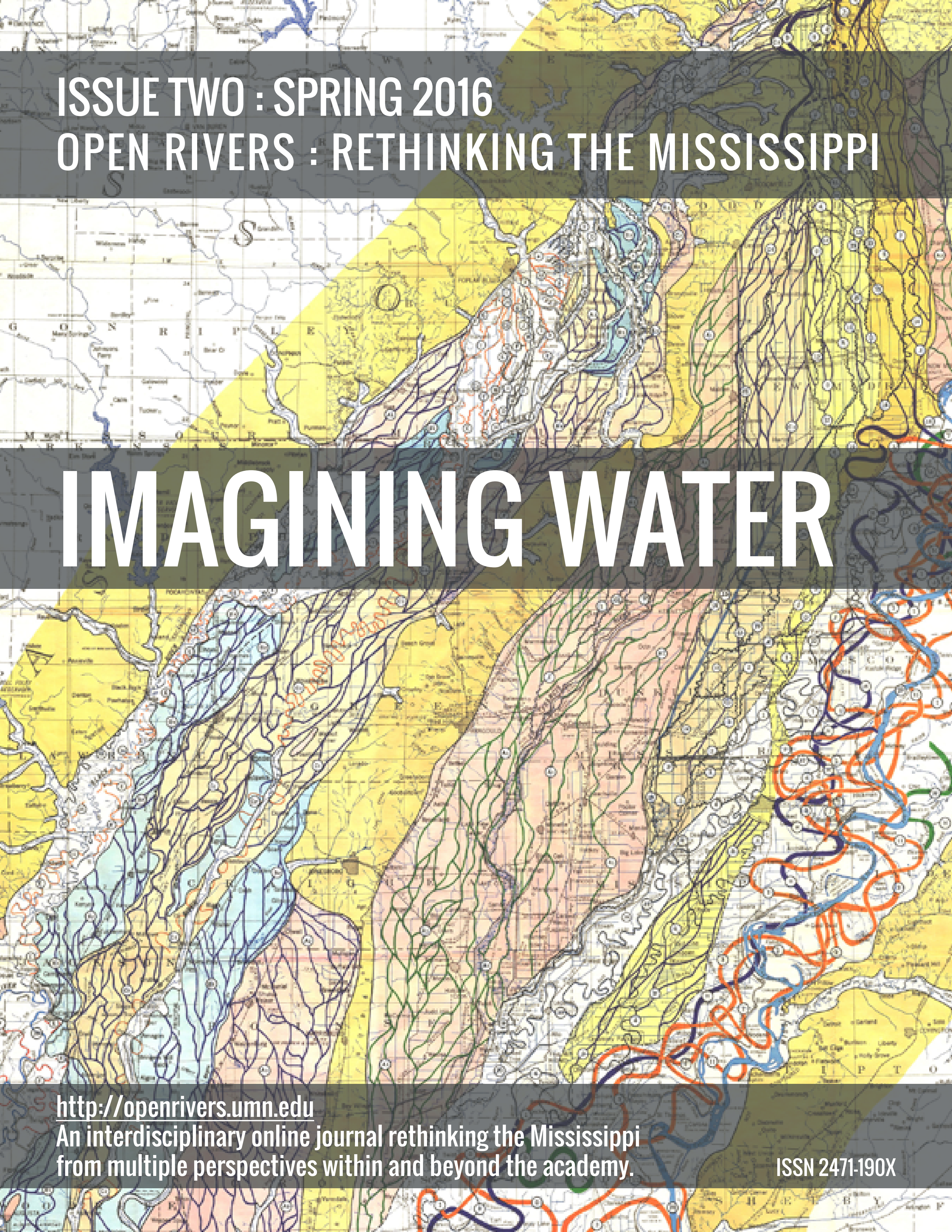


ISSUE TWO : SPRING 2016

OPEN RIVERS : RETHINKING THE MISSISSIPPI

IMAGINING WATER

http://openrivers.umn.edu

An interdisciplinary online journal rethinking the Mississippi from multiple perspectives within and beyond the academy.

ISSN 2471-190X

The cover image is by Harold Fisk, 1944, plate fifteen, sheet one, showing stream courses from *The Alluvial Valley of the Lower Mississippi River*. The map covers sections of Arkansas, Missouri, and Tennessee.

Open Rivers: Rethinking the Mississippi is produced by the University of Minnesota Libraries Publishing and the University of Minnesota Institute for Advanced Study.

Editors

Contact Us

Open Rivers
Institute for Advanced Study
University of Minnesota
Northrop
84 Church Street SE
Minneapolis, MN 55455

Telephone: (612) 626-5054
Fax: (612) 625-8583
E-mail: openrvrs@umn.edu
Web Site: http://openrivers.umn.edu

ISSN 2471-190X

Editorial Board

CONTENTS

FEATURE

DISTURBING THE MISSISSIPPI: THE LANGUAGE OF SCIENCE, ENGINEERING, AND RIVER RESTORATION

By Christopher Morris

From top to bottom, projects aimed at restoring the Mississippi River are underway in both deed and word. In the area of the Twin Cities, the U. S. Army Corps of Engineers is dredging pools along the floodplain and using the sediment to construct islands and restore wetland

Flooding in New Orleans.
NASA image courtesy Lawrence Ong, EO-1 Mission Science Office, NASA GSFC.

fish and waterfowl habitat. In the area of New Orleans, a coalition of engineers, scientists, and nonprofit organizations is likewise dredging and redirecting sediment in an effort to stem erosion of the Mississippi River delta and the Louisiana coastline. In between the upper- and lower-most portions of the river, conservation groups are restoring a forested floodplain habitat upon the batture, the ribbon of land between the levees and the river. Restoration of river and floodplain habitat in the Mississippi valley is part of a national and international trend. Across the country, decades-old dams are coming down, floodwaters are returning to floodplain, and migratory fish are swimming in streams where they have not been seen in living memory. Around the world, from the U.K. to India, governments and NGOs are formulating plans and raising funds to restore river and floodplain habitat.[i] Much of this restoration work is undertaken in the interest of minimizing or rolling back the effects of disturbances, such as hurricanes, erosion, and urban development, and shoring up resilience, a river's natural ability to resist disturbances. However, the words used to explain river systems have come to explain what threatens them, and to explain what river restoration must therefore accomplish. Words shape deeds. This essay explores some of the history of the language of river science, engineering, and restoration.

River Restoration

River restoration is a concept whose time has come. It is inspired by the growing awareness of human alterations of the global environment, and of climate change perhaps most of all. It also represents a reaction to the absolutely wretched state of so many rivers and the problems they pose for human health and welfare if remediation efforts are not undertaken.[ii] In some cases, modifications of rivers made during the industrial era have outlived their usefulness, so they may be dismantled without controversy.[iii] There is no shortage of good reasons to restore the world's rivers. However, there may also be reason to question some of the assumptions behind so many river restoration projects, including those underway along the Mississippi River.

Many of the Mississippi River restoration project planners invoke the concept of disturbance. For example, a proposal by the Lower Mississippi River Conservation Committee to restore floodplain forest habitat upon the batture between Cairo, Illinois and Vicksburg, Mississippi explains that many of the targeted locations comprise "relatively intact ecosystems," which "tend to respond better to disturbances." A report authored by a group of scientists and engineers working to restore the Mississippi River delta discusses the relationship between what it calls bottom-up and top-down disturbances. An Army Corps of Engineers paper on Upper Mississippi River System Ecosystem Restoration Objectives considers how the river's ecosystems might be managed so as to be "more productive of native life forms and resilient to human and natural disturbances." According to a Nature Conservancy report on the Mississippi River alluvial valley in Louisiana, centuries of "natural disturbance," including hurricanes, disease, and fire, shaped the region into one of "the most productive ecosystems in North America," until human disturbance, such as levees and deforestation, degraded the system. [iv]

Concepts of Disturbance and Resilience

Promotional literature for many river restoration projects offers only a simple gloss on the concept of disturbance. Nevertheless, it betrays the science upon which the projects are frequently based. Conservationists speak of natural and human disturbances to ecological systems, and of the resilience of those systems in the face of disturbances. Engineers and city planners seek to prevent flood disturbances and to make human communities more resilient. Disturbance has become a widely used concept within stream ecology to describe forces that intrude upon and often upset ecosystems, which, if resilient, survive and quickly rebound.

Science, which we like to think of as hypotheses formulated and tested with data carefully collected by objective researchers, owes much to language. The word "disturbance" means the interruption of or interference with the regular order or process. A disturbance, by definition, cannot be part of the system it upsets. It exists and acts upon the system from outside of it. A flood, for example, considered as a disturbance cannot be considered as a component of the floodplain ecological system, not because research indicates it is not—which may or may not be the case—but because the word by definition means it cannot be part of the floodplain ecological system. Scientists, like all people, use words to convey meaning and understanding, to conceptualize observed phenomena, to formulate questions that guide investigations. Once used, however, once fixed in the scientific lexicon, some words can take on lives quite apart from the research and ideas of the scientists who first used them. A scientist who sets out to study the effect of flood disturbance on a floodplain ecosystem has already decided what the relationship between a flood and a floodplain is, before initiating any research, and thus all research will help prove that floods are indeed disturbances, that they are outside forces that disrupt or interfere with floodplain ecologies. To consider floods as otherwise would require an imaginative leap over a linguistic hurdle.

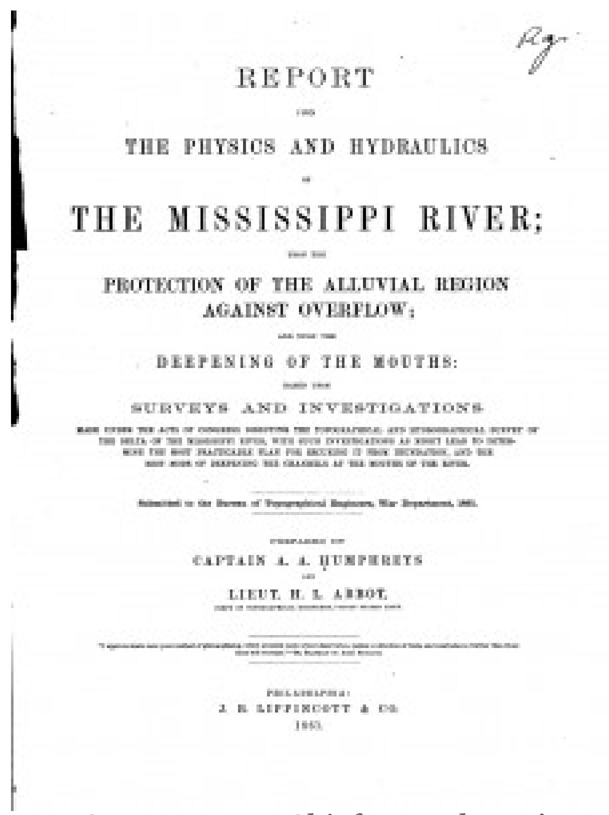
The power of words can give rise to more and equally powerful words. An ecological system's resilience to disturbance is a linguistic contrivance. Whatever the physical and material relationship is between floods and ecological systems, scientists, engineers, and conservationists have chosen to characterize it in terms of disturbance. Because they see floods as disturbances, they also see ecological systems in terms of resilience. Research into resilience—resilience studies is a rapidly growing field—assumes disturbance and cannot question or challenge it, for without disturbance there can be no resilience. So long as the words are used, research, no matter how careful, thorough, or objective, will necessarily confirm the apparent reality of disturbance and resilience. The relationship between a river and its floodplain, ostensibly an object of investigation, is assumed from the outset. The work of stream ecologists often informs the work of engineers, and increasingly, the work of conservationists.

History of the Concept of Disturbance

Where did the concept of disturbance, in particular as applied to the Mississippi River, originate, and why that word? It has not always been used to describe the river. In 1861, Andrew Atkinson Humphreys and Henry Larcom Abbot released the first scientific survey of the lower Mississippi River. Nearly six hundred pages in length, with chapters on the state of the science of hydraulics, methods of gauging velocity and discharge, and experimental theories of water in motion, and with over one hundred pages of tabulated gauge registers, soundings, velocities, and computed dimensions of river cross-sections, the report was nothing if not thorough. The authors claimed to have ascertained "every important fact connected with the various physical conditions of the river and the laws uniting them." After more than four hundred pages of mind-numbing data and discussion, with not one doubt that they might have lost their readers' attention hundreds of pages earlier, they at last made their point: The Mississippi River could be controlled with levees only, from Cape Girardeau to the Gulf of Mexico. [v]

Andrew A. Humphreys, Chief of Engineers, who conducted the first scientific survey of the Mississippi River.
Image source Library of Congress Prints and Photographs Division. Brady-Handy Photograph Collection.

Humphreys's and Abbot's conclusion settled a long debate over how best to control flooding along the Mississippi River. Since the days of the French and Spanish governors, many methods had been proposed, but authorities hesitated to fund one or another unproven scheme. Of course, no scheme could be proven to work until money was spent and construction completed. But the Humphreys-Abbot report seemed a safe bet, because it was so long and thorough. Whereas other engineers and hydrologists presented proposals based on succinct and sometimes even elegant theories, Report of the Physics and Hydraulics of the Mississippi River crushed all theory under an onslaught of numbers. The authors practiced science rather like the army that employed them would battle in the war just



REPORT

THE PHYSICS AND HYDRAULICS

THE MISSISSIPPI RIVER;

PROTECTION OF THE ALLUVIAL REGION
AGAINST OVERFLOW;

DEEPENING OF THE MOUTHS:

SURVEYS AND INVESTIGATIONS

CAPTAIN A. A. HUMPHREYS

LIEUT. H. L. ABBOT,

J. B. LIPPINCOTT & CO.

Cover page to Chief Humphreys's scientific survey, by A.A. Humphries, and H. L. Abbot, 1861.

then getting underway. By war's end the flood control structures, which had been so inadequate when Humphreys and Abbot first set about their research, lay in ruins. The landowners and states responsible for maintaining them were impoverished. Congress had to act. Republished in 1867, the Humphreys-Abbot report guided the science and engineering of the Mississippi River well into the next century.

Theories of River Behavior

Humphreys and Abbot approached science empirically. They said nothing about disturbance or resilience. They resisted proposals to control flooding based on theories of rivers and deltas. The Mississippi may have been pulled over the surface of the Earth by gravity, same as any river, and it may have meandered and topped its banks like many rivers—other engineers liked to compare it to Italy's Po River—but ultimately, the Mississippi River was like no other river. It was exceptional, Humphreys and Abbott argued, and therefore it had to be thoroughly understood on its own terms. Knowledge of other rivers would not take engineers very far toward understanding how to control the Mississippi.

At the moment that Humphreys and Abbot were rejecting theories of river behavior, biologists and ecologists were becoming more theoretical. In 1859, two years before the publication of the Humphreys-Abbott report, Charles Darwin published *On the Origin of Species*. In 1876, three years before the establishment of the Mississippi River Commission and the beginning of the implementation of many of Humphreys's and Abbot's recommendations, Lester Ward published an article that proposed a modification of the Darwinian theory. Evolution could not be the result of adaptation to natural environment, Ward argued, because many plants were in fact not ideally suited to their environments, and thrived when transplanted to places where they were not normally found. In many settings, Ward argued, plants lived in a state of static equilibrium forced upon them by the other plants in their community. When an outside force disturbed that community, however, plants adapted, some better and sooner than others. Thus, the process and pace of evolutionary change depended on equilibrium and its opposite, disturbance.[vi] Ward went on to a noted career as a sociologist, leaving others to pursue his original work in botany. Very quickly there emerged a consensus that the normal state for biological communities

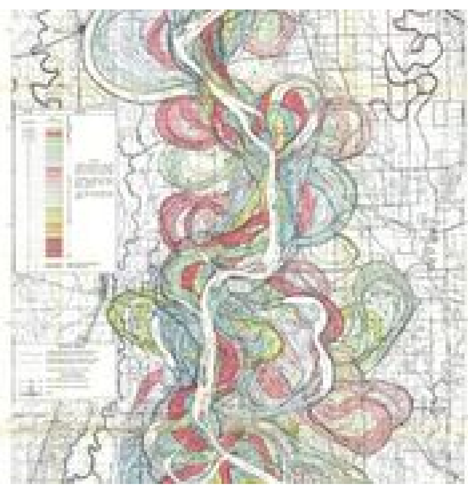
The Po River by Giorgio Galeotti.

was one of equilibrium, which was to be expected because a disturbance, by definition, could not be normal. For decades, researchers debated the nature of the state of equilibrium, whether it was "forced," to use Ward's word, upon individual species by the competition among them, as they pushed against each other in a kind of Newtonian world of opposing forces, or whether equilibrium was the result of mutual interests among species existing within a harmonious interlocking community, what Frederic Clements called a super organism. Early into the twentieth century, Clements proposed a concept of plant communities that, barring disturbances such as fire or agriculture, moved through a succession of stages toward a final climax stage of stability and equilibrium. Regardless of whether equilibrium was a standoff between competing species, or a harmonious balance between them, equilibrium was thought to be normal, and disturbance, no matter how inevitable, frequent, or regular, was not normal.[vii]

Balance and Equilibrium

The concept of equilibrium as normal spread beyond science and informed the popular notion of the balance of nature. Disturbances upset the balance. Old growth forests epitomized the balance of nature. Logging and forest fires epitomized disturbance. For anyone who thought about rivers, whether professionally or because they lived near one, floods were disturbances that upset the balance of nature along the river's edge. Geologist Harold Norman Fisk applied equilibrium theory to his research on the Mississippi River, arguing that the river had moved through several stages of development, from several braided streams to a single meandering stream that regularly jumped its banks and changed course, to an increasingly straight and stable stream, as forces of gravity, resistance, and turbulence came into balance. Floods, Fisk argued, were disturbances, signs of instability, which in time would diminish as the river settled into its final, climactic stage. Indeed, Fisk believed that levees and other devices could even assist a river system's progress toward climax and stable equilibrium.[viii]

On April 6, 1937, Chief of Engineers Edward Murphy Markham submitted his "Comprehensive Flood-Control Plan for Ohio and Lower Mississippi Rivers" to President Franklin Delano Roosevelt, who reviewed and endorsed it, and then three weeks later submitted it to the chairman of the House Committee on Flood Control.



Harold N. Fisk's Ancient Courses of the Mississippi River, Plate 22, Sheet 9. SOURCE: H. N. Fisk, Geological Investigation of the Alluvial Valley of the Lower Mississippi River, Oversized Plates (Vicksburg: Mississippi River Commission, 1944).

That year an Ohio River flood broke records. More than 500,000 people fled their homes. As the crest of water moved into the Mississippi River valley, it tested structures put in place over the previous decade. For the most part, the Mississippi's levees held, and the floodways and

Chief Engineer Edward Murphy Markham on the St. Francis River levee in Arkansas, with Harry Hopkins, Head of the Roosevelt Special Flood Commission, February 1, 1937. Image reverse available. Image used with permission, Jeff Daly.

spillways worked. Successful flood control on the Mississippi proved that new engineering would work on the Ohio and elsewhere.

Chief Markham's plan recommended nearly half a billion dollars in appropriations for new flood control structures. This was quite a request in a year when the economy collapsed into recession, as GDP fell by 30 percent. The Chief justified the expense by pointing to the success his engineers had had in the Mississippi valley, and by noting that the costs barely surpassed the estimated damages of a major flood. Most of all, he justified the expense in terms of human costs. "While figures have been compiled to establish the monetary benefits from the construction of the works that have been described," Markham argued, "and to establish their economic justification, I am of the opinion that the real justification for this large expenditure is to be found in the saving of human life and suffering, and in the prevention of the disturbance of the affairs of the Nation brought about by a flood disaster. I do not hesitate to recommend the construction of the works on these grounds alone."[ix] And there was the word, "disturbance," used perhaps for the first time officially in reference to engineering in the Mississippi valley. Markham used the word to

1937 Ohio River Flood.

represent the river as an outside force intruding into human affairs. In the next decade, the Corps of Engineers hired Harold Fisk and began to redesign the Mississippi and its tributaries in accord with his theories of stages of climax and equilibrium.

Resilience

In 1973, Clifford “Buzz” Holling, then at the Institute of Resource Ecology at the University of British Columbia, published an article on the resilience of ecological systems, in which he defined resilience as a system’s ability “to absorb change and disturbance and still maintain the same relationships between populations or state variables.”[x] What Holling sought was a way of understanding change and stasis, disturbance and equilibrium. The concept of resilience recognized that disturbance was frequent, and frequently quite natural, so natural, in fact, that systems often bounced back quite quickly. The normal state of ecological systems, argued Holling, was not static equilibrium, but adjustment and change to meet forces of disturbance.

Holling was among the first scientists to break free of the concept of equilibrium, which had dominated ecology for much of the twentieth century. Equilibrium meant nothing without the idea of disturbance, a force capable of upsetting equilibrium, and yet as a scientific concept, disturbance remained undeveloped until much later in the century. Holling focused on resilience, shifting emphasis away from undisturbed equilibrium and toward the speed and means with which systems recovered from disturbance. Disturbance and resilience, not equilibrium, were normative, Holling argued. Although Holling was not specifically interested in disturbance, his interest in resilience necessarily drew attention to it as a concept, which others began to develop into formal theory. In 1988, Vincent Resh and a large team of co-authors published a groundbreaking report on "The Role of Disturbance in Stream Ecology."[xi]

Clifford S. Holling discussing his concept of resilience.
Source: YouTube.

Holling, Resh, and other writers sought to move their field beyond the concepts of equilibrium and climax, and yet they persisted in thinking of disturbances as outside forces acting upon closed systems, just as Ward and Clements had done. Even theorists who, by the 1990s, began to see Mississippi River floods as integral to the health of floodplain ecologies, still thought of them as intrusions. In an important article published in 1990, Richard Sparks argued that the 1973 Mississippi River flood, while "a major disturbance to man," "was not a disturbance to the biota, because it occurred in the spring at the time 'expected' by the floodplain spawners and migratory birds, and simply increased spawning and feeding habitat available." However, Sparks's continued use of the word "disturbance" limited his efforts to integrate flooding into the floodplain ecology through what he termed the flood pulse concept, because he continued to regard floods as intrusions. He distinguished intrusions into ecological systems that upset those systems from intrusions that did not—there were disturbances that disturbed and there were disturbances that did not disturb—but the word meant he could only conceive of a flood as a force from outside the system and not as an integral component of it. Similarly, resilient systems for Sparks were those that were not easily disturbed by disturbances. The word itself, which originated with the concept of equilibrium, continued to shape the science of stream ecology long after ecologists rejected the concept of equilibrium.[xii]

Resilience is no more real, that is to say, no more natural than a state of equilibrium. Indeed, the concept of a disturbance regime, in which resilience and disturbance are balanced, is, I would argue, equilibrium theory in new packaging. Equilibrium, resilience, and disturbance are concepts—words—for articulating observed ecological change or system behavior. But what is inside and outside is constructed by the terms. The boundaries of an ecological system end where a river meets its bank, where water meets land, liquid meets solid. But these boundaries exist only partly in nature, for they also exist in the language scientists use to describe nature. The boundaries are never really interrogated, because the words that define them also reify and naturalize them. Land and water and the ecological systems upon and within them are defined as separate, each outside of the other, and when they mix they are each seen as disturbing the other, to greater or lesser degrees depending on the resilience of each to the other. Water disturbs the floodplain; silt disturbs the river. Both bounce back if they are resilient. In this linguistic context, the distinction between what is human and what is natural can really muddy the waters, so to speak. Levees disturb the interaction between river and floodplain, except when that interaction is itself a disturbance that levees can prevent. A human disturbance put in place to counter a natural disturbance raises questions for river restorationists: What is the real disturbance? The naturally occurring flood? The human-constructed levee? The flood that occurs because of the levee? The human-construction of devices to counter the effect of levees? The debates that occur after disasters—was Katrina a natural disaster or was it caused by human recklessness?—stem in part from the dichotomy perpetuated by the language of disturbance.[xiii]

In the spring of 1973 the Mississippi River reached its highest level in more than 150 years.

Restoration as Creative Disturbance

For ecologists, engineers, and even landscape architects who work on ecological restoration projects, human intrusions into a system that are intended to improve resilience, even though they come from outside the system, are not thought of as disturbances because they contradict or cancel other disturbances. Ecological restoration uses targeted human intrusions to restore ecological systems to an undisturbed state. Initially, a disturbance was anything that disrupted a state of equilibrium; where there was no equilibrium, there had to be disturbance. In time, disturbance came to mean anything from which a system could not rebound, anything that overpowered a system's resilience. Where resilience failed, there must be disturbance. But what, then, of restoration? How do we think of outside forces—disturbances—that improve resilience to outside forces? The politics of river restoration can become tricky the more one person's human disturbance becomes another person's effort to enhance resilience.[xiv]

Recent uses of the concept of disturbance tend to collapse differences between natural and human forces that act upon ecological systems. They also confuse the efforts of scientists to distinguish between what might be called creative and destructive disturbances. For example, human modifications of rivers originally intended to prevent natural disturbances (e.g. levees) have come to be thought of as themselves disturbances that reduce natural resilience. If, however, human modifications can make a river system more resilient in the face of natural disturbances—fires, storms, floods, weather events—then those modifications are not called disturbances. Proactive conservation measures, which are, after all, human intrusions into a natural system, are seen as less disturbing than natural disturbances.

Human (destructive) disturbances have modified the Mississippi River delta and the coastal marshes of Louisiana, making them less resilient to the natural disturbances of hurricanes, coastal erosion, and saltwater intrusion. In response, there are growing human interventions—creative disturbances, though they are not referred to as such—aimed at restoring the natural resilience of the delta and the coast. Natural disturbances are treated as destructive or creative in relationship to human disturbances. In the narrative of delta and coastal degradation, hurricanes and tides are (creative) disturbances that maintain coastal wetland resilience, until human (destructive) disturbances, such as levees and the activities of the gas and oil industry, weaken their ability to withstand natural (now destructive) disturbances. To save the Louisiana coast, to make it more resilient, requires still more human intervention, that is to say, human (creative) disturbances.

The problem, of course, is with the word. In 1937 Chief Engineer Markham sought congressional funds and authorization for levees that would stop the river from flooding. A half-century later, Richard Sparks surveyed some of the damage done to the Mississippi River system by those levees, and argued for a program of restoration engineering that included floating breakwaters, artificial islands, and the planting of aquatic macrophytes. Left alone, rivers recover somewhat, he argued, from both human and natural disturbances, however, "human intervention and continued maintenance will likely be required to maintain habitat diversity and desirable functional system characteristics." More to the point, he concluded, "man is required to take over many of the rejuvenating functions" that rivers once performed on their own.[xv] But whether they identified man or nature as villain, Markham and Sparks both called for people to step in heroically to stop disturbances. The meaning of the word is unclear, in part because as its meaning has changed over time, it nevertheless carries residual meanings. Once cannot hear Richard Sparks use the word without also hearing a little of Chief Markham. Consequently, the concept of disturbance is no longer very explanatory, if it ever was, and its application to phenomena thought to be destructive, creative, or both at once can seem rather arbitrary.

Designing Stability and Clarity

In the August 2013 issue of *Landscape Architecture Magazine*, regular contributor Lisa Speckhardt reported on the stream restoration work of two landscape architects. Paraphrasing them, Speckhardt wrote, "Disturbance, of course, affects how watercourses work, but in a dynamic way." She continues, quoting architect Chris Sass: "Streams will go through a series of three or four adjustments in form to achieve a new stability." Thus, Speckhardt concluded, "It is important to know what the stream's succession is going to be and where you are in that succession in order to do restoration." I suggest, however, that the relationship between "disturbance," "stability," and "restoration" demand interrogation. The first two words, disturbance and stability, are clearly set in tension, which means restoration is all about resolving that tension. But is that tension real, that is to say, observable in the natural river system? Or is it a product of the language ecologists, engineers, and landscape architects use to describe rivers? What if floods are not disturbances, but rather are stabilizers, or re-storers, or transformers? Whatever we call them and however we decide to think about them, they are still floods caused by water and land, gravity and resistance, friction and turbulence, and they contain and touch, feed and drown, many living organisms and communities of organisms; that much we know. Are they disturbances? What does resilience mean if we think of floods as restorative? What is restored by river restoration projects if we no longer have a concept of disturbance? Remove the word disturbance and thereby remove the tension? These are questions that do not get asked, largely because the word disturbance answers them preemptively. Inquiry into the behavior of rivers stops the moment our words—disturbance, stability, resilience, restoration—tell us how rivers behave.[xvi]

Drawing Lines

The lines that separate what is inside and outside a system are not always clear, though they must be drawn if systems, or portions of them, are to be isolated, studied, and understood. Engineers tasked with controlling floods need to draw lines between where water can and cannot go. Scientists studying ecological systems need to mark the limits of those systems, or they end up trying to comprehend everything on the planet touched by the sun. River restoration programs need to identify goals, which means drawing lines that distinguish between what will be restored and what will not, who will benefit and who will not, who is to be included in the program and who is not. At the very least, the politics of restoration requires that lines be drawn. But in certain instances, lines drawn for very practical reasons in one context get passed along to other contexts where, perhaps, they do not belong. Lines harden over time to where they seem to be natural, though they were originally human contrivances drawn for pragmatic or heuristic reasons. The line between a system and the forces from without that upset it, more or less, depending on its resilience, is such a line.

When biologists thought of closed communities of plants or animals moving toward static equilibrium, the forces that upset that equilibrium were disturbances. Later, when biologists began to think of ecological systems as normally dynamic rather than static, which encouraged them to think of disturbances as normal and even necessary for the health of those systems, they continued to use a word inherited from the earlier era, a word that encouraged them to draw lines between what lay inside the system and what did not and to think of those lines as natural. In the case of stream ecology, the concept of disturbance reinforces the notion that floods are forces that lie outside the floodplain ecology. It reinforces the notion that the ecology on the land is separate from the ecology in the river. It reinforces the idea that land and water ought to be kept separate, which makes it very difficult for engineers responsible for preventing floods to work with ecologists who see floods as necessary for the health of a resilient floodplain. One can imagine a conversation between an engineer set on stopping a flooding river from disturbing the land and human communities and an ecologist who insists that floods are necessary to the well-being of life on the land, and that it is the engineer's levee that will cause the real disturbance. And then one can imagine two legislators offering opposing bills, with each declaring his or her bill to be essential for stopping dangerous disturbances.

Facts, Conjectures, and Words In Between

The debate over the health of the Mississippi River delta exemplifies some of the confusion that comes, not from drawing lines between resilient systems and intruding disturbances, but from seeing those lines as natural. The delta has always changed, moved, eroded here and accrued there. The levees that seem to have caused the unwanted erosion of the coastline are also the levees that have kept the river in the channel that flows past New Orleans. To take down the levees in the name of restoring the delta so it can protect New Orleans from hurricanes would be to assume New Orleans would survive the dismantling of the levees, which it probably would not. Without the levees, the mouth of the river would be far to the west of its present location, and the delta around New Orleans, and the city itself, would go the way of the Chandeleur Islands, a former delta that long ago sunk into the sea. So lines must be drawn to designate levees that should remain to protect the city and its inhabitants from flood disturbances and levees that should be dismantled so that flooding can help rebuild the delta's resilience against storms and rising oceans, but also against human disturbances, including levees. All of this might be more clear if we were not so committed to the words "disturbance" and "resilience," or at least, if we used the words with careful consideration, precise definition, and clear intent.[xvii]

"There is something fascinating about science," wrote Mark Twain, in *Life on the Mississippi*. "One gets such wholesale returns of conjecture out of such a trifling investment of fact." Twain took his name from the unceasing accumulation of facts about river depth, the conjectures, that is, the theories of pilots about their significance for the safe passage of riverboats, and from the words that connected fact and conjecture. I think he well understood the value of both fact and conjecture and of the relationship between the two. The "wholesale returns" he spoke of come when fact and conjecture are confused. The problem is not with conjecture or with fact, but with language that, when used without due consideration,

Chandeleur Islands.
USGS.

confuses the two, turning conjecture into fact or vice versa. It is a fact that the Mississippi River is prone to flooding. However, what if anything a flood disturbs is a matter of conjecture. Similarly, it is a fact that levees interfere with the river's natural flood patterns. However, whether that interference is a disturbance or not is a matter of conjecture. It is a fact that the Mississippi River delta is shifting, sinking, eroding, and generally receding but also moving westward, and that the causes are both natural and human. But whether those causes, both the human and the natural, are disturbances, and whether efforts to stop them amount to restoration, or are themselves disturbances—those are conjectures, too.

References

[i] Faiz Rahman Siddiqui, "Plan To Restore Pachnada Health," *The Times of India* (August 27, 2012), online at http://timesofindia.indiatimes.com/city/kanpur/Plan-to-restore-Pachnada-health/articleshow/15795002.cms?referral=PM. On the project to restore the Thames River in England, see http://www.theriverstrust.org/riverstrusts/thames_restoration.html.

[ii] For a recent example, see the discussion over the Passaic River in New Jersey, and dangers of fish consumption and what to do about it: Sarah Gonzalez, "New Jersey River Polluters Fund Toxic Fish Swap—But There's a Snag," *NPR The Salt* (January 26, 2016), http://www.npr.org/sections/thesalt/2016/01/26/462918329/new-jersey-river-polluters-fund-toxic-fish-swap-but-there-s-a-snag.

[iii] Richard A. Lovett, "Dam Removals: Rivers On the Run," *Nature* 511 (July 30, 2014): 521-523.

[iv] Lower Mississippi River Conservation Committee, "Restoring America's Greatest River: A Habitat Restoration Plan for the Lower Mississippi River," (Vicksburg, 2015), online at http://www.lmrcc.org/programs/restoring-americas-greatest-river-initiative/. Restore the Mississippi River Delta Coalition, "Answering 10 Fundamental Questions About the Mississippi River Delta: A Report by the Mississippi River Delta Science and Engineering Special Team," http://www.mississippiriverdelta.org/our-work/overview/science/. On the Nature Conservancy's Project to restore the floodplain along the Ouachita River in Morehouse Parish see: http://www.mvp.usace.army.mil/Home/Projects/tabid/18156/Article/570958/habitat-restoration-upper-mississippi-river-restoration-program.aspx.

[v] A. A. Humphreys and H. L. Abbot, *Report of the Physics and Hydraulics of the Mississippi River* (Philadelphia: Lippincott, 1861), 30, 417.

[vi] Lester F. Ward, "The Local Distribution of Plants and the Theory of Adaptation," *Popular Science Monthly* 9 (October 1876), 676-684. Sharon E. Kingsland, *The Evolution of American Ecology 1890-2000* (Baltimore: Johns Hopkins University Press, 2005), 13-14, 144-145.

[vii] Frederic E. Clements, *Plant Succession: An Analysis of the Development of Vegetation* (Washington, D. C.: Carnegie Institution of Washington, 1916).

[viii] Christopher Morris, "Reckoning with 'The Crookedest River in the World': The Maps of Harold Norman Fisk," *Southern Quarterly* Special Issue on the Mississippi River as Twentieth-Century Southern Icon 52 (Spring 2015): 30-44.

[ix] 75th Congress House Com. Doc. No. 1: Comprehensive flood-control plan for Ohio and Mississippi Rivers (Washington, D. C.: Government Printing Office, 1937), 6.

[x] C. S. Holling, "Resilience and Stability of Ecological Systems," *Annual review of Ecology and Systematics* 4 (1973): 14.

[xi] Wayne P. Sousa, "The Role of Disturbance in Natural Communities," *Annual Review of Ecology and Systematics* 15 (1984): 353–391. P. S. White and S. T. A. Pickett, eds. *The Ecology of Natural Disturbance and Patch Dynamics* (New York: Academic Press, 1985). Edward J. Rykiel, Jr., "Towards a Definition of Ecological Disturbance," *Australian Journal of Ecology* 10 (1985): 361-365. Vincent H. Resh, et al., "The Role of Disturbance in Stream Ecology," *The North American Benthological Society* 7 (1988): 433-455.

[xii] Richard E. Sparks, Peter B. Bayley, Steven L. Kohler, and Lewis L. Osborne, "Disturbance and Recovery of Large Floodplain Rivers," *Environmental Management* 14 (September-October, 1990): 703, 707. J.W. Junk, P.B. Bayley, R.E. Sparks: "The Flood Pulse Concept in River Flood Plain Systems," *Canadian Special Publications of Fisheries and Aquatic Sciences* (1989): 106. The flood-pulse concept was intended to replace or modify River Continuum Concept (RCC) by taking into account

"the recurrent disturbance of the ATTZ by the flood pulse." (p. 120). The ATTZ is the Aquatic/terrestrial transition zone, i.e., the floodplain. Thus, Clements used "disturbance" to describe anomalies in climax theory. RCC and flood-pulse theory replaced climax theory for floodplain ecologies, yet continued to use here the concept of disturbance. Connell pushed matters further, when he suggested that disturbances often led to greater species diversity, meaning that disturbances were beneficial, even necessary, for the maintenance of a highly species-diverse ecology. Nevertheless, even beneficial and necessary disturbances, such as storms on a coral reef, are considered outside forces, or else they would not be disturbances. Joseph H. Connell, "Diversity in Tropical Rain Forests and Coral Reefs," *Science* 199 (Mar. 24, 1978): 1302-1310. Emily H. Stanley, Stephen M. Powers, and Noah R. Lottig, "The Evolving Legacy of Disturbance in Stream Ecology: Concepts, Contributions, and Coming Challenges," *Journal of the North American Benthological Society* 29 (2010): 67-83. Resilience is often measured by species diversity, which often increases following disturbances. See Connell, "Diversity in Tropical Rain Forests and Coral Reefs." On human community resilience see Lance Gunderson, "Ecological and Human Community Resilience in Response to Natural Disasters," *Ecology and Society* 15 (2010), online at http://ecologyandsociety.org/vol15/iss2/art18/, accessed 02-28-2014. See also, Thomas Homer-Dixon, *The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization* (Washington, D. C.: Island Press, 2008), 281-287.

[xiii] Stanley, Powers, and Lottig, "The Evolving Legacy of Disturbance in Stream Ecology," 69. The imagined separation of land and water ecologies is reinforced by academic disciplinary boundaries.

[xiv] For a clear definition of disturbance defined as the cause of a system response, which is defined as the effect of a disturbance, see Rykiel, Jr., "Towards a Definition of Ecological Disturbance."

[xv] Richard E. Sparks, et al., "Disturbance and Recovery of Large Floodplain Rivers," *Environmental Management* 14 (September-October, 1990): 706, 707.

[xvi] Lisa Speckhardt, "Streams of Many Shapes," *Landscape Architecture Magazine* (August 2013).

[xvii] For an example of a call for Mississippi River delta restoration that calls for continued human intervention to prevent flooding and human intervention to restore flooding, see Jeff Herbert and David Muth, "Guest Column: River Should Be Harnessed for Restoration," *The Advocate*, Baton Rouge (January 21, 2016), online at http://theadvocate.com/news/opinion/14632385-175/guest-column-river-should-be-harnessed-for-restoration .

Recommended Citation

Morris, Christopher. 2016. "Disturbing the Mississippi: The Language of Science, Engineering, and River Restoration" *Open Rivers: Rethinking The Mississippi*, no. 2. http://editions.lib.umn.edu/openrivers/article/disturbing-the-mississippi-the-language-of-science-engineering-and-river-restoration/.

About the Author

Christopher Morris is a professor of history at the University of Texas, Arlington, and author of *The Big Muddy: An Environmental History of the Mississippi and Its Peoples from Hernando de Soto to Hurricane Katrina* (Oxford University Press, 2011). He is working on a global history of nitrogen.