



**ISSUE TWO : SPRING 2016**  
**OPEN RIVERS : RETHINKING THE MISSISSIPPI**

# IMAGINING WATER

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

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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.

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FEATURE

# FUTURE RIVER - THE MISSISSIPPI IN LIGHT OF A LIFETIME IMMERSION IN WATER

By Patrick Hamilton

The Mississippi River, and all rivers everywhere, are canaries in a global birdcage. Their fates are no longer determined solely by the actions and behaviors of those who live and work within their watersheds. Their fates are now intimately intertwined with what collectively all 7.3 billion of us on Earth decide will be the fate of the global atmosphere.

The atmosphere and rivers have always been intimately connected and as humanity's global influence has waxed so has its interference with the flows of water and energy between the skies above us and the rivers amongst us. My appreciation of these relations has been a life-long growing consciousness that we all now reside on a human-dominated planet.

## Early Influences

I love water. Always have, always will. I delight in skimming across it in my kayak and dropping down into it with mask, fins, and snorkel. I was born in Detroit Lakes, Minnesota, and credit my early years amidst the lakes and streams of west-central Minnesota with imbuing me with a fascination of water that has endured my whole life. When I was five, my parents moved my three older brothers and me to Moorhead. You could argue that the Red River Valley, with its languid namesake river that meanders tortuously down its middle, is lacking in freshwater drama. And you would be correct if you only looked at that



*Patrick wading in a lake circa 1963.  
Image courtesy Patrick Hamilton.*

vast, flat panorama. But arching over that level landscape is a giant bowl of a sky capable of spectacular displays of atmospheric drama.

Growing up in Moorhead, I learned to spot a summer thunderstorm coming from three hours away. The ethereal cirrus tendrils of

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cumulonimbus off to the west in North Dakota would, to the discerning eye, gradually attenuate the bright afternoon sunlight. Then as the clouds thickened, the air would go completely still just before the dense gray curtain of rain and wind bent down the trees and peeled shingles off roofs. In winter, there was never a blizzard that I didn't adore (and they still captivate me as long as I am watching them from behind the windows of my living room and not the windshield of my car).

My fascination with the atmosphere further jelled in our backyard on a hot July afternoon in the summer after I graduated from high school. As a line of developing thundershowers passed overhead, I decided on a lark to set up the Sears and Roebuck telescope given to me for Christmas by my parents ten years earlier during the height of the NASA Apollo program. Rather than training it on the sun or moon, I focused instead on the tops of the clouds quickly sweeping eastward. This macro view revealed a bubbling cauldron of convection currents rapidly ascending high into the atmosphere and then quickly spreading out into the signature anvil-shaped tops of thunderheads.

After spending my freshman year of college at what was then Moorhead State University, I decided it was time to pursue my studies (from my perspective) at an eastern university. At the University of Minnesota in Duluth, I was astonished by a city with so much wild water and came to the realization that geography was the discipline that would allow me to study water in all its forms and manifestations. On my long hikes from the hilltop campus to the Hotel Duluth (where the overflow masses of freshman



*Patrick on the evening of his high school graduation in 1976.  
Image courtesy Patrick Hamilton.*

and sophomores were then housed in fall 1977), I trekked through elegant neighborhoods of stately homes dissected by cascades of water rushing down steep forested ravines. And then there was Lake Superior itself. Sure, at the time getting to it from the hotel required scrambling down slag piles, crossing abandoned rail lines, and snaking past broken foundations and abandoned buildings, but once you got to its gravel beaches and bedrock headlands you were face to face with a vast tempestuous magnificence.

## Graduate Training in Geography

In 1980 I moved to the Twin Cities to study geography at the University of Minnesota. My small apartment in Minneapolis left me yearning for the rugged shoreline of Lake Superior and the woods and lakes of west-central Minnesota. Fortunately, I discovered the Mississippi River gorge. I spent many hours exploring the

riverbanks and bluffs, finding fossils left behind by a very ancient sea. The Mississippi down below the city was a flowing reminder that a world of woods and wetlands, lakes and sloughs still existed, if one just followed the river north into the countryside.

## Creating Exhibits about Water and Rivers

After receiving my master's degree, I worked for a year as an environmental planner for the Metropolitan Council of the Twin Cities as part

of a large team grappling in the early 1980s with how to manage the enormous quantities of garbage produced by a large metropolitan area.



*Mist entrance to the H<sub>2</sub>O: Water = Life international touring exhibit organized by the American Museum of Natural History and the Science Museum of Minnesota in collaboration with the National Center for Earth-surface Dynamics.*

*Image courtesy Science Museum of Minnesota.*





*Ground Water Plaza in the Science Museum of Minnesota's Big Back Yard. Image courtesy of Science Museum of Minnesota.*

I joined the Science Museum of Minnesota in summer 1984. Since then, I have produced a wide range of exhibits about water and about rivers—H<sub>2</sub>O Minnesota, Watershed Science, Three Rivers Initiative, Mississippi River Gallery, Groundwater Plaza, Water Planet, and more.

My responsibility now is to produce environmental projects, especially exhibits and programs, for the Science Museum that explore the challenges and opportunities of living on a human-dominated planet. I conceive of ideas for new projects and then seek to convince those within the museum that there is a public appetite for these topics while persuading those outside the museum that

the realization of those topics into public experiences would be worth their investments, whether that be money or their own time and effort. My job in short is pushing circles of self-interest together with the goal of achieving as much mutual interest and public impact as possible. All of my projects over 32 years at the Museum have involved collaborating with a wide array of partners. But by far the most significant collaboration over those three decades has been with the University of Minnesota on a project about rivers that initially was planned to run 10 years but is still going after 13 years and counting. It started with a phone call.

# Launching the National Center for Earth-surface Dynamics

Professor Efi Foufoula called me in January 2001. She and her colleagues Chris Paola and Gary Parker were in the midst of preparing a multi-year, multi-institutional, multi-million dollar proposal to the National Science Foundation (NSF). Did the Science Museum want to be a partner? Absolutely. Getting a big proposal funded by NSF requires a big idea, and they had one.

Rivers are vital to the physical, economic, social, and cultural well-being of billions of people around the world. And geologists, ecologists and economists have been studying rivers for decades, even centuries. But these academic discipline-driven ways of knowing had never coalesced into a more systemic understanding of rivers, to the detriment of rivers everywhere and the people dependent upon them. So Efi, Chris, and Gary envisioned that their proposed National Center for Earth-surface Dynamics would create a new synthetic science they called earth-process science that would enable multi-disciplinary quantitative understandings of rivers.

As can be imagined, such an ambitious proposal received intense scrutiny and months of review. But we made it through the gauntlet and the National Center for Earth-surface Dynamics (NCED) was established in summer 2002. I got to be one of the principal investigators, not as a scientist, but as the point person tasked with imagining how to bring the research and insights of this big collaborative scientific enterprise with researchers from a dozen campuses to the attention of large public audiences.

It was a great gig. I got to eat with these scientists, drink with them, and visit their research sites. But after engaging in this work for several years,

I realized that I was hearing different versions of the same story from different scientists. The geomorphologists told me, “Do you realize that humanity is now the dominant agent of landscape change?” The sedimentologists asked, “Are you aware that humans are now responsible for the movement of more rock and sediment annually



*Chris Paola, Gary Parker, and Efi Foufoula, founders of the National Center for Earth-surface Dynamics. Image courtesy NCED, University of Minnesota.*



than all rivers and glaciers on the planet combined?” And the ecologists stated, “It is no longer possible to study an ecosystem on the surface of

this planet without taking human influences into consideration.”

## The Future Earth Initiative

Inspired by my interactions with NCED scientists and equipped with these new insights, I, too, wrote a proposal to NSF. It was funded, and in 2009 the Science Museum of Minnesota began the Future Earth Initiative. This project created a suite of exhibits, films, and programs about humanity’s new relationship with the world around it. While the project concluded in 2014, the three key ideas that drove the messaging of Future Earth continue to serve as the organizing principles of my work at the Science Museum:

- Humanity now is the dominant agent of global change – Humanity now dominates many of

the physical, chemical, and biological processes that make this world habitable.

- Humanity has many assets – This planet is now home to the healthiest, wealthiest, best-educated, most innovative, creative, and connected populace in history.
- Humanity needs to innovate and now – Humanity needs to be highly innovative technologically, economically, politically, and socially, because humans collectively have set in motion large-scale planetary changes.

## The Once and Future River

So when I consider the once and future Mississippi River in light of the above, the one thing for certain is that the future river will not be the same as the one in the present. The question for me is whether we will mourn this future river for what it once was and no longer is or cherish and celebrate it for what it still retains and what it has reclaimed. I suspect that we will be both mourning and cherishing the future Mississippi River. The degree to which we engage in one or the other will be determined by human decision making, either by default or by design, by accident or by intention.

The Mississippi River is a manifestation at all scales of humanity’s domination of our planet. The river and its watershed integrate all that we

do locally, regionally, and globally. After all, a river and its watershed are inseparable; they are complementary elements of the same system. The Mississippi River is an expression of the land use choices we have made locally through, for example, how we design and engineer our cities. The Mississippi River is an indicator of regional and national forces because how we use the watershed of the river is shaped by demands that others elsewhere place on the resources of that watershed, whether those be potatoes from fields carved out of recently cleared forests or wood products sourced from sustainably managed forests. And the Mississippi River and its watershed are a measure of whether and how we as a global species come to terms with how we manage the atmosphere that we all share in common.

# Is Our River Resilient?

Resilience to me is an easy word to use, but a difficult one to define. Here is how I consider the term. Resilience is the ability of a system to continue providing desired goods and services despite it having to endure increasingly disruptive forces, forces that may be beyond the bounds of what was originally imagined that system could accommodate. In the case of the Mississippi River, increased resilience to me means, in the face of disruptive changes that are occurring with increasing frequency and decreasing warning, that the river still has the ability to provide:

- water for human wants and needs;
- habitat for a richness and fecundity of plant and animal life;
- an essential respite from our human-dominated landscapes.

How resilient the future Mississippi River is will depend on how resilient our societies choose to become locally, nationally, and internationally. It may not be an easy path for some to take since



*Mississippi River in flood in downtown Saint Paul in spring, 2014.  
Image by Patrick Hamilton.*



the pursuit of resilience is an acknowledgement of vulnerability, which can be a humbling experience that some may prefer to avoid. But the pursuit of greater resilience can involve both defensive and offensive measures. I contend that for greater resilience of the future Mississippi River ultimately to be successful we will need to act in ways both reactive and proactive.

Our collective societal realization of a more resilient Mississippi River will be a blend of both

adaptation and mitigation measures. It will be adaptive through a common, shared awareness and appreciation that some changes are now unavoidable. Climates across the huge watershed of the Mississippi are already changing, and climate change will continue and likely accelerate in coming decades as heat-trapping gases continue to accumulate in the global atmosphere. The greater resilience of the future Mississippi River should be informed by these already discernible climate trends.

## Changing Weather Patterns

Temperatures are increasing across the state in all seasons and especially during winter. The ice-free season for the Mississippi River and for lakes across the state is trending longer. Episodes of high temperatures combined with high dew points leading to extreme heat indices are occurring more frequently. On July 19, 2011, an extraordinary combination of high heat and humidity made my home town of Moorhead the hottest spot on the planet with a heat index of 135F!

Extreme rainfall events are occurring with increasing frequency. Southern Minnesota experienced three 1-in-1,000-year storms between 2004 and 2010. These storms, exceptional because they dropped six inches of water or more in 24 hours or less across 1,000 square miles or more, had only a 0.1 percent probability of occurring in any given year. The fact that several occurred in the span of only six years suggests that the atmosphere now is behaving substantially differently than it has over the past 130 years since a network of volunteer citizen weather observers was established across Minnesota in the late nineteenth century.

The most recent storm in September 2010 dropped almost no rain on Saint Paul but deluged south-central Minnesota with so much water

that the Blue Earth River surged into flood and then disgorged so much water into the Minnesota River that it too flooded. That river in turn poured so much water into the Mississippi River where the two meet below Fort Snelling that the City of Saint Paul had to barricade roads, sandbag utilities, and otherwise mobilize for its first fall flood in recorded history.

Along with more incidences of extreme wetness, the state of Minnesota is experiencing more protracted periods of dryness. Climatologists are still studying the phenomenon, but evidence is accumulating that rapid warming of the Arctic is lowering the temperature contrast between high and mid latitudes, and thereby reducing pressure gradients and thus the speed by which the jet stream transports weather systems across the North American continent. Weather patterns in Minnesota, as a result, appear increasingly to oscillate between excessive wetness and protracted dryness. On the summer solstice of June 2012, for example, the City of Duluth and surrounding communities suffered a 1-in-500-year rainstorm and resulting flash flooding that caused over \$135 million in damage to public and private property. The Arrowhead region, along with the rest of Minnesota, then fell into drought, and the St. Louis River went from recording its largest

discharge ever to one of its lowest flows on record just three months later.

In the face of these climatic changes and more on the way, we will need to take steps to temper their impacts on the Mississippi River. In light of rising air temperatures, for example, we should consider retarding the rise in Mississippi River water temperatures that likely will stress native fish species by further lowering discharges of heat from human sources, such as power plants, along the river. In response to the increasing frequency

of extreme rainfalls, we should consider implementing measures to inhibit the overland flow of runoff into the Mississippi River, as exemplified by new state regulations to more vigorously enforce the buffer zone between farm fields and waterways. In light of increasing frequency of periods of dryness and wetness, we will need to pursue measures that make the watershed of the Mississippi River more porous so that we capture and retain more water during wet periods for availability during periods of drought.

## International Efforts

But our efforts to increase the resilience of the Mississippi River must also be informed by an awareness that there are limits to climate adaptation and that our ability ultimately to realize a more resilient Mississippi River will depend on agreements among nations to not allow global climate change to rage out of control. Climate change adaptation is comparable to pumping water out of the hold of a ship taking on water. Doing so helps protect those living and working on lower decks and directly at risk from the rising water and, of course, it slows the rate of sinking. Adaptation enables us to better cope with the new realities of climate change but eventually will prove ineffectual if we permit climate change to advance to the point where it overwhelms our abilities to cope. Successful climate adaptation ultimately will depend on our slowing and finally ending the flow of water into the hold of the global ship we are all traveling on through space.

The recent international climate agreement reached in Paris on December 12, 2015 is a very encouraging development. For the first time in history, an overwhelming global consensus has been reached that addressing climate change has never been more necessary, nor more possible. Many nations already are experiencing loss and

damages due to climate change, while at the same time costs of renewable energy have plunged so precipitously in recent years that their prices often are competitive and preferable to fossil fuel energy sources.

While we in Minnesota contemplate what adaptation steps to take to increase the resiliency of the Mississippi River to disruptive climate change, our success ultimately will depend on a partner in the form of a federal government that is working to mitigate the amount of future climate change with which we will need to grapple. As of this writing, climate change is a topic neither being addressed nor acknowledged by Congress nor by any of the Republican candidates vying to be our next president and the leader of the free world.

This situation is not just scientifically indefensible, but dangerous. Above all else, our political leaders have a responsibility to protect us, not just from those threats they may be most inclined to deal with, but from all of them. The present inability of our Congress to grapple constructively with the issue of climate change is the ultimate threat to the resilience of the once and future Mississippi River.



So here we are:

- Humanity now dominates many of the chemical, biological, and physical processes that drive the functioning of the Mississippi River.
- At the same time, Minnesota is home to one of the healthiest, wealthiest, best educated, most innovative, creative, and connected populaces in the history of the world.
- We, the citizens of this state, need to innovate creatively at all scales because the fate of the future Mississippi River will be determined not just by us, but by all 7.3 billion of us on this planet.

Changing the chemical composition of the atmosphere, as we are presently doing, inevitably alters the way the atmosphere works. Changes in the flow of heat and water around the planet inescapably will change the behavior of rivers everywhere. The alterations that humanity has already made to the global atmosphere are already affecting the behavior of the Mississippi River and rivers everywhere. The decision before us all now, either by default or by design, by accident or by intention, is whether future changes in the Mississippi River and all rivers due to climate change will be manageable or overwhelming.

We now live in a world where securing the future health and vitality of the Mississippi River requires that we collectively act to safeguard the well-being of all rivers everywhere.

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## About the Author

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