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Richard L. Hindle

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Patent Scenarios for the Mississippi River

Richard L. Hindle
University of California, Berkeley

When considering patents, one may automatically recall some type of *thing.* Throughout the last six centuries of Western technological progress the conflation of manufacturing, mechanization, and patents has resulted in a distinct object-oriented bias toward *things*.[1] However, a look back into the annals of the United States Patent and Trademark Office (USPTO) through the contemporary lens of the Anthropocene reveals that large-scale environmental systems, such as rivers and coasts, are also represented in patents and have been subject to the iterative and projective forces of patent innovation.

The Venetian government granted the first patents for "environmental" technology in the early fifteenth century, when radical new processes and devices were invented to urbanize the lagoon, build canals, and create terra firma from mud.[2] Patent law spread from Venice throughout Europe to France, England, Holland, and Germany, eventually crossing the Atlantic.[3] In the United States, where western and technological *frontiers* progressed concurrently, inventors continued to transform the physical environment, leading to a rich dossier of environmental innovation within the USPTO. The infrastructural space depicted by the 9 million patents issued in this 227-year history represents every known sector of the technosphere, including a unique subgenre that blurs the boundary between technology and environment.

To illustrate the dynamic reciprocity between patents and complex earth systems, I explore implications of four site-specific inventions granted between 1890 and 1901 that may have altered the morphology of the Mississippi and led to radically different futures for the river and its environs. Each invention, as described in the original patent document, has unique geographical dimensions and instrumentality that transcend the object orientation of typical patents and evoke the scale, scope, and contingencies of innovation in the Anthropocene. As projections of speculative futures, the patents also frame new and discursive visions for the Mississippi River.

US Patent 658,795

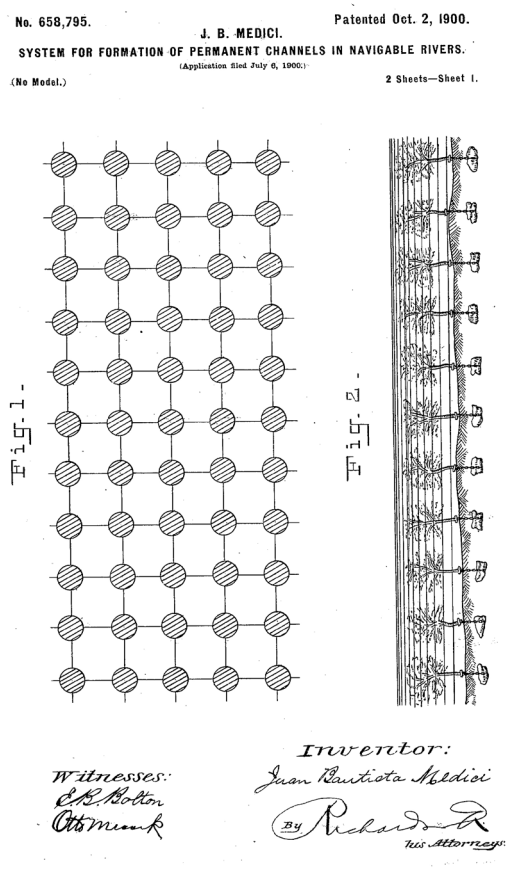
A Method for Building Navigable Channels in the Bird's Foot Delta of the Mississippi

The presettlement delta of the Mississippi, as described by early explorers, was a vast matrix of mud lumps, snags, natural levees, alligators, and migrating channels—a place formed over millennia. Juan Bautista-Medici's patent (1900)[4] for navigable channels at the Heads of Passes reconciles the inherent conflict between dynamic deltaic conditions and the necessity for stable navigation channel geometry by building the delta a channel using principles observed in nature (Figure 1).

Medici's system involves the anchoring of a subsurface "forest" or "orchard" of large cut trees with variable depths to guide flowing water and capture sediment. The arboreal grid would create a vast matrix of vertical trunks and branched canopies employed to alter the speed and direction of water by establishing a new bathymetry. Treetops would define deltaic channels and the flow of water by their height in the water column and their density based on tree size. In areas with no trees, or trees anchored in deep water, channels would form. In areas where tree canopies slow flowing water, an accretion of sediment would occur, ultimately resulting in the formation of new deltaic landmasses.

Initially, a 20-meter grid would be established, spanning distances of up to 40 kilometers. The basic unit of construction is trees of varying sizes—from 2 to 7 meters high, and up to 9 meters of canopy spread—anchored by chains to heavy boulders. The height of the trees varies in relation to the water's surface, and their depth defines the desired channel geometry. Just as in wild deltas, friction and the processes of accretion or scouring would define the channel location and geometry. And in areas where woody armatures remain unburied, mollusks and marine organisms would potentially colonize and ossify the branches to catalyze the formation of new ecologies. Medici's system operationalizes this cycle, essentially building a delta as a delta might build itself and defining navigable channels in the process.

Medici's system defies the notion of a singular object and instead evokes field conditions or matrices as the organizing structure. The scale of the intervention is commensurate with the scale of the islets and marshes associated with the world's great deltas. Given the flexibility of the grid layout, it is important to note that there is no preconceived formal configuration for the bathymetric forest, and in this manner the structure can conform to unique conditions. In fact, the system may adapt and grow over time, evolving as the bird foot of the Mississippi extends to the gulf and new channels are required. The patent invites us to imagine a vast deltaic landscape constructed on principles observed in



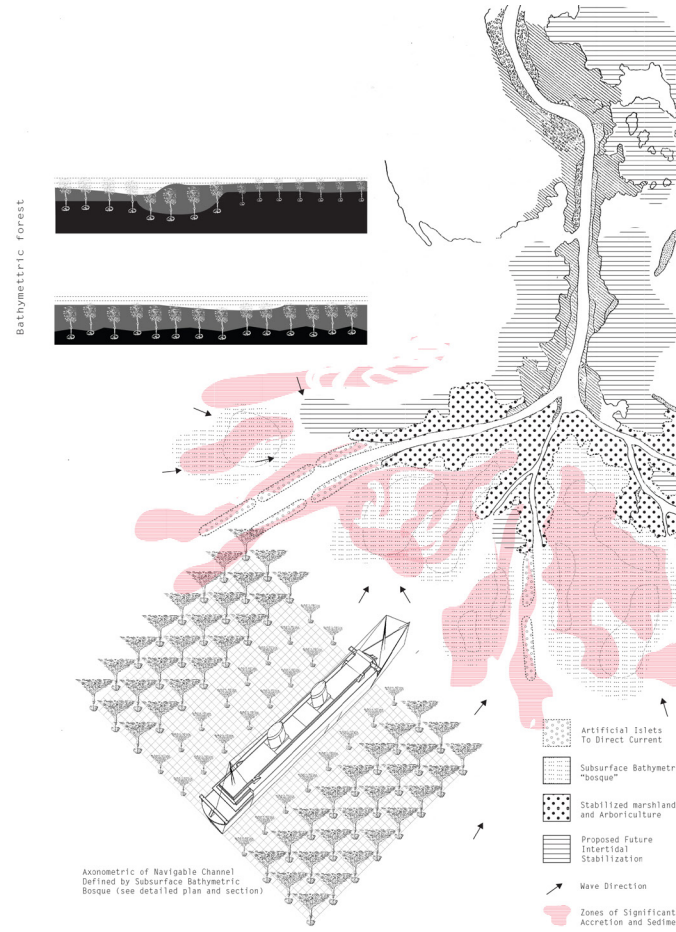


Figure 1. *Above, left:* US Patent 658,795 "System for Formation of Permanent Channels in Navigable Rivers" was granted to Juan Bautista Medici October 2nd, 1900. The original patent drawing shows 20m x 20m grid of large cut trees, in plan and section, anchored to boulders to define a subsurface "orchard" or "bosque" in the delta of sediment rich rivers. The grid of trees would be configured to define channel geometry and array across areas up to 40 kilometers in order to direct river water and build deltaic landforms. When scaled and sited at the mouth of the Mississippi.

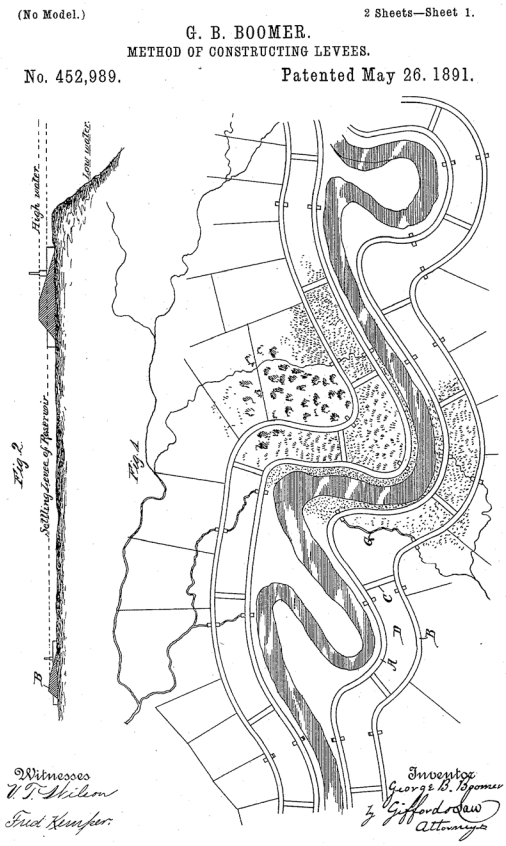
Figure 2. *Above, right:* The magnitude of the proposal becomes apparent. In this configuration, a series of "islets" would be situated at each of the main passes to define channel geometry. A secondary grid matrix would extend across vast horizontal areas to create a subsurface bathymetric "bosque," intended to stabilize and augment the delta through the accretion of sediments. (Drawing by Author.)

nature, yet designed to meet human necessity for navigation.
When compared with conventional technologies for the engineering of navigable channels, such as jetties, Medici's proposal precludes object-oriented descriptions, evoking instead conditions found in naturally forming delta systems. Envisioning the system implemented at the Southwest pass suggests the creation of a subsurface bathymetric field of trees aligned vertically and horizontally to direct the current of the Mississippi, while capturing sediment in a kilometer-thick matrix of tree limbs and trunks. The branches of these trees would become encased in silt and ossified by mollusks, further edifying the structure and catalyzing the formation of new ecological assemblages. Extension of the delta using Medici's principles would also require the cultivation of trees on the banks of the river to harvest as the basic building block of the deltaic system. The image that emerges is a quixotic kaleidoscope of sediment, vegetation, and water adapted to meet the needs of navigation—a tectonic delta that precludes simplistic binaries between man-made and natural.

US Patent 452,989

Syncopating Floods, Farming, and Riparian Ecology Throughout the Mississippi's Watershed

Levees bridle river channels, compress ancient floodplains between finely engineered lines, and exacerbate divisions between wet and dry land along unnatural gradients. A functioning floodplain not only accommodates vast quantities of floodwater during the natural ebb and flow of rivers but also inherently supports a unique ecology adapted to the fluctuations of sediment, water, growth, and decay that is fundamental to river health. George B. Boomer's levee construction method (1891) envisions a system in which the productivity of riparian and wetland ecology, agricultural production, conveyance of floodwaters, and sediment management are balanced through the utilization of a double levee system that hybridizes river


(No Model.) 2 Sheets—Sheet 1.

G. B. BOOMER.

METHOD OF CONSTRUCTING LEVEES.

No. 452,989. Patented May 26. 1891.

Witnesses
W. T. Wilson
Fred Kemper.

Inventor
George B. Boomer
by Gifford Shaw
Attorneys

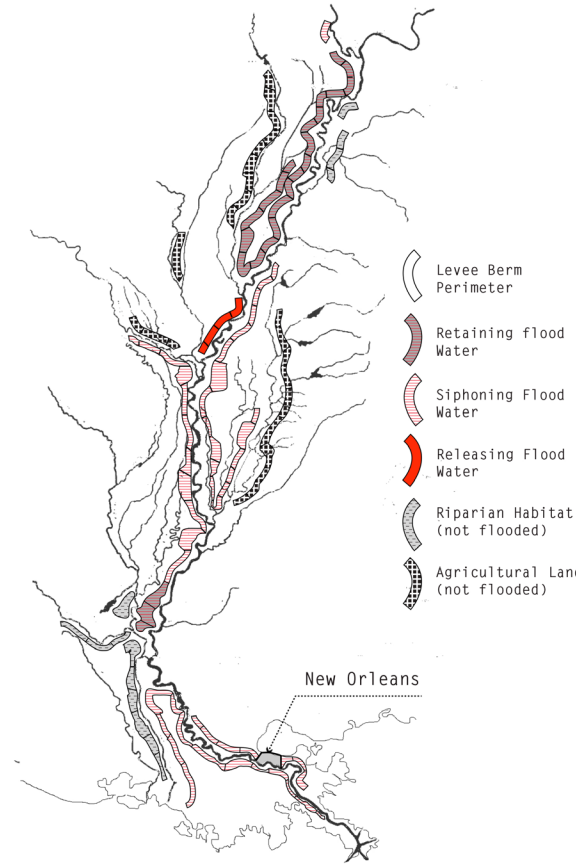


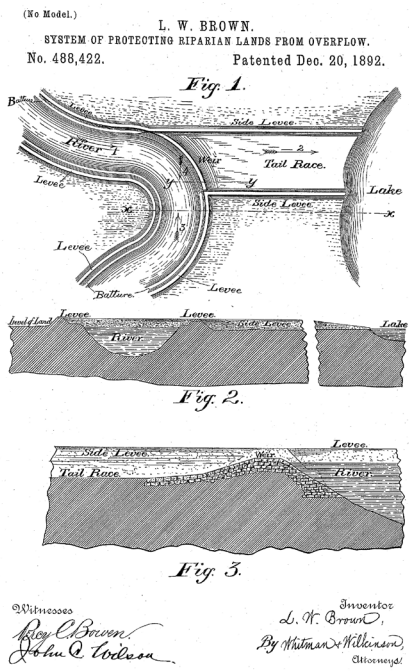
Figure 3. *Above, left:* US Patent 452,989 "Method of Constructing Levees" was granted to George B. Boomer on May 26th, 1891. The original patent drawing (left) describes a double levee system that is compartmentalized to allow for the syncopation of floodwaters from the main channel and/or tributaries. The controlled flood-zone, or batture, between the double levees is intended to span more than a mile and extend the length of the leveed areas of the Mississippi River. The segmented levee system allows each compartment to be programmed with farming, sediment recharge, or fallow riparian ecology, when not employed as flood control. Water control structures allow flows and discharges to be choreographed seasonally and in response to emergency flood events. When visualized at the scale of the Mississippi watershed

Figure 4. *Above, right:* The network of levees suggest a landscape management strategy hybridized with flood control, ecology, and agriculture.

processes with flood-control structures (Figure 3).[5]

Boomer's layered and compartmentalized levee network is multifunctional. During periods of flooding, the double levee allows for water storage and the control of inflow from streams. In periods of regular flow, it provides space for the ecological functionality or agricultural production within the mediated boundary between terrestrial and hydrologic systems. The system also links fluvial processes to the adjacent landscape by releasing water from the main river channel back into double levee enclosures. Reintroduction of floodwater from the main river channel recharges sediments in wetland and agricultural systems, maintains nutrient balance, and recharges groundwater levels essential to the health of riparian soils and ecosystems. If deployed at scale the multiplicity of levee berms utilized in the system thickens the boundary between riverine and terrestrial systems, allowing for the storage and gradual release of floodwaters along with increased ecological and agricultural productivity. The proposed levee system would also separate and buffer adjacent land uses through redundant flood-control structures, reducing risk and altering the regional and urban landscape. Each of the aforementioned performance criteria could be syncopated to periods of flood, crop production, or ecological cycles such as bird migrations.

By engaging the dynamic forces of the riparian zone as a multifunctional flood infrastructure, the patent reframes an entire river system as technology—instrumentalizing the movement of sediment and water while creating room for ecological and productive processes to adapt and respond. The cyclical forces that are mediated by the levees and floodgates situate it in larger sediment and water cycles that extend far beyond the boundary of the river, making it possible to manipulate and coordinate systems that operate at a watershed scale—which in the Mississippi River system is equivalent to approximately 40 percent of the land area of the contiguous United States.



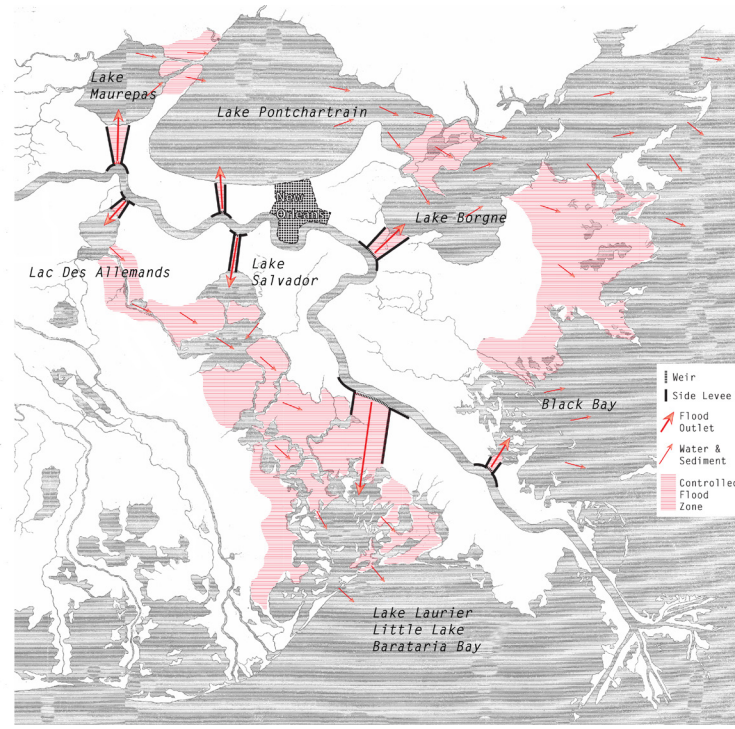


Figure 5. *Above, left:* US Patent 488,422 "System of Protecting Riparian Lands from Overflow" was granted to Linus W. Brown on December 20th, 1892. The original patent drawing shows the proposed configuration of weirs, levees, tail races, and natural lakes designed to relieve flood water and protect low-lying riparian areas. When visualized serially along the lower Mississippi near New Orleans.

Figure 6. *Above, right:* The interconnected system links the main river channel to its ancestral delta and floodplain. In this scenario, the natural lakes (Maurepas, Pontchartrain, Salvador, and Lac Des Allemands) would serve as flood storage reservoirs for cyclical flood events, reducing river levels near the city of New Orleans. Periodic recharge of the lakes with floodwater and sediment would also benefit the ecology of the delta, as they are essential to the health of wetlands and cypress forest ecosystems. (Drawing by Author).

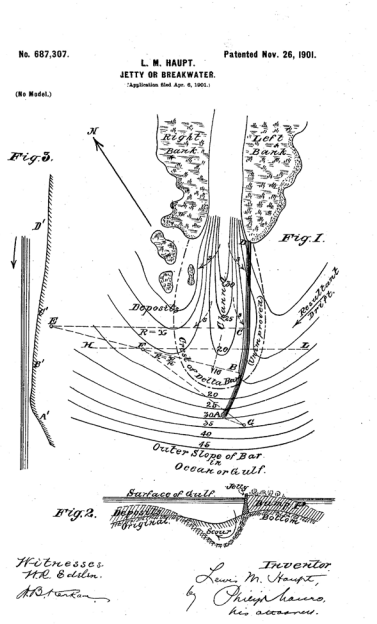
US Patent 488,422

Spillways, Tail Races, and Sediment Recharge in the Lower Mississippi Delta

The ancient delta of the Mississippi built southern Louisiana through deposition of sediment in extensive networks of bayous, lakes, and backwaters within vast plains of vegetation. Levees ultimately broke the vital link between river and landscape, altering the delta-building capacity of the river and starving lower Louisiana of life-giving substrate. Linus Weed Brown's patent for a "System of Protecting Riparian Lands from Overflow" (1892) partially reinstates this process through a series of outlets and tailraces that stitch the lower Mississippi back to an ancient network of lakes and deltas during periods of high water, while maintaining the health of the vegetation, sediment reserves, and waterway (Figure 5).[6]

Brown's deceptively simple topographical solution to flood control in New Orleans and its environs guides floodwaters back through their historic territories and works with nature to maintain flood control. According to the patent, outlets would be located at precise flood elevations along the lower reaches of the river, and during periods of flood the weirs would carry floodwater to adjacent lakes where it would be distributed naturally through the vast deltaic network of bayous and channels, ultimately draining into the gulf. Brown suggested that his system be implemented at Lake Borgne and Lake Maurepas, and at as many river bends as necessary to distribute floodwaters effectively. Although the primary purpose of Brown's invention was to protect low-lying lands and urban areas from overflow, the systems of weirs were also known to facilitate sediment recharge and even help reclaim land.

Relinking lakes and bayous back to the main river channel would ameliorate subsidence through the introduction of sediment-laden freshwater into distributaries, lakes, and the adjacent landscape. The benefits of periodic flushes of sediment-rich freshwater would also help maintain the health of native cypress trees, wetland grasses, and other vegetation that captures sediment and protects the landscape against storm surges and subsidence, increasing the resilience and stability of the delta. As a flood-control system, the weirs maintain a constant flood datum that water levels would not exceed, providing a consistent level that defines high and low ground. The weirs and tailraces utilized in the systems are by no means innovations in and of themselves, yet as a series of interventions strategically inserted within the existing levee system of southern



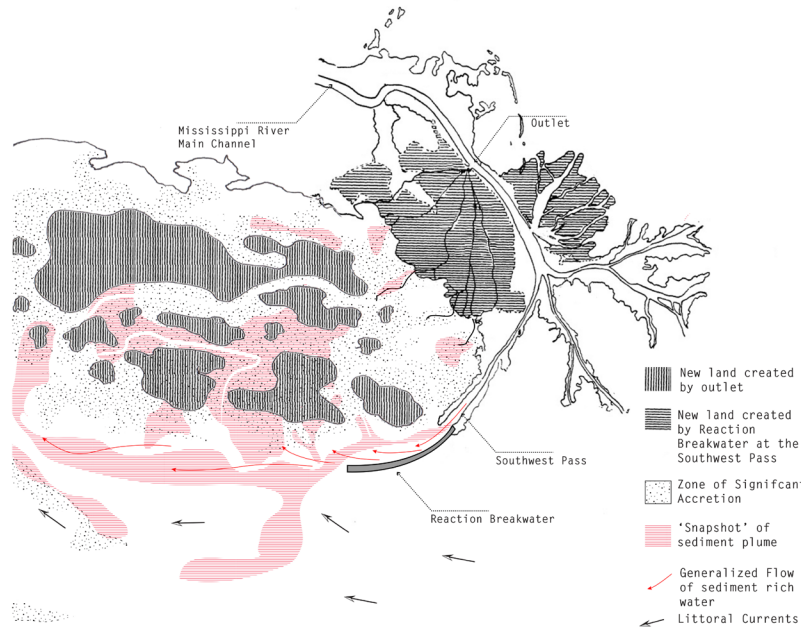


Figure 4. *Above, left:* US Patent 687,387 "Jetty or Breakwater" was granted to Lewis M. Haupt on November 26th, 1901. The original patent drawing (left) shows the doubly curved reaction breakwater in plan and section, sited at the South West Pass of the Mississippi. The breakwater is designed passively dredge a navigable channel at the mouth of the Mississippi using the energy of river water focused by the geometry of the breakwater. The design balances the source/sink sediment budget necessary for channel maintenance, and therefore does not require dredging. When envisioned over decades at the mouth of the Mississippi.

Figure 8. *Above, right:* The reaction breakwater would use littoral currents and the force of river water, in combination with upriver outlets, to build land and replenish sediment along the Gulf Coast of Southern Louisiana. (Drawing by Author).

Louisiana, they present an alternative function of the levees: changing them from singular impenetrable boundaries, to a complex series of topographical relationships between infrastructure, river, and city designed to optimize discharge of floodwater and maintenance of the deltaic landscape—a vision as prescient today as it was in 1892. The patent utilizes tactical interventions, or acupuncture, to retool existing landscape infrastructure and recalibrate regional water systems, providing an alternative interpretation of patented technology, not simply as singular or heroic inventions, but as complex operations, or landscape strategies, which may improve upon and adapt existing systems.

US Patent 687,387

Self-Dredging channel at the mouth of the Mississippi

Permanent jetties and nearly constant dredging have maintained navigable channels at the South and Southwest Passes of the Mississippi for more than 140 years. Diesel fuel, man-hours, and federal dollars keep the channels clear, while the constant force of the river rebuilds the sediment. The possibility of self-dredging channels has existed since 1889, when Lewis M. Haupt received the prestigious Magellanic Premium Award from the American Philosophical Society and his patent for the "reaction breakwater" from the USPTO—a system that was prototyped at the Aransas Pass, near Galveston, Texas (Figure 6).[7] In 1901, Professor Haupt modified his innovative self-dredging "reaction breakwater" for use at the Southwest Pass of the Mississippi, adapting his prior invention to respond to conditions found in sediment-bearing rivers.[8] A doubly curved (curved in plan and section) structure directs the hydraulic force of flowing river water, excavating a navigable channel, and depositing the sediment (with the help of littoral currents) on the adjacent bank. The system not only maintains a channel, but over time, it also builds land on the western bank of the Southwest Pass, using only the energy of flowing river water. A structure designed to engage the forces of water, instead of resisting them.

Professor Haupt was well aware of issues of land loss and the important role of sediment in recharging and stabilizing the delta. During a speech to the American Philosophical Society in 1904, he convincingly argued for the use of outlets in conjunction with his single concaved jetty, stating that the outlets would nourish the delta and reduce the need for dredging as the curvature of the jetty would deposit sediments and maintain depths. What emerges from Haupt's patent, lecture, and writing is an image of the delta in which the sediment budget and flow is balanced between outlets and the reaction breakwater, and the navigable channels are passively excavated by the forces of the Mississippi. The precise geometry of the reaction breakwater would direct sediment-heavy water toward the western bank of the channel and deposit it on the bank of the adjacent wetlands, while speeding up the flow adjacent to the structure to scour material from the navigable channel. When combined with the littoral drift of sediments, the reaction breakwater positioned at the Southwest Pass would replenish sediments closer to shore and contribute to land building instead of depositing it in deeper water where it would not recharge wetlands, as is

currently the case. Even conservative estimates suggest that the Mississippi carries an estimated 500 million tons of sediment to the gulf annually, and an estimated 200 million tons reach the delta plain, enough to build 2,740 square kilometers of new land in over a century when combined with vegetation and organic production.[9]

Haupt's invention puts the river to work maintaining a navigable channel and building adjacent wetlands, bucking the need for diesel fuel, dredge boats, pumps, jetties, and other Victorian-era inventions. Imagining the river itself as a sort of chimeric machine, capable of work, with strength to build and alter the morphology of its delta, represents a break in history, and potentially a divergent path in the evolution of modern rivers in which the power of the Mississippi is enhanced instead of shackled. From this perspective, Haupt's invention makes the river more like an improved cyborg with a prosthetic delta optimized for land building and navigation.

Inventing Rivers and Other Complex Environmental Systems

The Mississippi River has been building deltas at the Gulf of Mexico for approximately 7,500 years, after initially carving its alluvial valley from glacial outwash at the end of the last Ice Age. When compared to geologic time frames, the postsettlement "anthropogenic" history of the river is relatively short, spanning a mere three centuries. Yet transformations of the ancient river by levees, dams, urbanization, agricultural drainage, jetties, and dredge boats has been cataclysmic, leading to subsidence, hypoxia, and loss of the river's ancestral fluvial territory. Today, collapse of the Mississippi Delta is a very real possibility even though technology has been disclosed in patent documents for more than a century to reconcile natural river processes with human necessity.

The existence of alternative scenarios reveals a counterfactual history in which collapse of the river system was not an inevitable result of human technological intervention but instead a failure to innovate. Individually the patents challenge assumptions about the scale, scope, and agency of conventional patents, reframing the river as technology and defying object-oriented biases. Collectively they uncover something even more radical—the possibility of an alternate innovation model in which bottom-up sociotechnical processes of patent innovation reinvent rivers and complex environmental systems. As our understanding of the Anthropocene continues to evolve, from a geologic epoch to a projective framework for planetary management, the boundary between the technosphere and earth systems will collapse. At this frontier, the agency of architects, landscape architects, and planners will be reinvented in response to a shifting design paradigm that extends our thinking and "work" beyond discrete sites and buildings, into large-scale and complex systems. Patents have a 600-year history of building complex infrastructures and sociotechnical systems. Might the distinct agency, instrumentality, and legal mechanisms of the global patent system be employed to invent rivers and complex environmental systems of the future?

Author Biography

Richard L. Hindle is an assistant professor of Landscape Architecture and Environmental Planning at the University of California, Berkeley, where he teaches courses in ecological technology, planting design, and graduate design studios. Hindle's research focuses on technology in the urban landscape with an emphasis on material processes, innovation, and patents. His current work explores landscape-related technologies across a range of scales, from large-scale mappings of riverine and coastal patents to detailed studies of artificial "hard" habitats associated with coastal armoring. He has worked as a consultant and designer with firms such as Surface Design, Michael Van Valkenburgh Associates, Steven Holl,and Atelier Jean Nouvel, on advanced building systems integrated with vegetation.

Notes

1 The Venetian government began issuing patents in the first decades of the fifteenth century and in 1474 drafted the world's first patent law, known as the Venetian Patent Statute. The first "true" patent was issued in 1421 to the architect Filippo Brunelleschi of Florence, though patent law there did not develop as robustly as it did in Venice. Correlations between industrialization and patent law have arguably skewed the contemporary interpretation of patents toward objects, machines, and devices. For an in-depth analysis of the relationship between patents and industry, see Christine MacLeod, *Inventing the Industrial Revolution: The English Patent System, 1660–1800* (Cambridge: Cambridge University Press, 1988).

2 Salvatore Ciriacono, *Building on Water: Venice, Holland and the Construction of the European Landscape in Early Modern Times* (New York: Berghahn Books, 2006).

3 Craig Allen Nard and Andrew P. Morriss, "Constitutionalizing Patents: From Venice to Philadelphia," *Review of Law and Economics* 2, no. 2 (2006): 223–321.

4 Juan Bautista Medici, System for the formation of permanent channels in navigable rivers, US Patent 658,795, issued 1900.

5 George B. Boomer, Method of constructing levees, US Patent 452,989, issued 1891.

6 Linus Brown, System of protecting riparian lands from overflow, US Patent 488,422, issued 1892.

7 Lewis M. Haupt, "History of the Reaction Breakwater at Aransas Pass, Texas," *Journal of the Franklin Institute* 165, no. 2 (1908): 81–97.

8 Lewis Haupt, Jetty or breakwater, US Patent 687,387, issued 1901.

9 Bentley, Samuel J., et al. "Using what we have: Optimizing sediment management in Mississippi River delta restoration to improve the economic viability of the nation." Perspectives on the Restoration of the *Mississippi Delta. Springer Netherlands*, 2014. 85-97.