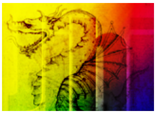
JOURNAL OF
INTERDISCIPLINARY
HISTORY OF IDEAS



2022

Volume 11 Issue 22
Item 11

– Section 2: Articles –

Mississippi

Working River

by

Thomas Turnbull

JIHI 2022

Volume 11 Issue 22

Editorial

Special Issue: Hybridisation in the History of Ideas

Special Issue: Historical Geoanthropology

General Section

Mississippi
Working River

Thomas Turnbull *

This article considers the history of various attempts to derive work from the Mississippi River and its constituent basin. Geographer Élisée Reclus's concept of a 'working river' is expanded upon in a series of reflections, meandering thoughts, and direct observations, some of which were made from a canoe. The article considers the Mississippi as an energetic system in which nothing is lost but entropy increases. A single drop of water is followed as it makes its way from the Appalachia to the Gulf of Mexico, as it contributes to the sedimentary record of both natural and human history. The article addresses how such flows were altered by European hydrological beliefs, and how the misguided visions of these same kinds of settlers created today's cyborg watershed. Our journey ends beneath the Gulf, where ancient geological processes of hydrocarbon formation have come to shape the region's fossil-fuelled present.

> All the agents of the atmosphere and of space, all the cosmic forces, have worked together to incessantly modify the appearance and position of the imperceptible droplet; it, too, is a world elike the normous stars that roll in the heavens, and its orbit develops from cycle to cycle by a restless motion.
> Élisée Reclus, *L'Histoire d'un Ruisseau* (1882), 2.

* Abt. I, Max-Planck-Institute for the History of Science (*tturnbull @ mpiwg-berlin.mpg.de*).

Journal of Interdisciplinary History of Ideas 11(2022), 22, p. 11:1–11:28. Peer-reviewed.

1. Continental Excreta

It never occurred to me that I might canoe down the Mississippi River (Rosol, Turnbull, and Renn 2021). Nor did I ever expect to write about it. Élisée Reclus had done both. Eager to avoid persecution for his anarchism, he left France in 1853. After a long journey, sea imperceptibly became land and, bump, his ship ran aground on a mud bar just south of New Orleans (Shallat 1993, 195). Reclus rejoiced in the silt's foul smell and wrote to his sister describing how "from a geological point of view, nothing was more interesting than these vast alluvia still in semi-liquid state" (Reclus 1855). This aspirant geographer believed that this obstacle was more than mud; it was continental excreta, the depositional record of a world as yet unknown. Towed ashore by a coal-powered tugboat, he first found work unloading ships in the port. To his imaginative eye, the docked luggers, schooners and steamboats in the port of New Orleans resembled nothing less than "gigantic stabled mastodons" (ibid.). More scholarly than athletic, he soon found less physically taxing work, tutoring the grandchildren of the owner of Louisiana's largest sugar plantation. Valcour Aime was supposedly the state's richest man and an early pioneer of sugar refinement (Toledano 1969). This work exacted a moral rather than physical toll. Reclus found the exploitation of enslaved people, upon whom his employer's wealth and his own income depended, utterly repugnant. Regretting his complicity in this crime, he quit to explore the river.[1]

Twenty-three years old, Reclus's revulsion at the cruelty of slavery contrasted with his enchantment with the nation's physical geography. Reclus travelled upriver from Louisiana's Saint James Parish as far north as the Niagara Falls, traversing this great continent-bisecting river system (Nettlau 1928, 67). It was the Delta however, which particularly drew him in. In a series of articles for European readers, he described the raising of levees and digging of drainage channels that had transformed the South's swampy "labyrinth of pools and marshes" into a single channel. Human labour, much of it enslaved, had engaged in backbreaking "mud work", hewing a dendritic wetland into a single channel river.

---

[1] His writing was notable for its anti-racism, anti-sexism, and almost pantheistic calls for the equality of all life, human and non-human. See Dunbar (1978), 29; Fleming (1988), 42-3.

Sediment now channelled out via a main deltaic fan, which opened like "an immense flower opening over the ocean its serrated corolla" (Reclus 1872, 349). At each corolla, sediment met seawater, incessantly reforming the delta and causing it to incrementally spread out into the Gulf of Mexico. In describing this work, Reclus invoked his teacher, the German geographer Carl Ritter, from whom he had learnt that the configuration of Earth's continents was an ongoing process, a dynamic stage upon which the more recent dramas of human history played out (Ferreti 2010). Drawing on Ritter's terminology, Reclus argued the Mississippi was one of many "working rivers" (*fleuves travailleurs*), a telluric force that works incessantly to "destroy only to reconstruct in another place" (Reclus 1872, 254, 408-409). Years later, himself now an established geographer, in *The History of a River* (1869) he expanded on the idea, explaining how rivers determine "the history of the planet" in undertaking the "double work" of both eroding and constructing Earth's surface (Reclus 1882 17-18).

While reporting on the Mississippi, Reclus was enthused by the various attempts made to calculate the kilometres of additional land the river would add to North America by extending it out into the Gulf of Mexico in coming centuries. He considered the survey work of Andrew Humphrey and Henry Abbot of the US Army Corps of Topographical Engineers particularly robust. Their federally-funded measurements and hydrological theorisation had led them to claim that between 79 and 101 metres of continental extension would occur every year as precipitation scoured sediment from much of the continent's surface and the river deposited it into the Gulf (Reclus 1866). Through this process the destructive-constructive work of the river could, within a degree of error, be measured. But in the 166 years between Reclus's observations and my own something had happened to the river's capacity for work.

Writing in the *New Yorker* a month before I travelled to the region, the journalist Elizabeth Kolbert described a flight over the delta in a four-seater Piper Warrior airplane. Today, from two-thousand feet in the air, the flowering delta that formed where the river meets the Gulf looks less like a blooming flower than something wilting and submerged. The work of continent-building seems to have slowed almost to a halt. Due to erosion, it is suggested that a tennis court sized parcel of land is lost to the sea every two minutes. Along with it go ecosystems, homes, critical infrastructure, and indigenous-owned land, all dissolving into the sea like sugar in tea (Kolbert 2019). Who is to blame? Some accuse those who built upriver dams, levees, and other infrastructure; others the rapacious extraction of on- and offshore oil and gas and the attendant access canals that crisscross coastal wetlands; while the accused seek exoneration in nature, emphasising the implacable role of sea level rise, hurricanes, and an unhelpful fusion of gravity and subsidence (Priest and Theriot 2016). Whoever or whatever is to blame, this once continent-building river has, in this case, become more a saboteur than obedient labourer.

If the Mississippi no longer works as it once did, what exactly does it do these days? Where has its constructive power gone? To begin to explore this, it is necessary to think of the river and its basin as an energetic system. In the mid-nineteenth century, a new understanding of work was beginning to emerge in Western Europe. Work was increasingly seen to be part of a system of physical equivalencies that allowed both natural and human forces to be measured and made comparable. The transformation of heat into motion provided a clear demonstration of this idea. Energy, as this idea became known, was recognised as a physical potential that was always conserved in some way via processes of conversion. However, each change in state could be seen to degrade a given source of energy and reduce its ability to create changes (Wise 1988). While Reclus was well versed in the laws of thermodynamics, it was North-American geologist Karl Gilbert who was among the first to quantify rivers and their enclosing landscapes in energetic terms. In studying the mountains of South Eastern Utah on behalf of the U.S. Geological Survey, Gilbert had described how the topography of the landscape imbued precipitation with energy. Rain that fell on raised ground was a source of energy that, in flowing, powered riverine Earth-making machines (Pyne 2007, 89-90).

The inescapable conservation of energy means the Mississippi's capacity for work cannot have disappeared; it must have assumed new forms. Locating this redistributed energy is complicated; we can only really speculate on where it may have gone. Around the same time Gilbert was casting rivers as energetic systems, his contemporary, North-American physical chemist Josiah Willard Gibbs, redefined the laws of energy in a probabilistic rather than deterministic way (ibid., 96). This statistical approach rested on the idea that energy is a probability whose likelihood decreases over time. This stochastic concept allowed the laws of energy to become more widely applicable. Understood as a probabilistic state rather than as laws, the insights of the energy concept were applied to more diverse systems ranging from the biological, meteorological, and as we will see, the fluvial geomorphological (Benson 2020, 20).

2. Entropic River

Extending Gilbert and others, in the early 1960s U.S. Geological Survey hydrologists Luna Leopold and Walter Langbein proposed that the evolution of rivers was governed by the law of entropy. Drawing on statistical mechanics, they recast hydrogeomorphology as a branch of statistical thermodynamics, and in doing so argued that river systems develop so as to minimize their work and achieve a uniform distribution of energy (ibid.). To fully understand the Mississippi as an entropic system, it must be approached not just as a river but as a basin. During the Pliocene era (5.4 to 24 million years ago), colliding slabs of Earth's crust raised the Rockies in the West and the Appalachia in the East. These mountains created a gently banked basin whose gravity tends southward. On this platform, we could follow a drop of Appalachian snowmelt as it falls from the branch of a spruce tree. Suspended at its tip, a single droplet is a minute world of suspended chemicals, microorganisms, and matter. As it falls, gravity and topography condition its path. As it moves, this densely populated drop imparts chemical and frictional forces upon Earth's surface. Over time, an incessant procession of innumerable droplets carve rills into the Earth, and others follow, resulting in deeper indentations. Droplets interconnect, creating streams and tributaries, eventually forming a river. Over time, this entropic process inscribes a drainage network upon the landscape (Horton 1945). In this way, each droplet shapes and is shaped by the basin's topography.

Within this morphological theatre, most energetic processes are ultimately powered by the Sun, the vast burning mass whose gravity creates the rotational force that pulls water downward on Earth, and whose radiative energy powers our planet's atmospheric and hydrological cycles. As a subsection of the planet's surface, this 3.2-million-kilometre square river basin can be imagined as a vast planar energy accumulator, a means for the collection and concentration of solar energy, water, matter, and biota (Turnbull et al. 2021). It is the Sun that raises the water, which then pumps out at 600,000 cubic feet of water per second into the Gulf of Mexico. There, due to our planet's rotational force and their distinct salinities, river water mixes with the clockwise current of the Gulf. Seeking a more probable entropic state, warmer river water is drawn toward the cool waters of the North Atlantic. Streaming out from the Florida Straits, our drop of Appalachian snowmelt is now part of a vast oceanic river 100 kilometres wide, 800 meters deep, and 3,000 times greater in volume than the Mississippi. The Gulf Stream flows at 30 million cubic meters per second, and brings humidity and rain to Northern Europe (Voituriez 2006). Oceanographers had once believed its source was the Mississippi, but its volume and energy are so great we now know this climate-determining phenomenon can only be driven by the energy of the Sun (Maury 1855, 26).

For mathematician Alfred Lotka, writing in the 1920s, the planet was a solar-powered "world engine", a dynamic totality consisting of "a multitude of subsidiary units, each separately, and all together as a whole, working in a cycle" (Lotka, cited in Kleidon 2016, 15). More recently, Earth Systems Science—or ESS—has reaffirmed this idea, and suggests a thermodynamic understanding of our planet and its limits is vital if we are to avoid deleterious climate change (ibid., and ibid., n23). Here we are concerned with one of these subsidiary units. As the Sun's radiant heat causes water to evaporate from Earth's surface, it rises, cools, and falls. Some lands in the Mississippi basin. The mass and elevation of this raised water gives a good indication of the watershed's potential energy. However, much of this potential is expended on the droplet's journey to the Gulf. Energy is lost in negotiating obstacles, or as friction and heat. This energy is not wasted, as discussed, the double work of erosion and deposition imprints the path of rivers upon Earth, contributing to the very topography that determines a watershed's energetic potentiality. So, while an estimated 98 percent of a river's energy is purportedly "lost" to heat, friction, and the shifting chemical composition of the water, inverted commas are necessary. Not only does this loss change the river's chemistry and raise its temperature, establishing the biological niches that sustain life along its course, more vital still, the energy that remains allows the river to undertake its Herculean geological labour. In Reclus's time, the river carried around 460 million tons of sediment per year. By the 1940s, the erosion caused by deforestation, intensified agriculture, and road-building increased this figure to 640 tons. However, since the 1970s, upriver dams have led to its waters carrying only about 130 million tons out into the Gulf (Russel et al. 2021). It is being starved of sediment, which not only contributes to land loss but also reflects the changing demands placed on this working river.

3. Take Off

Regions are distinguished by a perceived sense of their functional boundaries (Grigg 1967). The archetypal region is the river basin, sites where topography and hydrology offer a degree of holism to a given place. For geographers, the study of regions attests to the belief that meaningful descriptions of earthly processes can only be understood as interactions between natural and human history; a set of relations from which an almost infinite diversity emerges (Hartshorne 1935, 289). Geographers also argue that regions can best be understood via fieldwork, direct physical engagement with place. Environmental historian Richard White advocated canoeing as a way of knowing river regions. In paddling, he observed, we become intimately acquainted with a river's properties. Partly through our exertion, but also in negotiating its currents, eddies, whorls and boils, but also thanks to our experience of the labour-saving capacities of flowing water. The varying velocities of meanders and the smoothing or roughening effects of riverbeds offer a means of propulsion whose exploitation requires more skill and experience than brawn. White developed the idea of canoeing as a form of environmental research about 25 years

Figure 1: Plotting, Fort Defiance Park, Cairo, Illinois, 14 October 2019. Photograph by author.

earlier than our journey, and did so on a very different river, the shorter, smaller, and more turbulent Columbia River in the Pacific Northwest.[1] Before setting off on our canoes, my hope was to apply White's insights to the Mississippi, a deceptively languid looking river of less obvious but far greater power. The Columbia appears faster, more energised, as it is less than half the length of the Mississippi, but it descends 820 meters versus the Mississippi's gentle and longer 450 meter course. However, looks can be deceiving. The Mississippi discharges at 16,790 cubic metres per second, versus the Columbia's 7,500. This flow is fuelled by a catchment area six times greater than the Columbia's. This topography and flow rate has allowed the Mississippi to become a vast mechanism for moving water, matter, and sometimes people.

On a balmy October day, our canoe trip down a section of the river began

---

[1] The Columbia is less than half the length of the Mississippi, and its basin a sixth of its size. It descends 820 meters versus the Mississippi's 450. See White (1995), 10.

in the small town of Cairo (pronounced *Kay-ro*) at the confluence of the Ohio and Mississippi. Our guides laid out laminated maps of our intended route on the river bank (Fig. 1), a sinuous route that was dictated by the path of least resistance that this working had carved through the landscape (White 1995, 12). The geography we became part of—from its network of tributaries to its fractal delta—were an outcome of the spontaneous forms of order that the second law of thermodynamics, entropy, creates (Kleidon 2016, 118). A river's meanders may look like energy-sapping diversions: at 'Bessie's Bend' in Kentucky, where we camped a few days later, the river even turns northward. However, such paths result from interactions between the river's energy and the affordances and resistances of the landscape through which it passes. The meandering geometry of rivers testifies to their tendency to try to minimise their labour (Langbein 1966).

Like people, all rivers work, but some more than others. As we launched our three Voyager canoes from behind a cluster of empty barges, we could see vast containers of raw and processed materials tracking up and down the Mississippi, pushed and pulled by fossil-fuelled towboats. On lower sections, one boat can push as many as 46 barges in a coupling known as a tow. The twin engines of each boat can provide as much power as 10,500 harnessed horses. Instead of oats, each of these horses consume a gallon of diesel each day. Travelling downriver, these 195-foot-long 'Hopper' barges can contain as much as 1,500 tons of soybeans or grain grown in upriver fields in the Midwest.[1] About 40 per cent of U.S. agricultural exports travel down the Mississippi, to be unloaded into ocean-bound ships in Baton Rouge or New Orleans. Returning upriver, they likely carry Texan or Louisianan petroleum or its by-products, perhaps coal from Kentucky, fertiliser, liquidised methane, even molten sulphur (Fremlin 2004, 242). Each barge is a cell in a strange industrial metabolism; a fossil-fuelled feedback loop which turbocharges the planet's most photosynthetically-productive region.[2] Given its outsized productivity, the Midwestern Corn Belt, a second nature of terraformed prairie soil, rightly termed the world's bread basket (Cronon 1991). The U.S. has long engaged in the planetary circulation of

---

[1] Upriver, against the flow, a towboat can carry a maximum of 20 barges. See Fremlin (2004), 238-9.

[2] Measured in terms of chlorophyll fluorescence, an indication of photosynthetic productivity, see Mueller et al. (2016).

its agricultural output for both diplomatic and commercial gain (McGlade 2009). However, this superabundant agricultural region depends on fossil-fuel derived synthetic fertilisers. While more recently, its harvests have been converted into 'biofuels' in an extravagant conversion process that some argue consumes more energy than it yields (Turnbull et al. 2021, 290-291).

Per ton, the river's flow allows goods to be transported with significantly less energy than other means of inland freight. Water's low viscosity imparts comparatively little molecular friction on buoyant hulls as they carve through water (Morisawa 1968). A ton carried a mile on water requires a sixth of the energy needed by a truck, and significantly less than the same amount by train (Davis and Boundy 2019, 21). With over 400 million tons of goods conveyed on inland U.S. waters each year, transporting things by river can seemingly offer significant energy savings (ibid., 25; see also Sebald 1974). However, as with most of these kinds of claims, it is difficult to prove river-borne energy efficiency replaces rather than supplements fossil-fuelled transport elsewhere.[1] Reclus had once optimistically wondered if rivers might lighten human labour. A watermill, he reasoned, could be a substitute for human strength as it "wheat, breaks ore, crushes lime and mortar, prepares hemp, weaves cloth" (Reclus 1882, 248). He imagined them becoming monuments to the alleviation of toil. However, with rivers as elsewhere, increased efficiency tends to cause both work and energy use to assume other forms, appear elsewhere, and increase in rate and scale.

4. Hydro-profaned

Two hundred or so miles upriver from Cairo, where our journey began, French fur trader René-Robert Cavelier Sieur de La Salle and his crew had passed by in 1682. Their journey had ended at the Gulf of Mexico, where amid oozing alluvium, La Salle reputedly turned back and declared all upriver land, water, people, and resources as the possession of the French king Louis XIV.[2] Returning to Paris, La Salle became Viceroy of what he named *Louisiane*. Two years later, he sailed from La Rochelle with four ships loaded with priests, guns, soldiers, and women, aiming to establish a colony there. Led astray by a defective

---

[1] For this dynamic in a wider context see Saunders (2013).

[2] The parallels to Werner Herzog's later film *Aquirre* (1972) are clear. See Wood (1984).

astrolabe, his crew mistakenly landed in Texas. Looking for the Mississippi, he and his retinue dragged canons and supplies overland and subsisted on alligator flesh. An increasingly unhinged La Salle was eventually murdered by his mutinous crew (Wood 1984). The expedition may have been a failure, but La Salle's territorial claim would prove to be of geo-historical consequence. To Europeans, the watershed was a cornucopian 'New World', a landmass six times larger than France, ready to be colonised and exploited.

Of course, the valley was no such thing. To those who lived there it was a distinctly old world. For instance, the lower floodplain, near present-day St Louis, had once been populated by a complex society known as the Cahokian. Around 1150 AD they built a large city with raised mounds, complex fortifications, places for worship and recreation, irrigation, and agriculture; they engaged in trade and warfare over long distances. Settler colonialists found a state that had fallen into ruin for reasons that remain contested. One idea is that the smaller tribes that French and other European settler colonialists met on arrival, the Choctaw, Koroa, Taensa, Tunica, and other groups who they subsequently tried to exploit, destroy, or enslave, were not remnant people of an earlier stage of social evolution, but groups who, for reasons unknown, had turned against the questionable advances of Cahokian life. The arrival of European nobles reimposed a violent form of social organisation on groups of people who had possibly once already rejected such imposition.[1]

French settler colonialists considered water a holy substance. Catholicism still involves washing oneself of one's sins, and immersion into a baptismal font marks entry into the Church. However, in seventeenth-century France, water's sacrality was increasingly challenged by the demands of an expanding state. Engineers combined hydrological engineering and statecraft, building the nation-spanning Languedoc canal and Dunkirk's fortified harbour (Mukerji 2009; Shallat 1993, 17). From 1648 the symbolic centrepiece of this hydropolitical state was the 'Machine de Marly' where 14 waterwheels 11 metres in diameter pumped the River Seine into a network of fountains adorning the Versailles palace of the Sun King. These gravity-defying jets of water ostentatiously demonstrated the monarch's control over water.[2]

---

[1] Not least taxation and mass funerary killings. See Graeber and Wengrow 2021, 441-493.

[2] Testifying to absolutist appetites, the mechanism diverted as much water as was required by the

At the time, not unconnected to statecraft, water was becoming a subject of sustained scientific inquiry in France. In the 1640s bankrupt lawyer and amateur natural scientist Pierre Perrault had made a series of observations upriver of the Seine. On the basis of these careful measurements, he concluded that the volume of the river was a result of the precipitation that had fallen in its encompassing catchment area. Though this is common knowledge today, at the time Perrault overturned the belief that rivers were created by air mysteriously transformed into water in subterranean caves. In establishing a determinate relation between rainfall and river volume Perrault set hydrology on a path to exactitude (Nace 1974).

Measuring rivers would lead to the quantification of their productive potential. In 1827, following their defeat in the Napoleonic wars, mathematician-engineer Charles Dupin estimated the total productive forces available to the nation. The unit of comparison he settled upon was the average force exerted by an adult male during a day's physical labour (Reddy 1984, 141). Armed with estimates of the total quantities of water which flowed into the sea from France's major rivers, and with records of the various heights from which these streams began, he calculated that the nation had an unexploited hydro-potentiality equivalent to the labour of nearly 800 million men. Fully harnessed, it would be as if the nation's workforce increased 24-fold (Bradley 2012, 201). Engineer Lazare Carnot and his son Sadi drew similar comparisons between the dynamics of water and those of heat, arriving at one of the earliest rigorous conceptions of thermodynamics (ibid., 213; see also Cardwell 1965). With growing awareness of the relation between labour, and hydro-, and thermodynamics, the work of rivers and that of humans, free and unfree, was unified under a far wider concept, that of energy (Harman 1982).

The arrival of a conception of water as an untapped energetic potentiality informed Europeans' rapacious approach to exploiting the Mississippi Basin. However, the 'New France' of *Louisiane* lacked sufficient human labour to turn land into property. What use was this fecund place without people to work it? What was a kingdom without subjects? In 1689 Louis XIV passed an edict authorising slavery. Eight hundred French prisoners arrived in the city of Biloxi in 1718, soon followed by 6,000 enslaved people, mainly from West Coast Africa.

---

whole of Paris. See Brandstetter (2005), 206.

In 1709 the law was extended to permit the enslavement of indigenous people (Rushforth 2003, 780). Their labour and expertise was exploited to create the levees and drainage canals which fashioned New Orleans on top of alluvial mud, and which would protect upriver plantations where succeeding generations would toil (Johnson 2016; Powell 2013, 77). Over the next century, North America's economy grew with the unpaid labour of over one million enslaved people (Baptist 2014, 31).

Some economic historians speak of the 'Nieboer-Domar thesis', the idea that in a region where land is abundant and labour is scarce, only those who are enslaved will work for another (Green 2014). Geographer Ellen Churchill Semple, a follower of colonialist geographer Friedrich Ratzel, claimed the valley's vast expanse of fertile land "necessitated" slavery (Churchill Semple 1911, 622). This economistic explanation marginalises the deep-seated racism that permitted slavery and allowed it to persist even when other forms of labour were available.[1] The idea that a landscape could be an accomplice to human evil was a false absolution that joined the similarly cruel idea that the enslaved were functionally equivalent to steam engines or water mills.[2] In 1840 demographer Pierre Levasseur claimed the spread of coal-fired engines in France meant the nation gained a million "true slaves" the "most tireless that the imagination can dream" (Lavasseur 1889, vol. 3, 73-74). The idea travelled. In the mid 1920s, planner Marion Jackson argued the kinetic power of the South's rivers were equivalent to 75 million "idle slaves" (Johnson 2016). These dehumanising parallels betray the persistent violence upon which the region's plantations and subsequent and ongoing systems of human and environmental racism were grounded. This can be witnessed along the "Chemical Corridor", a stretch of the lower river where former planation land now houses petrochemical refineries, many a breath of wind from predominantly African American communities (Allen 2003). In maintaining this ongoing violence, the region is clearly a 'necropolitical' one, a place where the right to life continues to be denied to some as a result of the maintenance of a social order that devalues Black lives (Mbembe 2019, 18-19).

---

[1] On racism as a product of the economics of slavery, see Williams [1944] (2022).

[2] Sylvia Wynter wrote that the use of slave labour in the New World marked the "reduction of man to labour, and of nature to land under the impulsion of the market economy", cited in Yusoff (2019), 44; See also Debeir, Deléage, and Hémery (1991), 32-37.

5. Transubstantiation

In 1803 France's turbulent dominion over the Mississippi basin ended. Following conflicts with Britain in the French-Indian War, the break-away United States purchased Louisiana from France. For 15 million dollars, the United States claimed what North American geographer Frederick Jackson Turner later described as the "heartland" of a new type of human society. In 1910 he told a meeting of North American historians that the Mississippi Valley "yields to no region in the world in interest, in romance, and in promise for the future" and whoever controlled the valley, he believed, held the world's destiny in their hands (Clark 1978). He explained how following hundreds of years of destructive rivalry between colonial powers, the Louisiana purchase was "the decisive step for the United States in its taking of an independent career as a world power, free from entangling foreign alliances" (ibid.). Could it really be that the United States' rise to globalism, its twentieth-century hegemony, and the unequal distribution of capital and rights that developed alongside this, began in the Mississippi basin? If so, what role did the river and its energies play in this ascendance?

French influence remained inscribed in the river's very path. The United States Army Corps of Engineers had engineered its form since the early 1800s. Students at West Point Academy, way up north on the banks of the Hudson River, learnt a distinctly French approach to hydro-engineering (Shallat 1993, 3; 201). Levees were reinforced using methods first developed to support the crumbling banks of the flood-prone Pont de Grave (ibid., 191-192). The Corps riverine reformation had begun in earnest after the U.S. Civil War, when they began what would become a continent-spanning Earth engineering project that transformed this sinuous river and its wetlands into a uniform channel for the transportation of goods-laden ships that could float in at least 4½ feet of water at its lowest (Anfinson 2011). The barely submerged wing dams we dodged as we canoed the outer edges of the river acted as sentinels to this ambition, the funnel-like flow they create maintains a concentrated flow of water in the river's *thalweg*, its deepest point, an intervention that ensures transported sediment incessantly scours the riverbed, maintaining sufficient depth for towboats and their barges (Reuss 1985). When canoeing downriver between levees, coasting on the flow, it is easy to forget the work it took to create this uniform riverscape.

Early North American industry was tied to the river. Industrialists built sawmills amid the crisp pine forests surrounding Saint Anthony Falls, Minneapolis. Here, at the end of the last ice age, glacial retreat had carved an escarpment higher than even the Niagara Falls. By the 1800s, sediment inundation had reduced this to just 70 feet. Even so, it remained the river's most significant fall, with 25,000 tons of water descending each minute. Water-powered sawmills made light work of the surrounding forest, and a proportion of the remaining bare earth found its way into the river (Scarpino 1997, 2). The arrival of a flour mill in 1823 meant the river became a means to transform grains of chemical energy from Midwestern corn fields into a more easily digested form. By 1880 waterwheels converted the river into mechanical energy equivalent to 13,000 horses incessantly driving the mills of Minneapolis (Hunter 1979, 234). In a single day the 'Washburn A' facility ground enough flour to bake 12 million loaves of bread until one fateful day in May 1878 when airborne particles of flour spontaneously ignited, launching the roof into the air and killing 18 people (Russel et al. 2011, 246-247).

However, despite some notable exceptions, the Mississippi remains relatively unsuited to the derivation of hydrological power. Gravity imparts a subtle power upon the Mississippi, distributing its energy more evenly along its course than the more turbulent Columbia. From source to sink the river descends just 450 meters over its 2,350-mile length, a mere 20 centimetres per mile. In the words of waterpower historian Louis Hunter, the main branch was often "unable to power much more than a country mill" (Hunter 1979, 133). Travelling by canoe allows you to experience this subtle power. While the river transports you downstream, you won't travel faster than about five miles an hour.[1] Despite

---

[1] Thanks to John Kim our canoes carried sensors to record various parameters, from geolocation to acceleration. Over five legs the canoes averaged 4.5 miles per hour.

this seeming lack of dynamism, the upstream lakes and reservoirs of its tributaries constitute a vast battery of stored energy (Hunter 1979, 509). The lower river acts as a mobile transformer for this stored power, aggregating flows from the Missouri, Arkansas, Red, Ohio, Minnesota, Saint Croix, Chippewa, and Wisconsin, and upper river (ibid., 134). In normal conditions, the lower river redistributes this great force, conveying it out to sea. When this system gets overloaded, as in 1927, devastating flooding can occur (Barry 2005). A combination of technological advancement and visionary planning would help to harness and regularise this power, to transform it into a less intermittent energy source.

In White's words, for much of human history, to derive power from a river "one had to be close enough to spit in it" (White 1995, 49). This changed in the 1880s when European engineers made use of falling water to rotate coils of wire within a magnetic field. This hydrologically derived electricity could only be conveyed short distances at first, but the invention of alternating current, intermittent reversals in direction of transmission, allowed for long-distance conveyance (Hughes 1983, 93-94; White 1995, 49). With taut wires hung between wooden poles, electricity could bypass the limits of riverine geography (Devine 1983, 356). Despite such innovations, given its gentle gradient the Mississippi still remained largely unsuited to the derivation of hydro-electricity. There were some exceptions. At Saint Anthony's Falls, the Minnesota Brush Electric Company built North America's first central hydroelectrical station in 1882. In an attempt to win over a sceptical public who still used tallow lamps, eight electrically-powered arc-lights were hung from a 257-metre tower in downtown Minneapolis. The aim was to create a Mississippi-powered 'moon', a transformation of the river's energy that would supposedly cast a shadow over a mile away. Underwhelmingly, the lamp shone a mere hundred feet.[1]

The diversion of more significant amounts of energy would require dramatic terraforming. In 1907 the U.S. Army Corps of Engineers and the Saint Paul's District built the Meeker Island Lock and Dam System. A set of artificial barriers and entrances allowed large ships to negotiate the river's escarpment while also allowing water through narrow apertures to generate power. In 1910 Congress agreed to build a higher dam, submerging the first. This dam provided low-

---

[1] Zalusky 1961. Thanks to Joe Underhill and Jacqui DeVries from Augsburg University for locating the reference.

cost electricity to the Ford Motor Company's Twin Cities factory from 1924 onward (Anfinson 1995). Here, the history of automobility flowed out from the Mississippi. Its power was used to transform the river's silica sediment into the windshields of the Model 'T' Ford (McMahon 2016, 133-134).

In a further expansion of the river's engineered components, in 1910 the Mississippi River Power Company began work on 4,500-foot-wide dam stretching into the river in Keokuk, Iowa. On completion, it was the world's largest lock system. The water and sediment it impounded caused the river to back up 65 miles to Burlington, submerging the Des Moines Falls. Constrained in this way, the river could be transformed into 110,000 volts of electrical energy and transmitted over wire over 144 miles to St Louis. As historian Philip Scarpino wrote, in becoming a feedstock for the generation of electricity, the river' was now "forced to flow through turbines and compelled to labor in the service of man" (Scarpino 1997, 13).

6. Artificial Order

The drive toward hydro-electrification stemmed from a Federal government scheme that sought to better exploit the basin's inherent powers. The intellectual powerhouse behind this basin-centred thinking was Iowan autodidact William McGee, a geologist-anthropologist who had perceived wildly transformative possibilities in North America's river system. McGee worked for the hydrographic branch of the United States Geological Survey (USGS) in the 1880s. McGee cast water as the 'fulcrum' between Earth's human and non-human processes, a means to achieve hydrologically-powered national greatness (Schmidt 2017, 59). McGee's hope was that water could be controlled with the precision achieved with fire. Hydrodynamics mastery would herald changes "no less sweeping and cosmic" than the discovery of laws of thermodynamics (McGee, cited in Tyrell 2015, 120). Encouraged by the advent of hydroelectricity, McGee calculated that the nation's waterways could produce 300 million horsepower of electrical energy, "thrice the pulling power of all the horses now living in the world" (McGee 1908).[1] His hope was the capital generated by this hydroelectricity could be used to fund a vast hydroengineering program in which the nations' rivers would form continent-spanning conduits for transporting goods (McGee 1909).

McGee presented his vision of riverine productivity during a boat journey. In early 1907 President Theodore Roosevelt and his wife Edith had accepted an invitation to travel down the Mississippi with a group curated by McGee under the banner of the Inland Waterways Commission. Formed in 1906, its members included conservationist Gifford Pinchot, USGS hydrographic branch head Frederick Newell, and General Alexander McKenzie, chief of the Corps of Engineers. Under McGee's direction, they sought presidential approval to more radically transform the Mississippi into an industrial working river. The journey was a public relations exercise. Crowds gathered and saluted the palatial steamboat *Mississippi* as it passed. At each stop, guns, steam whistles, and fireworks announced the groups' arrival (McGee 1908, 289-302).

Roosevelt's vision for the Mississippi Basin was informed by his river journey. It encouraged him to convene a conference on the conservation of resources at the White House (ibid., 149). Conservation, in this context, did not mean the preservation of a pristine wilderness so much as stewardship, the search for means to better exploit nature's inherent affordances and to avoid waste (Tyrell 2015, 120). The need for this was encouraged by the fact that as the economic depression of the 1890s had eased, global demand for the basin's goods, its grain, cotton, and sugar had soared. Railways were running at capacity, and the cotton harvest of 1906 had rotted in storehouses in Memphis (Cross 1953, 148-162; Tyrell 2015, 405-406). The future seemed to lay in rivers. Ongoing development of the Panama Canal had raised the prospect of using the Mississippi as a conduit to the West Coast, South America, even Asia (Pisani 2006, 393). Roosevelt recast the river as an intra-continental artery for conveying U.S. commodities nationwide and abroad. Just as many today have faith in the allocative capacities of an untrammelled market, Roosevelt argued the river could efficiently

---

[1] On McGee generally see Cross (1953).

allocate goods and become a fundamental driver of economic growth. He also deployed the Mississippi allegorically, chiding critics by arguing his plans were like levees rather than dams. Instead of halting free progress, they could channel economic growth, avert disasters, and "confer inestimable good" on the nation (Roosevelt 1913).

As historian of conservation Ian Tyrell has written, McGee encouraged Roosevelt to believe in 'the "Valley" not as a mere catchment area but as an imagined space', the productive heartland of a new American Empire. Ambitious re-engineering would be required. The Inland Waterways Commission's vice-chair, Senator Francis Newlands spoke of the "artificialization" of the nation's rivers, in which the Mississippi would serve as a testcase for developing a continent-wide system of uniform channels for conveying goods and deriving power. Forests, precipitation, erosion, flood control, irrigation, and soil enrichment placed multiple and often conflicting demands upon the river (Tyrell 2015, 119). The final report of the Waterways Commission acknowledged that such artificialization must engage with all aspects of the Mississippi, from the economics of freight to the "physics of sediment charged waters" (ibid.).

A large-scale program for the full artificialization of the river had been set out. However, in the run of things, the lobbying of state interests, the local interests of the Army Corp of Engineers, and the outbreak of the First World War stymied this plan. In 1920, with the passing of the Federal Power Act, an act of legislation intended to allow federal government to develop hydro-electrical power on federally-owned land, this vision of a comprehensive river basin management came to an end. Electricity was granted precedence over all other aspects of river use. Flood control, drainage, and navigation remained administratively distinct concerns (Pisani 2006, 415). However, a decade later, during the Presidency of Theodore's distant cousin, Franklin Delano, visions of a cornucopian multi-use riverbasin would be revived.

The second Roosevelt, Franklin, came to power during a sequence of unprecedented environmental disasters and a biting period of economic depression (Holmes, Bolen, and Kirkbride 2021). One proposed corrective was raised by the president's advisor, engineer and advocate of the principles of scientific management Morris Lewellyn Cooke, who reimagined the watershed as the basis of a wide-ranging 'total conservation' approach in which soil, recreation, electricity generation, and regional development could act in concert to help

Figure 2: Barge-carried wind turbines, New Madrid, Missouri, 17 October 2019. Photograph by author.

improve the environment and the prospects of Americans, while bolstering the productive capacities of North America's heartland (Cooke 1934). A plan was formulated for the transformation of the Mississippi River Basin into a federally managed 'mixed use' system. However, only a tributary, the Tennessee River would be transformed in this way (Schmidt 2017, 94; Pisani 2002). During the 'New Deal' of the 1930s, the Tennessee Valley Authority would bring river-derived electricity to one of the U.S.'s poorest regions, and later powered North America's planet-altering wartime industry (Holmes, Bolen, and Kirkbride 2021).

7. Continental Accumulator

McGee and Cooke had envisioned a wide channel stretching from Chicago to New Orleans, a hard-working conduit for good, ships, and the generation of electricity and capital. It was the partial achievement of this mega-engineering project through which we travelled by canoe. This was less a river than an industrial archaeology. Once more in the words of historian Phil Scarpino, the river is now a 'cyborg-like' environment.[1] While stretches looked deceptively wild, as we paddled—besides the occasional Asian Carp, a so-called 'invasive' species—we were more often joined by towboats and barges incessantly churning up- and downriver and with whom we negotiated our path with via walkie-talkie. These vessels were loaded with anything from Brazilian-made wind turbine blades headed to the Midwest, to crude petroleum and ten-foot-high refinery components headed to Texas via the Gulf Intracoastal waterway (Fig. 2). Despite the potential of water, solar, and wind power, it appeared that one form of energy has come to shape the region more than any other.

Petroleum-filled barges, shipping the remnants of hundreds of millions of years of photosynthesis, mark a later stage in this region's industrial history. A prime reason North America rose to hegemony was its abundant supplies of fossil fuels. The Gulf, as Reclus suggested, was a cistern that collected the continent's excreta for many thousands of years, and before that, the sediment and biotic waste of the preceding continents and rivers which assumed different forms. Under the heat and pressure imposed by the force of many millions of years of sediment inundation and tectonic activity, through a still-not-fully-understood geochemical process, organic matter became petroleum (Priest 2019). The geology of the Gulf provided an almost perfect environment for not only the formation of petroleum, but also its aggregation and storage. Deep underground, monumental mounds of salt rise as much as eight miles upward through sedimentary strata, forming great domes of permeable matter. Some are so vast that they would be taller than Mount Everest if they lay on the surface. They formed around 150 million years ago, as dense brines were trapped in a low-lying basin and were gradually projected upward via seismic activity. Many of these domes contain petroleum. Over hundreds of millions of years this substance leached into these soluble caverns, and they have become the target of the U.S. offshore petroleum industry. Since 1975 some of these cavities have even been refilled with petroleum to create a strategic reserve, a subterranean storehouse for maintaining fossil-fuelled capitalism amid market fluctuations and the threat of

---

[1] An observation also made by Denise Frazier, Scarpino, *Large*, 5.

embargoes from non-U.S. oil producers (Martinez 1991). Petroleum is removed and refilled into offshore caves in order to regulate an industrial ecology in which production, mobility, and human appetites are met by burning ancient fossilised biota.

So, our journey ends eight miles underground, encased in salt. What have we learnt? Like all river systems, the work of the Mississippi has fundamentally changed. Increasingly, it is us, humankind, who have come to dominate its entropic processes. However, increasing human influence over the basin's energetic flows has only illusorily led to greater control. In fact, anthropogenic fossil fuel use has resulted in the unleashing of possibly deleterious instabilities for a variety of Earth-system processes, from flooding and extreme storms, to land loss, and even the potential breakdown of the Gulf Stream drift. If we are to look for the fundamental shift that occurred, we might look to a computer model of the Mississippi Basin created by ecologist Howard Odum and colleagues in the 1980s. In fact, they created two models. The first represented the region before colonisation, when the river was the dominant driver of regional environmental change, governing sedimentary and chemical cycles, and conditioning the spatial distribution of organisms, including humans. The second model represented the region in 1984, after colonisation, a period in which large-scale use of soils, minerals, and natural resources had become enrolled in a non-renewable 'system dominated by fossil fuel use' and the appetites of a global economy (Fig. 3). In this model, the Mississippi basin can no longer be considered a closed or stable energetic system, but one that draws energy from prehistory and then uses it to consume resources and propel them out into the world (Odum, Diamond, and Brown 1987, 12-14). Which model is the more sustainable? Given our current turbulent climate, and the increasing evidence that archaeologists are unearthing that affirms the very long timespans over which, before colonization, indigenous communities sustained their existence in this and many other regions, perhaps it will be settler-colonialist society with its systems of energetic overexploitation that will prove comparatively short-lived?

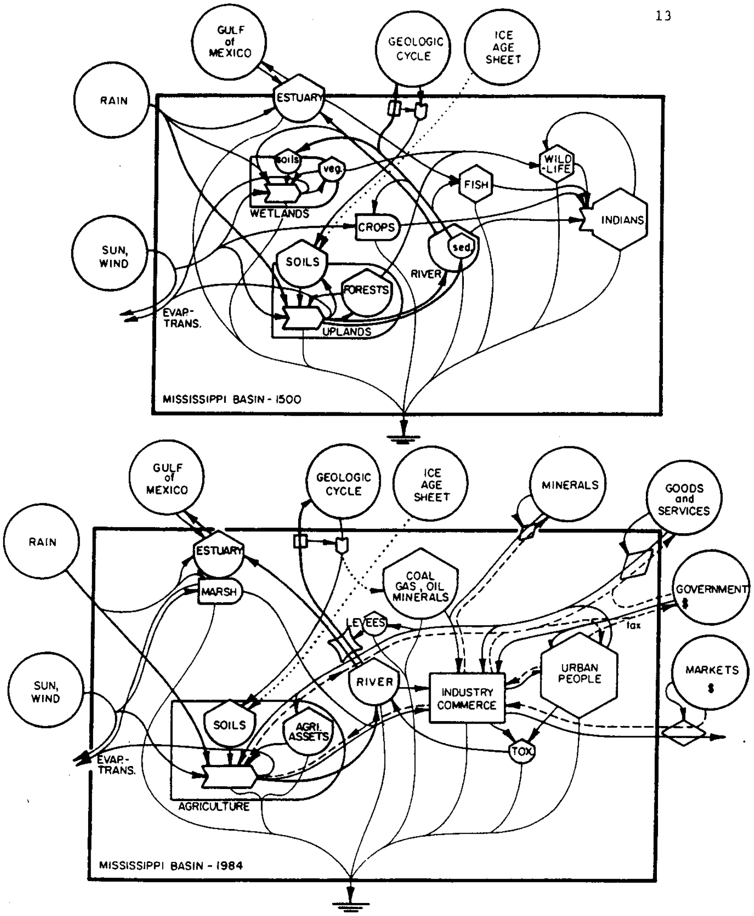


Figure 3: Energy systems overview of the Mississippi Basin in 1500 (above), and the Mississippi Basin in 1984. Taken from Odum, et al., (1984), 13.

References

Allen, Barbara. 2003. *Uneasy Alchemy: Citizens and Experts in Louisiana's Chemical Corridor Disputes*. Cambridge Massachusetts: MIT Press.

Anfinson, John. 1995. "The Secret History of the Mississippi's Earliest Locks and Dams". *Minnesota History* 54, no. 6: 254-67.

—. 2011. "Perfecting and Recreating Nature on the Upper Mississippi River". In *Engineering Earth: The Impacts of Megaengineering Projects*, edited by Stanley Brunn, vol. 1, 1283-1297. Dordrecht: Springer. `https://doi.org/10.1007/978-90-481-9920-4_71`.

Baptist, Edward. 2014. *The Half Has Never Been Told: Slavery and the Making of American Capitalism*. New York: Basic Books.

Barry, John. 2005. *Rising Tide: The Great Mississippi Flood of 1927 and How it Changed America*. New York: Simon & Schuster.

Benson, Etienne. 2020. "Random River: Luna Leopold and the Promise of Chance in Fluvial Geomorphology". *Journal of Historical Geography* 67: 14-23.

Bradley, Margaret. 2012. *Charles Dupin and his Influence on France, 1784-1873: The Contributions of a Mathematician, Educator, Engineer and Statesman*. Amherst New York: Cambria Press.

Brandstetter, Thomas. 2005. " 'The Most Wonderful Piece of Machinery the World Can Boast of': The Water-Works at Marly, 1680-1830". *History and Technology* 21, no. 2: 205-220.

Cardwell, Donald. 1965. "Power Technologies and the Advance of Science, 1700-1825". *Technology and Culture* 6, no. 2: 188-207.

Clark, Thomas. 1978. "Our Roots Flourished in the Valley". *Journal of American History* 65, no. 1: 85-107.

Cooke, Morris L. 1934. *Report of the Mississippi Valley Committee of the Public Works Administration*. Washington DC: USGPO.

Cronon, William. 1991. *Nature's Metropolis*: *Chicago and the Great West*. Chicago, Chicago UP.

Cross, Whitney. 1953. "W.J. McGee and the Idea of Conservation". *The Historian* 15, no. 2:: 148-162.

Churchill Semple, Ellen. 1911. *Influences of Geographic Environment: On the Basis of Ratzel's System of Anthropo-geography*. New York: Henry Holt and Company.

Davis, Stacy, and Robert Boundy. 2021. "Transportation Energy Data Book: Edition 37". *Oak Ridge National Laboratory,* January. Accessed online 17 December 2022. `https://cta.ornl.gov/data/tedbfiles/Edition37_Full_Doc.pdf`.

Debeir, Jean-Claude, Jean-Paul Deléage, and Daniel Hémery. 1991. *In the Servitude of Power: Energy and Civilization through the Ages*, translated by John Barzman. London: Zed Books.

Devine Jr, Warren. 1983. "From Shafts to Wires: Historical Perspective on Electrification". *The Journal of Economic History* 43, no. 2: 347-372.

Dunbar, Gary. 1978. *Élisée Reclus: Historian of Nature.* Connecticut: Archon Books.

Ferreti, Federico. 2010. "Comment Élisée Reclus est devenu athée. Un nouveau document biographique". *Cybergeo.* Accessed online 17 Dicember 2022. `https://journals.openedition.org/cybergeo/22981`.

Fleming, Marie. 1988. The *Odyssey of Elisée Reclus: The Geography of Freedom.* Black Rose Books, Montréal.

Fremlin, Calvin. 2004. *Immortal River: The Upper Mississippi in Ancient and Modern Times.* Madison, University of Wisconsin.

Graeber, David, and David Wengrow. 2021. *The Dawn of Everything: A New History of Humanity.* New York: Farrar, Straus and Giroux.

Green, Erik. 2014. "The Economics of slavery in the Eighteenth-Century Cape Colony: Revising the Nieboer-Domar Hypothesis". *International Review of Social History* 59, no. 1: 39-70.

Grigg, David. 1967. "Regions, models and classes". In *Models in Geography*, edited by Richard Chorley and Peter Haggett, 461–501. London: Methuen and Co.

Harman, Peter. 1982. *Energy, Force and Matter: The Conceptual Development of Nineteenth Century Physics.* Cambridge: Cambridge UP.

Hartshorne, Richard. 1935. *The Nature of Geography: A Critical Survey of Current Thought in the Light of the Past.* Lancaster: Association of American Geographers.

Holmes, Brian, Jeremy Bolen, and Brian Kirkbride. 2021. "Born Secret (Cash for Kryptonite): A Field Guide to Anthropocene Mode of Production". *Anthropocene Review* 8, no. 2: 183-195.

Horton, Robert E. 1945. "Erosional Development of Streams and Their Drainage Basins: Hydrophysical Approach to Quantitative Morphology". *Geological Society of America Bulletin* 56: 275-370.

Hughes, Thomas. 1983. *Networks of Power: Electrification in Western Society*, 1880-1930. Baltimore: Johns Hopkins.

Hunter, Louis. 1979. *A History of Industrial Power in the United States, 1780-1930: Waterpower in the Century of the Steam Engine.* Charlottesville, VA: University of Virginia Press.

Johnson, Bob. "Energy Slaves: Carbon Technologies, Climate Change, and the Stratified History of the Fossil Economy". *American Quarterly* 68, no. 4: 955-979.

Johnson, Rashauna. 2016. *Slavery's Metropolis: Unfree Labor in New Orleans During the Age of Revolutions*. Cambridge: Cambridge UP.

Kleidon, Axel. 2016. *Thermodynamics of the Earth System*. Cambridge: Cambridge UP.

Kolbert, Elizabeth. 2019. "Louisiana's Disappearing Coast". *The New Yorker*, March 25.

Langbein, Leopold. 1966. "River Meanders". *Scientific American* 214, no. 6: 60-73.

Levasseur, Pierre E. 1889. *La population française: histoire de la population avant 1789*. Vol. 3. Paris: Arthur Rousseau.

Martinez, Joseph D. 1991. "Salt Domes". *American Scientist* 79 (5): 420-431.

Maury, Matthew. 1855. *The Physical Geography of the Sea*. New York: Harper and Brothers.

Mbembe, Achille. 2019. *Necropolitics*. Durham: Duke UP.

McGee, William. 1908. "Our Inland Waterways". *Popular Science Monthly* 72: 289-302.

—. 1909. "Water as a Resource". *Annals of the American Academy of Political and Social Science* 33, no. 3: 37-50.

McGlade, Jacqueline. 2009. "More a Plowshare than a Sword: The Legacy of US Cold War Agricultural Diplomacy". *Agricultural History* 83, no. 1: 79-102.

McMahon, Brian. 2016. *The Ford Century in Minnesota*. Minneapolis: Minnesota UP.

Morisawa, Marie. 1968. *Streams: Their Dynamics and Morphology*. New York: McGraw-Hill.

Mueller, Nathaniel, et al. 2016. "Cooling of US Midwest Summer Temperature Extremes from Cropland Intensification". *Nature Climate Change* 6: 317-322.

Mukerji, Chandra. 2009. *Impossible Engineering: Technology and Territoriality on the Canal du Midi*. Princeton, NJ: Princeton UP.

Nace, Raymond. 1974. "Pierre Perrault: The Man and His Contribution to Modern Hydrology". *Journal of the American Water Resources Association* 10, no. 4: 633-647.

Nettlau, Max. 1928. *Élisée Reclus: Anarchist und Gelehrter*. Berlin: Topos Verlag.

Odum, Howard, Craigh Diamond, and Mark T. Brown. 1987. *Energy Systems Overview of the Mississippi River Basin*. Gainsville FL: Center for Wetlands, University of Florida.

Pisani, Donald. 2002. "A Conservation Myth: The Troubled Childhood of the Mixed-Use Idea": *Agricultural History* 76, no. 2: 154-171.

—. 2006. "Water Planning in the Progressive Era: The Inland Waterways Commission Reconsidered". *Journal of Policy History* 18, no. 4: 389-418.

Powell, Lawrence. 2013. *Accidental City: Improvising New Orleans*. Harvard UP.

Priest, Tyler. 2019. *Shell Oil's Deepwater Mission to Mars*. Accessed 17 December 2022. https://dsps.lib.uiowa.edu/mars-deepwater-gulf/

Priest, Tyler, and Jason Theriot. 2016. "Who Destroyed the Marsh? Oil Field Canals, Coastal Ecology, and the Debate over Louisiana's Shrinking Wetlands". *Jahrbuch für Wirtschaftsgeschichte/Economic History Yearbook* 50, no. 2: 69-79.

Pyne, Stephen. 2007. *Grove Karl Gilbert: A Great Engine of Research.* Iowa: University of Iowa Press.

Reclus, Élisée. 1855. "Fragment of a Voyage to Louisiana". Translated by Camille Martin and Clark, John. Accessed online 17 December 2022. `https://theanarchistlibrary.org/library/elisee-reclus-fragment-of-a-voyage-to-louisiana`.

—. 1866. "Les estuaires et les deltas: Étude de géographie physique". *Annales des Voyages, de la Géographie, de l'histoire et de l'Archéologie* 190: 5-55.

—. 1872. *The Earth: A Descriptive History of the Phenomena of the Life of the Globe.* New York: Harper & Brothers.

—.1882. *Histoire d'un ruisseau.* Hetzel, Paris.

Reddy, William. 1984. *The Rise of Market Culture: The Textile Trade & French Society 1750-1900.* Cambridge: Cambridge UP.

Reuss, Martin. 1985. "Andrew A. Humphreys and the Development of Hydraulic Engineering: Politics and Technology in the Army Corps of Engineers, 1850-1950". *Technology and Culture* 26, no. 1: 1-33.

Roosevelt, Theodore. 1913. *Theodore Roosevelt: An Autobiography.* New York: Charles Scribner's Sons.

Rosol, Christoph, Thomas Turnbull, and Jürgen Renn. 2021. "Introduction: The Mississippi River Basin – A Model for Studying the Anthropocene in Situ". *Anthropocene Review* 8, no. 2: 99-114

Russell, Edmund, et. al. 2011. "The Nature of Power: Synthesising the History of Technology and Environmental History". *Technology and Culture* 52, no. 2: 246-59.

Rushforth, Brett. 2003. "A Little Flesh We Offer You": The Origins of Indian Slavery in New France". *The William and Mary Quarterly* 60 (4): 777-808.

Russell, Catherine, et al. 2021. "Geological Evolution of the Mississippi River into the Anthropocene". *Anthropocene Review* 8 (2): 114-140.

Saunders, Harry. 2013. "Historical Evidence for Energy Efficiency Rebound in 30 US Sectors and a Toolkit for Rebound Analysts". *Technological Forecasting & Social Change,* 80: 1317-1330.

Scarpino, Philip. 1997. *Large Floodplain Rivers as Human Artifacts: A Historical Perspective on Ecological Integrity.* USGS, Wisconsin.

Schmidt, Jeremy. 2017. *Water: Abundance, Scarcity, and Security in the Age of Humanity.* New York, NY: New York UP.

Sebald, Anthony. 1974. "Energy Intensity of Barge and Rail Freight Hauling". *Centre for Advanced Computation* 127.

Shallat, Todd. 1993. *Structures in the Stream: Water, Science, and the Rise of the U.S. Army Corps of Engineers.* Austin, TX: University of Texas Press.

Tyrell, Ian. 2015. *Crisis of the Wasteful Nation: Empire and Conservation in Theodore Roosevelt's America*. Chicago: University of Chicago Press.

Toledano, Roulhac. 1969. "Louisiana's Golden Age: Valcour Aime in St. James Parish". *Louisiana History* 10, no. 3: 211-224.

Turnbull, Thomas, et al. 2021. "Quantifying available energy and anthropogenic energy use in the Mississippi River Basin". *The Anthropocene Review* 8, no. 3: 1–24.

Voituriez, Bruno. 2006. *The Gulf Stream*. Intergovernmental Oceanographic Commission.

White, Richard. 1995. *The Organic Machine: The Remaking of the Columbia River*. New York: Hill and Wang.

Williams, Eric. [1944] 2022. *Capitalism and Slavery*. London: Penguin.

Wise, Norton. 1988. "Mediating Machines". *Science in Context* 2 (1): 77-113.

Wood, Peter. 1984. "La Salle: Discovery of a Lost Explorer". *American History Review* 89, no. 2: 294-323.

Yusoff, Kathryn. 2019. *Billion Black Anthropocenes or None*. Minneapolis: University of Minnesota Press.

Zalusky, Joseph. 1961. "Bridge Square: Going, Going, Gone". *Hennepin County History* 21, no. 1: 5-7.

Photo by Külli Kittus on Unsplash (`https://unsplash.com/it/foto/qyt0cPByJjs`.