paper congratulated the community on the wisdom of its efforts, headlined as "Efficiency of Ditch Pronounced Perfect." The story read as follows: "The efficiency of the drainage ditch was again demonstrated last week. The mouth of the ditch where it joins the Nemaha became clogged, and but for the prompt action of Mr. Meeker and others who dislodged the debris with dynamite, the bottoms would have been flooded, but for the ditch."[35] The author missed the point of the story. The efficiency of the ditch was not perfect. His assessment displays a characteristically over-optimistic assessment of using technology to solve nature's "imperfections." It also demonstrates an inability, or an unwillingness, to recognize the limitations of their technology, even at a most basic level.

While the Little Nemaha flooded periodically between 1917 and mid-century, the flood of 1950 dramatically revealed the harmful effects of the inhabitants' land-use practices and the limitations of their engineering efforts. The Soil Conservation Service's postflood survey (which was limited to agriculture and county roads, as the Corps of Engineers was responsible for assessing municipal, industrial, and state and federal highway damage) determined the 8-9 May 1950 storm and flood caused $53 million in damages. Of this they judged fully 88 percent resulted from "sheet erosion in the uplands in the flood area." Bare, freshly tilled fields awaiting corn suffered severe erosion, particularly on sloping land. Wheat fields did much better but still lost as much as an inch of soil. Oat fields, with plants "barely past the emergence stage," eroded heavily, sometimes losing more than two inches. The damage on the lowlands was the reverse: "Ironically, much of this soil, which constitutes such a vital resource in its position on the uplands, formed a suffocating blanket over thousands of acres of growing crops along bottomlands on the lower reaches of streams where it was deposited in some instances up to depths of five feet."[36] Farmers on the floodplain probably would not have characterized the situation as "ironic"; their expressions would have more likely tended toward "tragic."

The Soil Conservation Service based its assessment of damage on an amortization of reduced crop yields at $5,183,537 per crop year. This would occur yearly "until such time as steps are taken to restore it to its former level of productivity. . . . When considered in terms of the present or capitalized value of the loss in production to the landowner, the total loss due to sheet erosion adds up to $46,661,775."[37] Restoration, here, is in terms of crop production. The topsoil, the windblown loess from the Rocky Mountains that had taken tens of millions of years to form, was gone for good. The Soil Conservation Service noted that while the monetary figure was "startling," the accumulation of damages from past storms (before their efforts in implementing soil conservation techniques) would have been an even "more staggering figure." That was true, but a more interesting and thought-provoking comparison would have been with the land prior to the removal of sod.

A comprehensive Congressional report published nearly a decade and a half later, in 1965, revealed inadequacies in the valley residents' grand technological solution to flooding; the channelization had done both more and less than it was originally intended to do. Channelization created its own hydraulic characteristics. As intended, it allowed greater water flow, but this increased the rate of erosion both of the channel bed and stream banks. The result was, as the Corps of Engineers report later found, "Stream erosion had greatly enlarged this original channel both in width and, particularly in the upper reaches, in depth." As the river continued to cut down, it created a steeper slope. The result: "The channel enlargement, the river gradient, and the drainage pattern have resulted in unbalanced capacities." At Syracuse river bankfull occurred at about 30,500 cubic feet per second (cps) of flow. Near Talmage this increased to 50,000 cpg, but then the channel narrowed and the gradient moderated so that at Auburn bankfull capacity of the river was only 26,500 cps.[38] The channel constriction near Auburn meant that water, increasing in velocity as it traveled down the channel from Syracuse, would "pile up" as it approached Auburn. And piling up in a channel meant flooding. Below Auburn, the Corps study reported flooding would occur every two or three years. While the Syracusans had apparently solved their town's flooding problem by their ditching, they had increased the danger downstream. Although the project had been intended to decrease danger of flooding, it actually resulted in less safety, as residents, particularly along the upper reaches of the valley, expanded settlement and farming in the floodplain. When big storms arrived as they did in 1950 and 1993, the scale of disaster would be just that much greater.

Human transformation of the prairie to farms in the Little Nemaha Valley had serious interrelated consequences for both the land and the river.[39] As farmers removed more and more of the thick prairie sod, there was less vegetation to retard runoff and more water ended up more quickly in streams that fed the Little Nemaha, causing faster rises and higher peak flows.[40] Of course, southeastern Nebraska farmers were not turning the prairie because of a hatred of grass; they were turning it to make crops for market. And they were not turning it to let it remain bare. But for a good part of the year it would be bare, or with crops just peeking above ground, as they found to their sorrow in the early May flood of 1950. While land in crops held water much better than did bare land, it rejected water much more than did land left to sod (or planted in certain other nonnative grasses). The significant point is that row crops compared to sod had 500 to 1,500 percent more runoff.[41]

A River's Nature

When residents of the valley attempted to correct flooding brought about by their land-use practices, they did so through channel modifications. In doing this they were violating a river basin's natural processes. Perhaps it did not occur to them that the river had purpose in making all those time-wasting, senseless meanders that they were so anxious to correct. Most of the time a river flows low in its channel. Several times a year it flows at three-quarters depth, and about twice a year at bankfull. Flows above this level are not contained within the channel but flow out over the floodplain (overbank flows). Hydrologists Luna Leopold and Thomas Maddock Jr. explained in 1958 why a river does not remain within its channel: "a series of complicated actions and reactions of water and sediment leading to a type of equilibrium between river water and river channel requires the existence of a flood plain."[42] The floodplain is built by the river as it swings laterally. The less rapidly a river downcuts through a channel, the more it swings. Hydraulic forces act to establish an equilibrium between what a drainage area offers in potential energy and what the river is able to transport in water and debris, "When a given reach of river attains near-stability of elevation and gradient," a condition railroads are particularly fond of, as we have seen, "then lateral widening of the valley becomes the dominant process."[43] As the river channel bends, water on the outside speeds up, eroding bank material, while water on the inside slows and, as it does so, drops its suspended load. This repeated deposition on the inside of river bends creates the floodplain.

> The height of the flood-plain surface is not determined by the truly extraordinary floods because of their rarity, but by the more common floods of moderate size. That is why the river channel is not built with banks high enough to contain the unusual flood. It is axiomatic, then, that during the unusual flood the flood plain is truly a part of the river channel.[44]

Forty years later, Leopold theorized why rivers and streams of all sizes tend to form the same meandering pattern, and do so to a degree that even he, as a geomorphologist, found surprising. He describes a river as a classic case of an "open system"—one that has a continuing source of potential energy (here, water to drain from elevation). Leopold tells us that an open system has a "tendency toward two conditions: that of minimum of work and that of uniform distribution of work or energy utilization." Because an open system cannot achieve both conditions at once, there is a compromise between the two. A compromise, here, indicates a minimization of variance, "a condition known as the most probable state. The compromise toward the most probable state is exhibited in channel meanders."[45] The reason that rivers and streams assume the "S" shape of the sine-generated curve is that this shape represents the most uniform distribution of change along the curve. The result, expressed in this contest between water and land, is that "by deposition and erosion, the river assumes a pattern that is both the most probable and the one having the smallest sum of the squares of deviations."[46]

Here emerge several crucial ideas for the history of human alterations of the Little Nemaha Valley. Most basic is the concept of a floodplain. Leopold states that, "the flood plain is part of the river channel."[47] While this floodplain—which widened from a half mile to two miles on the river below Syracuse—may be divided for hydrologic purposes into the "living floodplain" and an inactive or "historic floodplain," we might just as easily speak of the floodplain as being the normally dry part of the river. Part of the conceptual problem for those who settle near rivers is that they consider the floodplain separate from the river. While townsmen and farmers might choose to live in a floodplain, surely they would not want to settle in a river.

Leopold's scientific profile of a river helps to explain why human alterations in the Little Nemaha Valley—destroying the prairie, then straightening and shortening the river—created a particularly dangerous, unstable situation. In so radically changing the hydrologic characteristics of the land, settlers created an imbalance in this river system between its upland energy potential and the "compromise" of its downstream channel profile in relation to its water and debris transport. Upland farmers were awakening the river; it would now have to reach a new downstream compromise (which it did through flooding). In "improving" their river through channel modifications, the valley's residents were setting a straightened channel at war with the river's natural tendency toward meanders and floodplain creation. The river would predictably try to create a larger floodplain. This was a dangerous, essentially unrecognized, situation.

With the self-evident "efficiency" of their drainage ditch in mind, farmers and townspeople were safe to plow and build—or so they thought. As larger floods proved so disastrously, particularly in 1950 and 1993, they were not safe. Their ditch had given them a false sense of security that allowed them to expand development. In making this development on the floodplain, to great effort and expense, they were escalating their problems geometrically, as their river would act forcefully to express itself when the big storms came. With new development, and a new scale of damage the next time around, the solutions they would ponder would have to be correspondingly larger.

The history of Euro-American land use and settlement patterns in the Little Nemaha Valley provides a clear example of one way in which humans have created natural disasters.

In not understanding, and then ignoring or resisting the nature of the prairie that had been conditioned by its western skies through the ages, humans here created their own tragedies. By placing the economic value of their system of commercial agriculture as the prime consideration in their relationship with nature, and then only attempting piecemeal solutions on the periphery of this system, the valley's inhabitants—farmers and townspeople—were setting themselves up for disaster. They turned the sod and planted fencerow to fencerow, while they created towns in a river's floodplain. Even as the Soil Conservation Service during and after the 1930s pressured farmers to use better soil conservation practices, and even when it warned that the land was already approaching diminishing returns in steeper sections, farmers resisted change.[48] Even today, the Nebraska Natural Resources Commission reports that 43 percent of Nebraska's cropland needs better erosion control, with about 34 percent eroding at a rate damaging its ability to produce.[49] As we have seen, farmers also altered the hydrologic characteristics of the land, resulting in increased flooding and increased severity of flooding. While townsfolk would alter their urban settlements to a degree, eventually not rebuilding in areas subject to repeated flooding,[50] their preference was to change the nature of their river. This they did and then they placed too much trust in their efforts. But water and gravity acted according to their natures, altering the marvels of human engineering. Even when humans were subjected to the consequences of their actions on the land, they did not recognize that they were responsible for this type of "natural" disaster. Nature here, as everywhere, continues to teach its lessons.

NOTES

1. The Corps of Engineers calculated the discharge per size of watershed at Syracuse for the storm of 8-9 May 1950 was a record for the continental United States. While Syracuse was not gauged at the time, the Corps later computed a discharge using "contracted-opening and flow-over-embankment methods." The April 1943 flood of the Missouri River at Omaha was 200,000 cubic feet per second. US Geological Survey, *Floods of May-July 1950 in Southeastern Nebraska*, Water-Supply Paper, no. 1137-D (Washington, D.C.: US Government Printing Office, 1953), pp. 356, 409. See also William G. Hoyt and Walter B. Langbein, *Floods* (Princeton: Princeton University Press, 1954), fig. 20, p. 60.

2. Norman Rodaway, *Unadilla: The First Hundred Years, 1871-1971* (Lincoln: Nebraska State Historical Association, 1971); "Nemaha Valley Hit By Worst Flood," "Three Survive More Than Nine Hours in the Flood," and "Syracuse Residents Tell of Night of Terror," *Syracuse Journal-Democrat*, 12 May 1950, 1; "Two Children Die in Dunbar Flood," *Syracuse Journal-Democrat*, 12 May 1950, 4; Soil Conservation Service, US Department of Agriculture, *Floodwater and Sediment Damages in Southeast Nebraska Resulting From Storm of May 8-9, 1950* (Lincoln, Nebr.: Water Conservation Division, 1950), foreword, pp. 5-6; "Miraculously Escaped From Pickup Truck," *Nemaha County Herald*, 18 May 1950, 1, 5; "Highest Water Level Ever Recorded Struck on the Nemaha," *Nemaha County Herald*, 11 May 1950, 1.

3. William Whitman, *The Oto* (New York: Columbia University Press, 1937), p. 5; Berlin Basil Chapman, *The Otoes and Missourias* (Oklahoma City: Times Journal Publishing Co., 1965), p. x. For purposes of consistency, this article will adopt the spelling "Otoe."

4. Whitman, ibid., p. 1; Mildred M. Wedel, *The Prehistoric and Historic Habitat of the Missouri and Oto Indians* (New York: Garland Publishing, 1974), p. 52.

5. David J. Wishart, *An Unspeakable Sadness: The Disposition of the Nebraska Indians* (Lincoln: University of Nebraska Press, 1994), p. 36.

6. Wishart, *Unspeakable*, pp. 5,8; Wedel, *Prehistoric* (note 4 above), pp. 55-56; Wishart, *Unspeakable*, pp. 5, 8.

7. Basil Chapman noted the "Otoes were prairie dwellers, accustomed to a woodland environment" (*Otoes* [note 3 above], p. xi). Wishart writes, "Like the cottonwood tree that is native to the area, these late arrivals quickly and firmly attached themselves to the land" *Unspeakable* (note 5 above), p. 4.

8. See Superintendent Miller's report in *Annual Report of the Commissioner of Indian Affairs*, 28th Cong., 2d sess., 1844, Sen. Ex. Doc. 1, serial 449, 440. A secondary point here, and one that clouds our water, is that the Otoe-Missouria by this date were becoming increasingly dependent upon a very parsimonious federal government.

9. Charles A. Flowerday, "Native Americans and Water, Prehistory to 1900," in *Flat Water: A History of Nebraska and Its Water*, ed. Robert D.

Kuzelka, Charles A. Flowerday and Robert N. Manley (Lincoln: Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska, 1993), pp. 37-38; Margaret Dale Masters, *For The Record: The Centennial History of Syracuse, Nebraska* (Syracuse, Nebr.: Maverick Media, 1972), pp. 4-5. For the most cogent examination of this whole land cessation process see David J. Wishart, *Unspeakable* (note 5 above).

10. Howard Eugene Sautter, *Soil Survey of Otoe County, Nebraska* (Washington, D.C.: US Department of Agriculture, Soil Conservation Service, 1982), p. 2. The watershed averages 29 to 32 inches of rainfall, progressing southeastward. Averages, of course, on the Great Plains conceal extreme variability. A study of the Syracuse Soil Conservation Area in Otoe County for the years 1883 to 1938 showed an average yearly precipitation of 28.77 inches with a maximum of 40.95 inches in 1883 and a minimum of 19.02 inches in 1894. We should note that the data in this study were affected by the lengthy drought of the 1930s (1936 had only 19.33 inches, just shy of the record for the period). Richard H. Flynn, "Farm Organization and Conservation Practices in the Syracuse Soil Conservation Area, Otoe County, Nebraska" (master's thesis, University of Nebraska, 1940), pp. 14-15.

11. Masters, (note 9 above), p. 6; Aileen Lowson Williams, "A History of Syracuse, Nebraska," (master's thesis, University of Omaha, 1958), pp. 10-12.

12. Masters, (note 9 above), pp. 13, 31, 76; Williams, "History" ibid., 36n. Louis Henry Siekmann noted that most of the German immigrants came from the northern German states in "The German Element and Its Part in the Early Development of Otoe County, Nebraska" (master's thesis, University of Nebraska, 1930), pp. 2, 2n, 20; Tricia M. Rietz, "British and American Settlers in Palmyra Township, Nebraska, 1870-1880" (master's thesis, University of Nebraska, 1993), p. 134.

13. Williams, ibid., pp. 21-22.

14. Jane Graft, *Nebraska: our Towns East Southeast* (Seward, Nebr.: A Second Century Publication, 1992), p. 163.; Rodaway, *Unadilla* (note 2 above), pp. 1-3 (unpaged).

15. Arthur Mellon Wellington, *The Economic Theory of the Location of Railways* (New York: John Wiley and Sons, 1891), p. 660, quoted in Gilbert F. White, *Human Adjustment to Floods*, Department of Geography, Research Paper no. 29 (Chicago: University of Chicago Press, 1945), p. 116.

16. Quoted by Clement C. Williams, *The Design of Railway Location* (New York: John Wiley and Sons, 1924), p. 388.

17. White, *Human* (note 15 above), p. 117.

18. Rodaway, *Unadilla* (note 2 above), p. 7.

19. *Ibid.*, p. 3.

20. More accurately, the farmers of the Little Nemaha Valley had sufficient rainfall for 60 percent of the cropland to be given to corn, 25 percent wheat, 10 percent oats, and the remainder clover, alfalfa, brome grass, and soybeans. The principle is the same. USDA, *Floodwater* (note 2 above), p. 1; Donald Worster, *Dust Bowl: The Southern Plains in the 1930s* (New York: Oxford University Press, 1979), p. 13.

21. Rietz, "British" (note 12 above), p. 140.

22. Masters, (note 9 above), p. 49.

23. US Department of Commerce, Bureau of the Census, *Ninth Census of the United States 1870: Compendium* (Washington, D.C.: Government Printing Office, 1872), p. 197; idem. *Tenth Census of the United States 1880: Compendium* (Washington, D.C.: Government Printing Office, 1883), pp. 42, 794; *Eleventh Census of the United States 1890: Compendium* (Washington, D.C.: Government Printing Office, 1893), pp. 269, 376.

24. J. M. Wolfe, *Nebraska Gazetteer and Business Directory for 1879-80* (Omaha: Republican Book Binding and Job Printing House, 1879), p. 222, in Williams, "History" (note 11 above), p. 34.; *History of the State of Nebraska* (Chicago: Western Historical Company, 1882): p. 1232., in ibid., p. 34.

25. Some farmers had to use a team of four oxen to remove the sod. Masters, *Record* (note 9 above), p. 9.

26. "The Heaviest Rain Ever Known in This Section," *Syracuse Journal*, 22 June 1883.

27. "The Great Storm: Cyclone High Water, Ruined Bridges, Destructive Lightning Etc., Etc," *Syracuse Journal*, 29 June 1883.

28. Ibid.

29. Sally J. Herrin and Charles A. Flowerday, "Environmental Quality and Changes in Ecosystems," in *Flat Water* (note 9 above), p. 168.

30. Rodaway, *Unadilla* (note 2 above), p. 13; Masters, *Record* (note 9 above), p. 49.

31. Rodaway, ibid., pp. 13-14.

32. Masters, *Record* (note 9 above), p. 80.

33. Stoddard, Mr. and Mrs. Hugh P., et al., *An Informal History of Nemaha County, 1854-1967* (Nebraska State Historical Association, 1967), unpaged; Masters, *Record* (note 9 above), pp. 80-81.

34. For a history of these irrigation and water-power projects see Robert Manley, "Land and Water in Nineteenth-Century Nebraska," in *Flat Water* (note 9 above), pp. 9-31.

35. "Efficiency of Ditch Pronounced Perfect," *Syracuse Journal-Democrat*, 15 June 1917.

36. USDA, *Floodwater* (note 2 above), foreword, pp. 5-6.

37. Ibid., p. 8.

38. Brigadier General George H. Walker, *Report of the District Engineer, US Army Engineer District, Kansas City, Corps of Engineers*, Report to Divisions Engineer, US Army Engineer Division, Missouri River, Omaha, Nebraska (1964), in US House, *Report on Little Nemaha River and Tributaries, Nebraska*, 89th Cong., 1st sess., H. Doc. 160 (Washington, D.C.: US Government Printing Office, 1965), pp. 11, 18.

39. One scientist, writing shortly after the 1950 flood, described the general relationship between vegetation and peak flow: "Vegetation is effective in reducing the peak flows of streams to the extent to which it acts in reducing the quick flow of water into channels. This may be accomplished by withholding water from land and water surfaces, by inducing water to enter and flow through the soil rather than over it, by storing water within the soil, and by causing drainage water to percolate deeply into the material beneath the soil before being released to streams." Edward A. Colman, *Vegetation and Watershed Management: An Appraisal of Vegetation Management in Relation to Water Supply, Flood Control, and Soil Erosion* (New York: Ronald Press, 1953), p. 112.

40. Luna Leopold and Thomas Maddock Jr. reported in 1954: "The difference between well vegetated and exposed ground with respect to runoff and erosion during flood periods is in the order of at least 1:50 and 1:150; that is, amounts of runoff and soil loss from exposed ground are at least 50 to 150 times the losses from well-protected areas." Luna B. Leopold and Thomas Maddock Jr., *The Flood Control Controversy: Big Dams, Little Dams, and Land Management* (New York: Ronald Press, 1954), p. 71.

41. Edward Colman reported on several studies that may guide us. In a study made between 1933 and 1938 of surface runoff and erosion on rolling land in Wisconsin, an ungrazed cover of bluegrass sod released 5.5 percent of its annual rainfall as runoff, in contrast to land cropped continuously in corn which released 29.2 percent, and land cropped in barley 21.3 percent. Soil loss was even more striking. The land in sod lost .1 ton per acre per year, whereas the corn plot lost 111.7 tons, and the barley 16.8 tons. On a loessial soil plot in a hilly area of Iowa from 1933 to 1942, bluegrass sod released 1.2 percent of its annual rainfall, compared to corn, which released 18.7 percent (soil loss was .03 and 38.3 tons, respectively). Colman, *Vegetation and Watershed Management*, 192. Current soil science for Nebraska specifies an acceptable rate of soil loss without a loss of productive capability (known as the "T" factor, for tolerance) at about five tons per year. Sally J. Herrin and Charles A. Flowerday, "Environmental" (note 29 above), p. 167.

42. Leopold and Maddock Jr., *Flood* (note 40 above), pp. 9-10.

43. Ibid., p. 10.

44. Ibid., p. 12.

45. Luna B. Leopold, *A View of the River* (Cambridge, Mass.: Harvard University Press, 1994), p. 57.

46. Ibid., pp. 70-71.

47. Leopold and Maddock Jr., *Flood* (note 40 above), p. 12.

48. See Flynn, "Farm" (note 10 above), for evidence and discussion of this resistance.

49. Herrin and Flowerday, "Environmental" (note 29 above), p. 167.

50. Rather than using the de facto "regulation" of flood insurance to mitigate floodplain occupation, in recent years Nebraska and other states have created increasingly stricter controls over floodplain occupation. By 1993 Nebraska's laws had real teeth in them, with the state having the power to enforce sensible floodplain occupation, even if local political entities refused to do so. Nearly a half-century after Gilbert White began his crusade of floodplain regulation as an element of mitigating flood damages, his wishes are coming to fruition. White's position in his doctoral dissertation at the University of Chicago was that flood control programs to be truly successful had to take human encroachment on the floodplain into account, had to include nonstructural solutions, and must fully evaluate costs and benefits. See White, *Human* (note 15 above). For a recent assessment of floodplain regulation see Nancy S. Philippi, *Floodplain Management: Ecologic and Economic Perspectives* (Austin: R. G. Landes/Academic Press, 1996).