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Technical Lands: A patent Perspective

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Author
Hindle, Richard L

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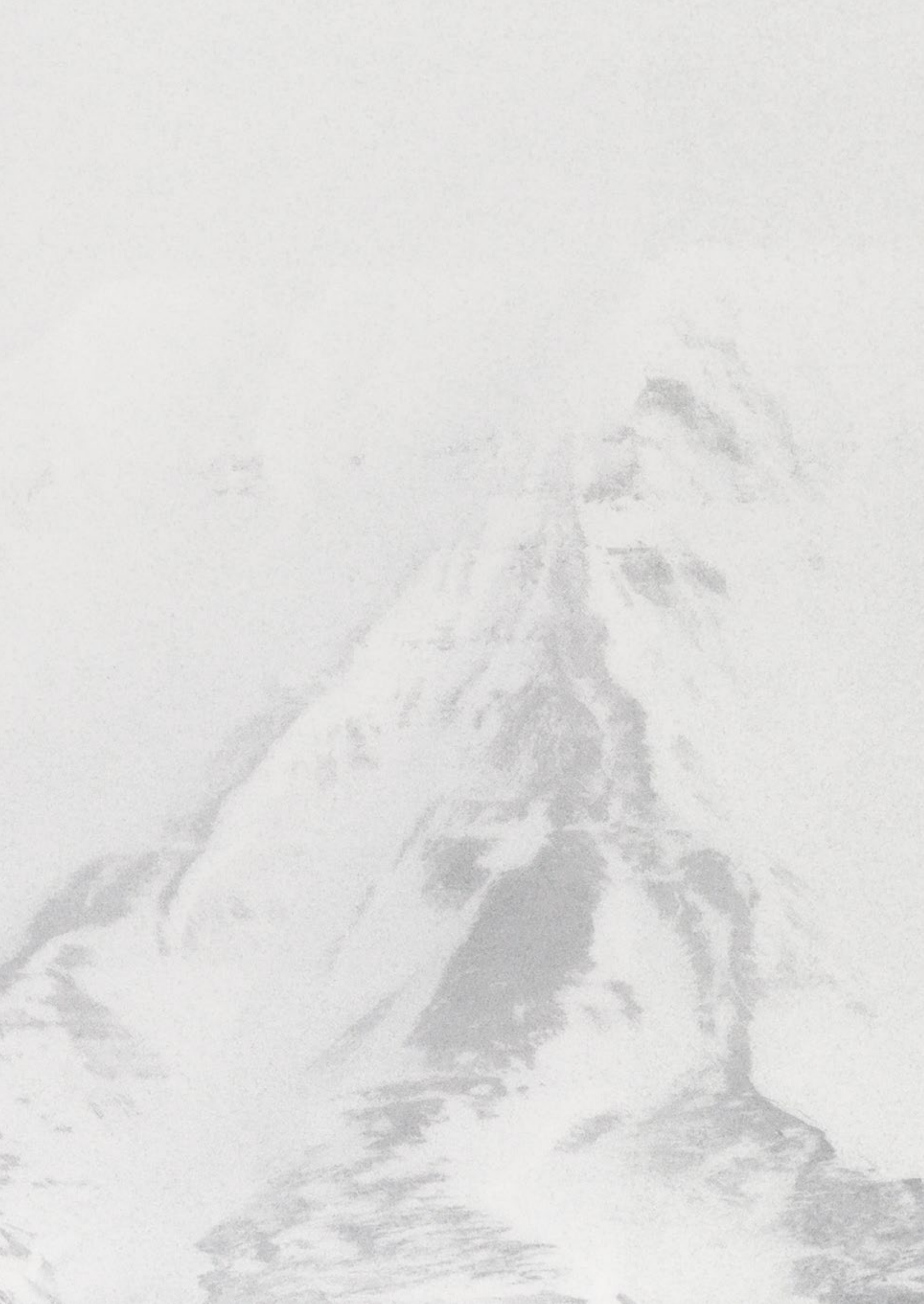
Technical Lands

editors
Jeffrey S Nesbit
Charles Waldheim

jovis

A Critical Primer

Technical lands are spaces united by their "exceptional" status – their remote location, delimited boundary, secured accessibility, and vigilant management. Designating land as "technical" is thus a political act. Doing so entails dividing, marginalizing, and rendering portions of the Earth inaccessible and invisible. An anti-visuality of technical lands enables forms of hypervisibility and surveillance through the rhetorical veil of technology. Including the political and physical boundaries, technical lands are used in highly aestheticized geographies to resist debate surrounding production and governance. These critical sites and spaces range from disaster exclusion and demilitarized zones to prison yards, industrial extraction sites, airports, and spaceports. The identification and instrumentalization of technical lands have increased in scale and complexity since the rise of neoliberalization. Yet, the precise theoretical contours that define these geographies remain unclear. *Technical Lands: A Critical Primer* brings together authors from a diverse array of disciplines, geographies, and epistemologies to interrogate and theorize the meaning and increasing significance of technical lands.



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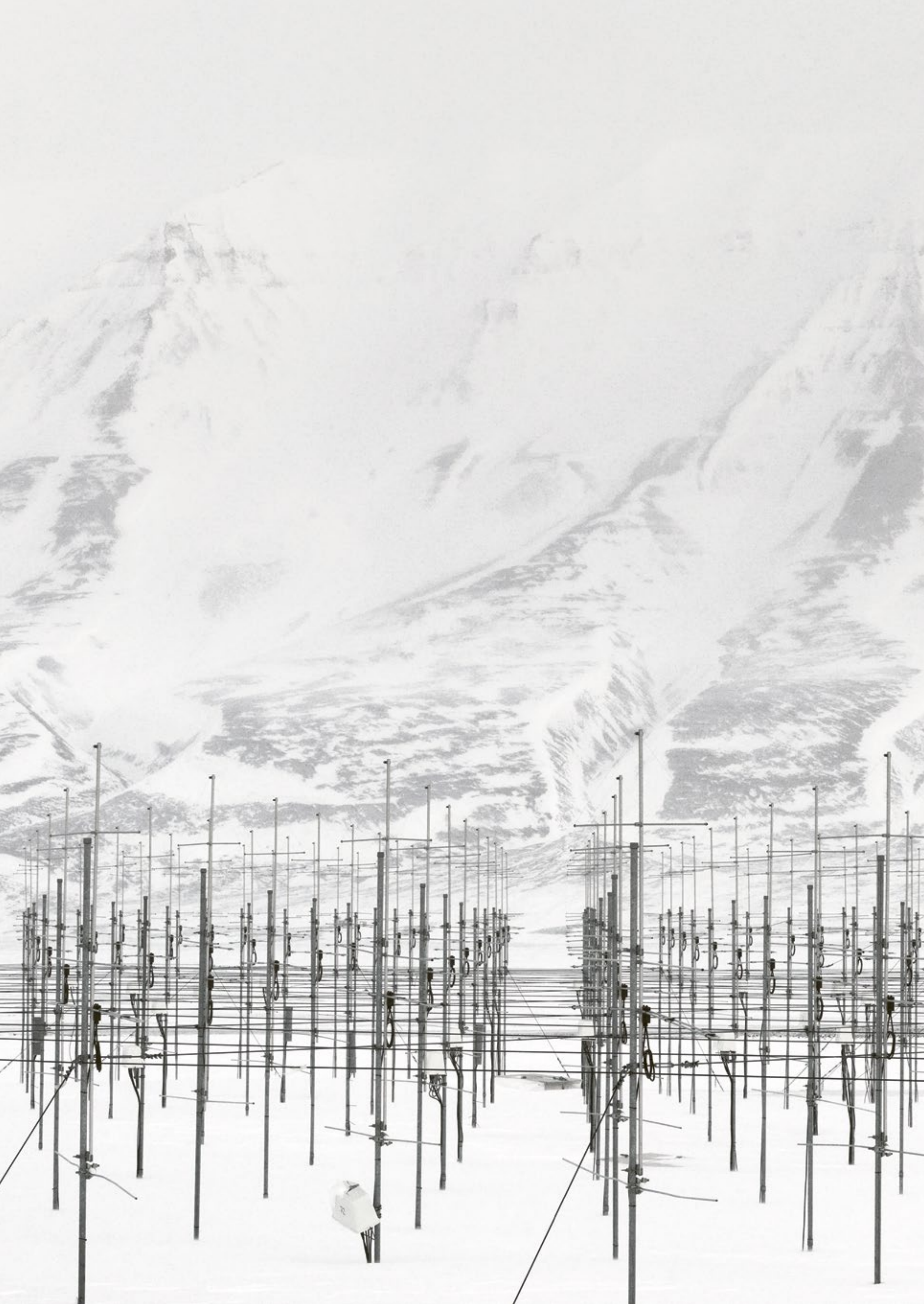

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Technical Lands

A Patent Perspective

Richard L Hindle

Patents and physical geography have paralleled each other for more than six centuries. The systems, modules, instruments, strategies, material processes, and devices disclosed in patents transform landscapes, construct sites, and are integrated into the everyday environment. Patent law, and the bureaucratic infrastructure that supports the global patent system, also have geographical dimensions through the management of sequential innovation, transfer of technology, and strategic initiatives at the intersection of innovation and environment. The agency of patent law and patented technology is particularly relevant today, as environmental systems and the infrastructure of urban landscapes become more technologically advanced, networked, logistical, and integrated, simultaneously expanding the disciplinary scope of environmental design and planning disciplines while challenging conventions of representation and praxis. This chapter explores the geographical dimension of patents, representations of technology and environment in patent documents, and the patent system's role in creating knowledge infrastructure and anticipatory governance for future planetary management. Together these interconnected themes and histories offer a critical reflection on the history of environmental innovation and a framework for designing technical lands.

Geographical Dimensions

In 2018 the European Patent Office launched the Y02A patent classification scheme to facilitate the diffusion, transfer, and implementation of "Technologies for Adaptation to Climate Change," covering the cross-sectoral innovations in coastal and riverine technology, flood control, mapping, sensing, human health, infrastructure, etc.[1] The 457,748 patents currently tagged in the Y02A classification suggest the emergence of a new stratum of environmental technology for adaptation to climate change—describing technical lands and their geographies ranging from sediment bypass systems and artificial reef datacenters to automated systems to map glacial retreat and farm arid regions.

fig 1

The special "Y02" designation was developed by the European Patent Office following the 2015 Paris Agreement to tag climate change mitigation technologies and develop a clearer picture of the capacities of existing and future technologies.[2] A subsequent report, "Invention and Global Diffusion of Technologies for Climate Change Adaptation: A Patent Analysis," published by the World Bank in 2020 notes that among the sectors experiencing rapid growth in the Y02A scheme, flood protection is experiencing the most growth "by far."[3] The notable uptick in patenting flood-mitigation technologies is not surprising as "natural" disasters often catalyze innovation. This trend will likely continue as climate change scenarios are further impacted by social-ecological-technical systems.[4]

The establishment of the Y02A classification scheme is not the first time the patent system was operationalized to help develop technologies with geographic, urban, and environmental dimensions. However, it may be the

1 A summary of the Y02A classification scheme and information on related patents can be found at the European Patent Office's patent search website, https://worldwide.espacenet.com/patent/cpc-browser#!/CPC=Y02A.

2 Stefano Angelucci, F Javier Hurtado-Albir, and Alessia Volpe, "Supporting Global Initiatives on Climate Change: The EPO's 'Y02-Y04S' Tagging Scheme," *World Patent Information* 54 (2018): 85–92.

3 Antoine Dechezlepretre et al., "Invention and Global Diffusion of Technologies for Climate Change Adaptation," World Bank, 2020.

4 Qing Miao and David Popp, "Necessity as the Mother of Invention: Innovative Responses to Natural Disasters," *Journal of Environmental Economics and Management* 68, no. 2 (2014): 280–95; Ariel E Lugo, "Effects of Extreme Disturbance Events: From Ecesis to Social–Ecological–Technological Systems," *Ecosystems* 23, no. 8 (2020): 1726–47.

US010524395B2

(12) **United States Patent**
Cutler et al.

(10) **Patent No.: US 10,524,395 B2**
(45) **Date of Patent: Dec. 31, 2019**

(54) **ARTIFICIAL REEF DATACENTER**

(71) Applicant: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

(72) Inventors: **Benjamin F. Cutler**, Seattle, WA (US); **Norman Ashton Whitaker**, Seattle, WA (US); **Spencer G. Fowers**, Duvall, WA (US); **Jeffrey Alex Kramer**, Redmond, WA (US)

(73) Assignee: **Microsoft Technology Licensing, LLC**, Redmond, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 315 days.

(21) Appl. No.: **15/167,755**

(22) Filed: **May 27, 2016**

(65) **Prior Publication Data**

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(Continued)

(51) **Int. Cl.**
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CPC ***H05K 7/20836*** (2013.01); ***A01K 29/005*** (2013.01); ***A01K 61/00*** (2013.01); ***F25D 1/02*** (2013.01); ***F28D 1/022*** (2013.01); ***F28D 15/00*** (2013.01); ***G06F 1/20*** (2013.01); ***G08B 13/2491*** (2013.01); ***H05K 7/2079*** (2013.01); ***H05K 7/20236*** (2013.01); ***H05K 7/20263*** (2013.01); ***H05K 7/20709*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC A01K 29/005; A01K 67/033; A01K 61/70; F28D 1/022
USPC 119/221, 219
See application file for complete search history.

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Primary Examiner — Magdalena Topolski
Assistant Examiner — Morgan T Barlow

(57) **ABSTRACT**

Examples of the disclosure provide for an apparatus for actively promoting marine life. The apparatus includes a datacenter implemented in a body of water and coupled to a network, a pressure vessel that houses the datacenter, and one or more components coupled to the pressure vessel and adapted to actively promote reef life and sustain a surrounding ecosystem.

20 Claims, 7 Drawing Sheets

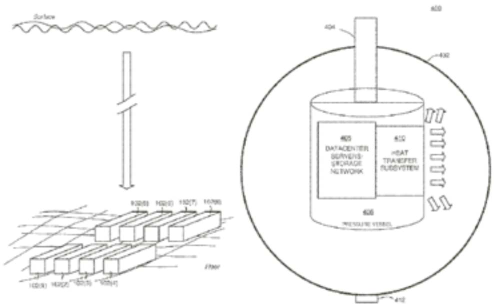


fig 1 US Patent 10,524,395, "Artificial Reef Datacenter," granted to Microsoft Technology Licensing, LLC, on December 31, 2019. United States Patent and Trademark Office

first with a planetary scope. In 1421 the Florentine government issued the first actual patent to the eminent architect Filippo Brunelleschi for a ship designed to move heavy materials on the River Arno to construct the Duomo of Florence, helping to solve one of three engineering challenges associated with the building project and establishing a legal precedent for the "patent bargain" between inventors and the state.[5] Fifty-three years later, the Venetian State formalized patent law with the Venetian Patent Statute of 1474, codifying the patent bargain to incentivize the sharing of new inventions in exchange for protection of intellectual property within Venetian territories.

Venetian patent rights were highly sought after, catalyzing innovation among Venetian citizens and the transfer of foreign technological know-how to the lagoon city. The effects of the patent statute were widely realized, leading to innovations in the broader economy, territorial development, and advances in urban and environmental infrastructure. This included "mud" technologies used for ground stabilization, reclamation, drainage, and dredging.[6] Perhaps the grandest and most conspicuous features of the urban landscape resulting from this process are the canals of Venice, built-in part with innovative technology developed in partnership with private inventors through the granting of patent rights.[7] The operationalization of the patent system in public works meant that innovative technologies could be tried and tested as Venice urbanized the lagoon, revealing the distinct agency of the patent system in the production of technical lands, and situating environmental innovations in a specific location with a "distinctly local and immediate notion of utility"[8]

As a political act, the Venetian patent statute decoupled invention from privilege, class, and guilds, liberating inventor and democratized ingenuity to allow broad constituencies to engage the processes of innovation as anyone could be granted a patent for their invention. According to Mario Biagioli, a leading scholar of law, science, and technology, this paralleled "the demise of political absolutism, the development of liberal economies, and the emergence of the modern political subject."[9] These ideas spread through Europe and the Americas were later constitutionalized. Some legal scholars even argue that all patent law is only an amendment to the original Venetian patent statute.[10] The conflation of invention and democratic principles gives modern patent rights hybrid vigor—leading to their universal adoption in early Western legal traditions. As Buckminster Fuller states of this historical development, "The necessity of invention and growth were highly apparent to the budding democracies, for had not invention itself forwarded [hu]man to the possibility of emergent DEMOCRACY?"[11] This political sentiment echoed in his Guinea Pig B design experiments and twenty-eight patented inventions.[12]

In the United States, patents and the patent system were again intertwined with nation-building, statecraft, territorialization, and physical geography. Prior to the American Revolution, patents and monopolies for manufacturing issued in the American colonies mirrored pieces of European, and more commonly English, patent law. They were, therefore, dependent on

5 Frank D. Prager, "Brunelleschi's Patent," *J. Pat. Off. Soc'y* 28 (1946): 109.

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

7 Roberto Berveglieri, *Le Vie Di Venezia: Canali Lagunari e Rii a Venezia: Inventori, Brevetti, Tecnologia e Legislazione Nei Secoli XIII–XVIII* (Cierre, 1999).

8 Mario Biagioli, "Patent Republic: Representing Inventions, Constructing Rights and Authors," *Social Research* (2006): 1129–72.

9 Biagioli, "Patent Republic."

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

11 Richard Buckminster Fuller, *Nine Chains to the Moon* (London: Feffer & Simons, 1938).

12 Richard Buckminster Fuller, *Inventions: The Patented Works of Buckminster Fuller* (New York, NY: St. Martins Press, 1983).

European institutions for enforcement.[13] American independence necessitated the creation of a new patent system, helping to chart an independent technological trajectory in the United States premised on political sovereignty. Article 1, Section 8, Clause 8 of the US Constitution gives Congress the power "to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries." The establishment of patent rights was codified within the newly formed government, charting a liberal, egalitarian approach to invention.[14] Arguably, the new patent system was so integral to the American domestic agenda that it served as the foundation for technologies that would define the colonies and western territories as infrastructural space. Pieces of this early history can be found throughout the patent archive and across the American landscape, from boundary fences demarcating homesteads to Gallatin's infrastructure plan (1807) that envisioned interstate transit and trade using canals and newly invented steamships.[15]

The interconnection between patent innovation and nation-building is also evident in the organizational structure of the Patent Office itself. From 1790 to 1849, the Patent Office was operated by the Department of State. At the time, the Department of State was primarily concerned with domestic affairs and development, including managing innovation. The increasing rate of patent submissions and an explosion of domestic concerns overwhelmed the State Department and led to the creation of the Department of Interior in 1849. Congress first considered creating a "Home Department" in the early decades of the nineteenth century to alleviate Patent Office caseloads from the Department of State's ever-expanding portfolio.[16] Arguments supporting the restructuring were elaborate, but in essence, reflected the sentiment that innovation was integral to nation-building. A congressional report supporting the Patent Office's relocation states, "Progress of the arts of civilization keep pace with each other; the arts are favorable to civil liberty; they alone give rise to internal improvements; and that nation is of all others the most certain of prosperity by which these principles are well understood and put into practice."[17] The Department of Interior was eventually formed through a strategic reorganization of the USPTO, General Land Office, Census Bureau, and Bureau of Indian Affairs and charged with managing domestic affairs, including wilderness areas and new US territories. The combined interests of the Department of Interior made it the de facto department of the West, playing a vital role in the expansion and development of western states. Richard Andrews, an environmental policy scholar, has argued that in an ideal world, the integration of interior, patent, land, and census departments might have provided the "foundation for integrated planning and management of the nation's environment."[18]

Inclusion of the Patent Office within the Department of Interior was strategic, following a track record of progress in infrastructure and innovation internal improvements. The Patent Office's early role in managing sequential innovation in these sectors is documented in Class 9 of the patent classification scheme (1790–1847) related to inventions of "Civil engineering and

13 P. J. Federico, "Colonial Monopolies and Patents," *J. Pat. Off. Soc'y* 11 (1929): 358.

14 Edward C. Walterscheid, "Charting a Novel Course: The Creation of the Patent Act of 1790," *AIPLA QJ 25* (1997): 445.

15 Karl Raitz, "Making Connections via Roads, Rivers, Canals, and Rails," *North American Odyssey: Historical Geographies for the Twenty-First Century*, eds. Colten and Buckley (Lanham, MD: Rowman & Littlefield, 2014),117; United States et al., *Report of the Secretary of the Treasury on the Subject of Public Roads and Canals Made in Pursuance of a Resolution of Senate of March 2, 1807* (Washington, DC: Printed by R.C. Weightman, 1808).

16 Henry Barrett Learned, "The Establishment of the Secretaryship of the Interior," *The American Historical Review* 16, no. 4 (1911): 751–73.

17 United States Congress, "State Papers on the Patent Office and Arguments for Creation of a Home Department," *American State Papers: Documents, Legislative and Executive, of the Congress of the United States* (Washington, DC:ales and Seaton, 1834), 187–91, https://books.google.com/books?id=MhV-FAQAAMAAJ.

18 R. N. L. Andrews, *Managing the Environment, Managing Ourselves: A History of American Environmental Policy* (New Haven, CT: Yale University Press, 1999), https://books.google.com/books?id=yxzcMhK9HdYC.

architecture, comprising works on rail and common roads, bridges, canals, wharves, docks, rivers, dams, and other internal improvements, buildings, roofs, etc.," which chronicles core infrastructure of a developing nation as well as technologies employed in environmental transformation.[19] Notable examples include the Superintendent of Western River Improvements, Henry Shreve's patented snag boat "Heliopolis," which was used to open the Mississippi River to shipping and Oliver Evans' steam engine used to power *Oruktor Ampibibolos* (amphibious digger), which was driven around the streets of Philadelphia before diving into the Schuykill River where it aimed to clear sandbars and build docks, thereby timestamping the advent of the world's first amphibious vehicle.[20]

The agency of the patent system and incentives of patent rights in infrastructure delivery was clear and sometimes utilized by the US Congress to procure, test, and prototype innovative urban and environmental technologies. For example, in 1821, Congress waived the residency requirement to grant Englishman Thomas Oxley a patent for his "American Land Clearing Engine," which promised to hasten development. In 1844, while pondering interstate communications, Congress passed acts to construct an experimental telegraph line from Washington to Baltimore following Samuel Morse's patent. Similarly, in 1845, Congress approved the creation of a panel of experts to test an experimental dredge machine, patented by J. R. Putnam for the removal of sandbars at the mouth of the Mississippi River.[21] And, in 1847, James Crutchett was commissioned to prototype and test his experimental gaslight in the US Capitol, proving the viability of artificial lighting in the urban landscape.[22]

The US Patent Office was also actively engaged in geographical, atmospheric, and technological initiatives. The first meteorological studies in the United States were commissioned jointly by the Patent Office and Smithsonian Institute in 1855, helping to promote advances in agricultural technology and the science of climate.[23] The data, standards, and instrumentation developed by the Smithsonian Institute during this venture led to creating the formal national weather system known as the Signal Service (1870–1891).[24] The Patent Office's involvement in this meteorological research venture was also fruitful, building upon a track record of agricultural innovation that eventually led to the creation of an independent Department of Agriculture in 1862 and the publication of pioneering works of agrometeorology such as "Meteorology and its Connection with Agriculture" in 1857.[25] The US Patent Office began collecting agricultural germplasm in the early nineteenth century, distributing the seeds, along with knowledge of agricultural innovations, essentially defining the future role of the Department of Agriculture.[26] In this expanded role, we see a patent office broadly concerned with the technology and data that would transform western states into a vast agricultural territory. During these early days of discovery, the Patent Office also served as the National Botanical Garden (c. 1942), storing and accessioning the botanical findings of Charles Wilkes's voyage to the Pacific West Coast of the American continent. In a subsequent exhibition, the

19 United States Patent Office, *List of Patents for Inventions and Designs: Issued by the United States, from 1790 to 1847, with the Patent Laws and Notes of Decisions of the Courts of the United States for the Same Period* (Printed by J. & G. S. Gideon, 1847), https://books.google.com/books?id=oHq0AAAAMAAJ; Heather J. E. Simmons, "Categorizing the Useful Arts: Part, Present, and Future Development of Patent Classification in the United States," *Law Libr. J.* 106 (2014): 564.

20 Edith S. McCall, *Conquering the Rivers: Henry Miller Shreve and the Navigation of America's Inland Waterways* (Baton Rouge: Louisiana State University Press, 1984).

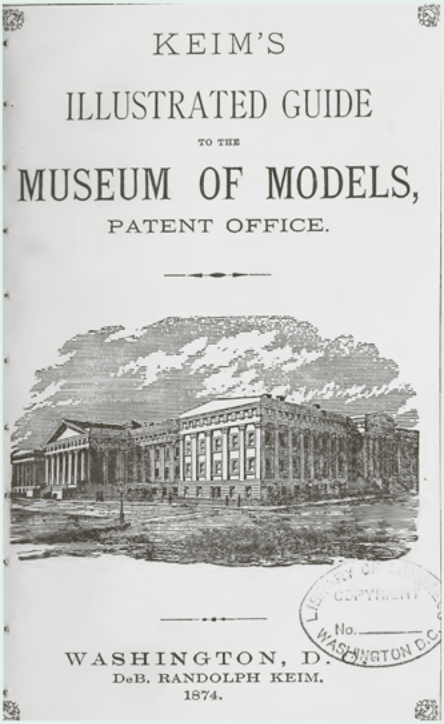
21 James R. Putnam, *J. R. Putnam's Plan for Removing Bars at the Mouth of the Mississippi River and Other Harbors on the American Coast and Interior. With a Full Description of His Patent Ploughing and Dredging Machine, Invented by Him for That Purpose, with Drawings, Etc.* (New Orleans: Bulletin Office, 1841).

22 John B. Miller, *Principles of Public and Private Infrastructure Delivery* (New York, NY: Springer US, 2013).

23 United States Patent Office, Bishop, William D., Henry, Joseph, Hough, Franklin B., Coffin, James H., Smithsonian Institution., *Results of Meteorological Observations, Made Under the Direction of the United States Patent Office and the Smithsonian Institution from the Year 1854 to 1859, Inclusive, Being a Report of the Commissioner of Patents Made at the First Session of the Thirty-Sixth Congress, Vol. I–II: Pt. 1* (Washington, DC: US Government Printing Office, 1861).

24 Joseph M. Hawes, "The Signal Corps and Its Weather Service, 1870–1890," *Military Affairs* 30, no. 2 (Summer 1966): 68–76.

25 Joseph Henry, *Meteorology in Its Connection with Agriculture* (Washington, DC, 1857), 455–492, 419–[552; 461]–524 incl. diagrs., illus. tables, //catalog.hathitrust.org/Record/012307539.



KEIM'S

ILLUSTRATED GUIDE

TO THE

MUSEUM OF MODELS,

PATENT OFFICE.

WASHINGTON, D.

DeB. RANDOLPH KEIM.

1874.

fig 2 Keim, De B. R. *Keim's Illustrated Guide of the Museum of Models, Patent Office* (Washington, DC: Be B. R. Keim, 1874). Library of Congress

Patent Office symbolically displayed discoveries from the nation's distant and prospective territories right alongside the Declaration of Independence, George Washington's War Tent, and a trove of other patent models and drawings.[27] By 1925, the Patent Office found its permanent administrative home in the US Department of Commerce (where it remains), signaling a shift in the organizational structure and the economy.

The frontiers of climate change and planetary urbanization will necessitate the geographical dimensions of patented technology. Collectively, the global patent system will remain integral to the invention of adaptation technologies and the production of future technical lands. In response to this global imperative, the Y02A classification scheme was created by the European Patent Office to leverage sociotechnical aspects of inventions and increase the pace of diffusion. We see elements of a Venetian model for environmental innovation revised through six centuries of precedent incentivizing innovation, building knowledge infrastructure, and serving as an anticipatory form of governance. Notably, the patent documents tagged by the Y02A scheme disclose technologies with the capacity to construct, construe, and manipulate the environment across scales and geographies in response to the wicked problem of climate adaptation—foreshadowing the emergence of new strata of innovation.

fig 2

Invention, Representation, and Environmental Imaginaries

This technological stratum's invention, representation, diffusion, and implementation have environmental, urban, and social implications. A patent is, in essence, a textualized and visualized representation of an invention, operating simultaneously as a legal document disclosing the nature of an invention and projection of a future potentiality. Of course, the invention process is more than representational and requires research and development of specific novel technologies. But in the context of patent law, the boundary line between invention and representation is sometimes opaque, enabling the projection of future technologies and environmental imaginaries without the invention being realized (that is, reduced to practice). This peculiarity creates a significant epistemological loophole in the inventive process, simultaneously facilitating the projection and disclosure of leading technology and exploitation through misrepresentation and fallacy. Irrespective of the tension between fact and fiction, the representation of technology in patent documents is integral to managing sequential innovation and the disclosure of new inventions. This is fascinating to ponder as we approach and project a future in which natural and cultural systems are more integrated, networked, sustainable, and technologically advanced.

Modern representational standards for patents originated in the United States and later France in the latter part of the eighteenth century.[28] The US Patent Act of 1790 states that grantees shall deliver to the Secretary of State, Secretary of War, and Attorney General "a specification in writing, containing a description, accompanied with drafts or models, and explanations and models (if the nature of the invention or discovery will admit of a model) of

26 Alfred Charles True, *A History of Agricultural Experimentation and Research in the United States 1607–1925 Including a History of the United States Department of Agriculture* (Washington, DC: US Government Printing Office, 1937).

27 Henry, *Meteorology in Its Connections;* United States Patent Office, et al., *Results of Meteorological Observations.*

28 Biagioli, "Patent Republic: Representing Inventions, Constructing Rights and Authors."

the thing or things, by him or them, invented or discovered."[29] If the invention was found to be new and valuable by the cabinet secretaries and the Attorney General, the patent was granted and signed, bearing the "teste" (witness) of the President. In that manner, the government and inventors coevolved the technological substrate of "the arts" towards unforeseen ends through future projections and representation of innovative technology—a process so integral to the founding of the country that Thomas Jefferson, the first Secretary of State and Patent Commissioner, is rumored to have slept with newly submitted patents in special boxes under his bed.[30] Through time, models and drawings of new inventions curated by the Patent Office amassed. By 1870 the Patent Office, designed by the architect Robert Mills and situated between the Capitol Building and the White House in L'Enfant's plan, was the busiest tourist destination in Washington, DC, surpassing the Washington Monument and the White House, effectively consolidating a grand tour of American innovation in a single location.[31]

fig 3a, 3b, 3c

Fusion between representation and invention unlocked ingenuity and hastened the rate of patent submissions, allowing American inventors to project forward a new technological sublime designed for the new nation. Critics argue that drawings of patented technology using patent conventions of plan, section, axonometric, diagram, data, and text determine the types of technology that can be invented, leading to a kind of banal standardization.[32] Yet, patent drawings and the inventions they represent do have the capacity to construct, construe, and transform the environment across scales and geographical contexts. Take, for example, attempts to build permanent navigable channels at the southwest pass of the Mississippi River. Three distinct technological scenarios were developed and patented by leading engineers, with two leading prototypes in other locations.[33] We know of these proposals through archives at the US Patent Office, documentation in *Scientific American*, their inclusion in Acts of Congress, and through the impact once implemented on the geomorphology of the Mississippi's bird-foot delta. The site-specificity of these inventions dissolves the boundary between technology and environment, simultaneously designating the delta as technical through the patent's representational standards and leveraging the patent system's bureaucratic procedures in service of environmental transformation.

fig 4

Other environmental imaginaries exist in patents, ranging from early biomorphic coastal structures and vegetated facades to oyster architecture and polyfunctional flood infrastructure strategies. Like other patents, these environmental technologies are disclosed using requisite representational standards to describe the nature of the module, typological configuration, material assembly, logistics, and processes. Interestingly, some environmental patents also include uncommon modes of technological representation, including perspectival and cartographic drawing types that position an

29 US Government, "United States Patent Act" (1790).

30 Timothy Lee Wherry, "Patents in the New World," *Science & Technology Libraries* 17, no. 3–4 (1999): 217–22.

31 Teresa Riordan, "Patents," *New York Times*, February 18, 2002.

32 William Rankin, "The 'Person Skilled in the Art' Is Really Quite Conventional: US Patent Drawings and the Persona of the Inventor, 1870–2005," *Making and Unmaking Intellectual Property: Creative Production in Legal and Cultural Perspective*, eds., Mario Biagioli and Peter Jaszi (Chicago, IL: University of Chicago Press, 2015).

33 Richard Hindle, "Prototyping the Mississippi Delta: Patents, Alternative Futures, and the Design of Complex Environmental Systems," *Journal of Landscape Architecture* 12, no. 2 (n.d.): 32–47, https://doi.org/10.1080/18626033.2017.1361084.

invention in a place, space, and context. Although the inclusion of perspectives, maps, and other spatial drawing types is by no means universal, they do help situate an invention in context, revealing the instrumentality and effect of the proposed technology. Briefly consider a recent patent by Keith Van de Riet, Jason Vollen, and Anna Dyson known as a "Method and apparatus for coastline remediation, energy generation, and vegetation support."[34] The patent drawings include technical specifications and models, with mappings that show the ecological extents of the invention. Spatial context is also provided through perspectival images, such as in Stanley Hart White's patent for a "Vegetation Bearing Architectonic Structure and System."[35]

fig 5a, 5b

The history of perspectival representation of patented technology can be traced back to Venice through the work of Cornelius Meijer. He arrived in Venice from the Netherlands in 1674, bringing news of a mighty chain dredger. He received a patent in 1675 and the title of engineer in exchange for his knowledge and drawings of the new method. Historians note that a similar chain dredger was invented in Holland decades earlier, but the technology was new to Venice, and the patent was granted.[36] A drawing of the technique and machinery used reveals a system of massive scrapers tethered to ships designed to scour the bottom of a water body. Meijer is noteworthy in the history of science and technology, not just for inventions but also for his drawings of technology, many of which use the representational technique of perspective to site distinct environmental technologies.[37] In the broader history of science and technology, this situates Meijer among greats such as Alexander Von Humbolt and Leonardo Da Vinci, who validated their discoveries "not only with trustworthy eyewitnesses and elaborate verbal descriptions, but precise, lifelike, and attractive visual representations" that could represent their "newly discovered worlds convincingly to those who were not there."[38] In this context, Alexander Von Humbolt's theory of plant biogeography is particularly relevant as the geologic cross-sections and cataloging of the biological world were fundamental, validating the theoretical premise through the visual representation of plants situated in specific locales and climatic zones.

fig 6

Cartographic modes of representation are another technique used in environmental patents to situate an invention. The direct correlation between the configuration and function of a novel invention and a specific location, landscape, or environmental condition is atypical. However, a unique subset of patents includes texts and images that suggest site-specificity within intellectual property claims, collapsing the boundary between technology and geography. The potentiality of these technical lands creates a unique hybrid in which an invention is associated with a site, giving the proposed technology scale, scope, and context while simultaneously instrumentalizing the landscape. Early examples include proposals for the removal of ice from New York Harbor and the East River; a passive dredge system for Galveston Bay; and a hydroelectric plant for Niagara Falls that

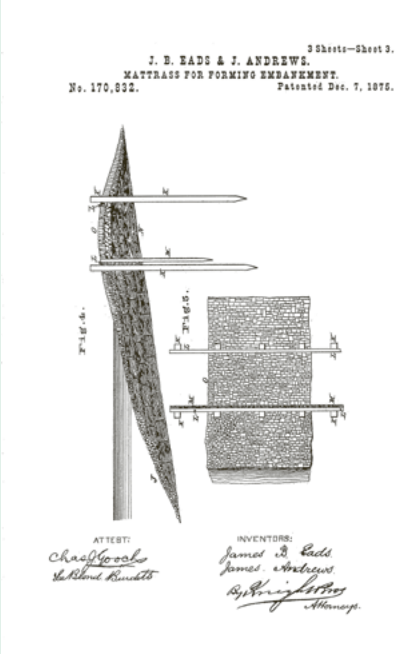
34 Keith Van de Riet, Jason Vollen, and Anna Dyson, "Method and Apparatus for Coastline Remediation, Energy Generation, and Vegetation Support," US8511936, 2013.

35 Stanley Hart White, "Vegetation-Bearing Architectonic Structure and System," US2113523, 1938.

36 Karel Davids, *The Rise and Decline of Dutch Technological Leadership: Technology, Economy and Culture in the Netherlands, 1350–1800, vol 2* (Boston: Brill, 2008), 288.

37 Cornelis Meijer, *L'arte di restituire à Roma la tralasciata navigatione del suo tevere* (Rome: Nella Stamperia del Lazzari Varese, 1685).

38 Klaas van Berkel "Cornelius Meijer Inventor et Fecit': On the Representation of Science in Late Seventeenth-Century Rome," in *Merchants and Marvels: Commerce, Science, and Art in Early Modern Europe*, eds. Pamela Smith and Paula Findlen (London: Routledge 2002), 277.



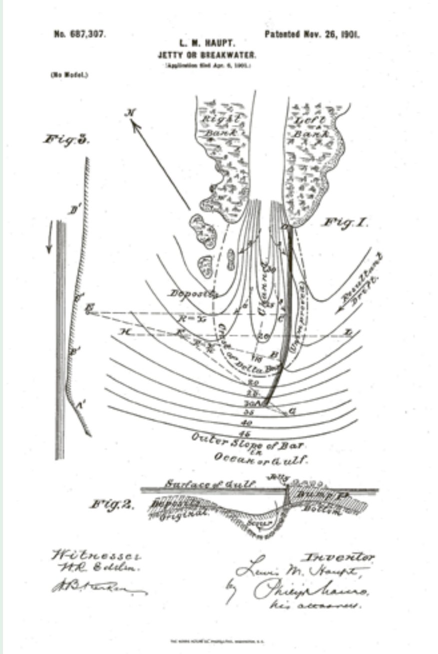
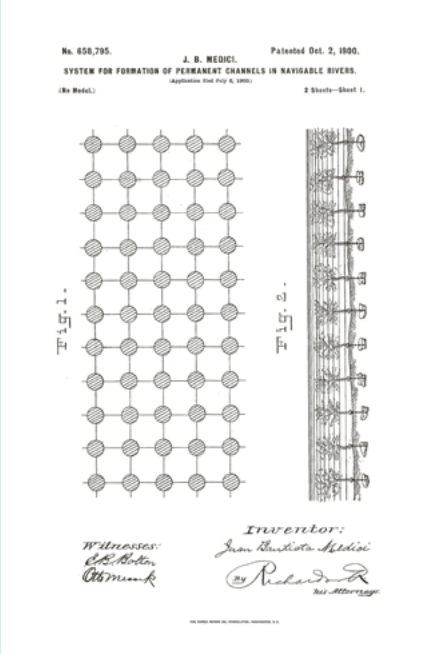
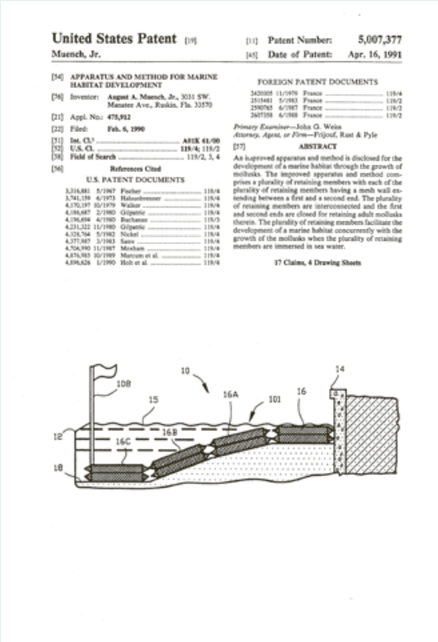


fig 3 J. B. Eads and J. Andrews, “Mattrass for Forming Embankment,” US 170,832; Lewis M. Haupt, “Jetty of Breakwater,” US 687,307; and Juan Bautista Medici, “System for Formation of Permanent Channels in Navigable Rivers,” US 658,795.
United States Patent and Trademark Office





United States Patent [19]
Muench, Jr.

[11] **Patent Number:** **5,007,377**
[45] **Date of Patent:** **Apr. 16, 1991**

[54] **APPARATUS AND METHOD FOR MARINE HABITAT DEVELOPMENT**

[76] Inventor: **August A. Muench, Jr.**, 3031 SW. Manatee Ave., Ruskin, Fla. 33570

[21] Appl. No.: **475,912**

[22] Filed: **Feb. 6, 1990**

[51] **Int. Cl.**[5] **A01K 61/00**
[52] **U.S. Cl.** **119/4**; 119/2
[58] **Field of Search** 119/2, 3, 4

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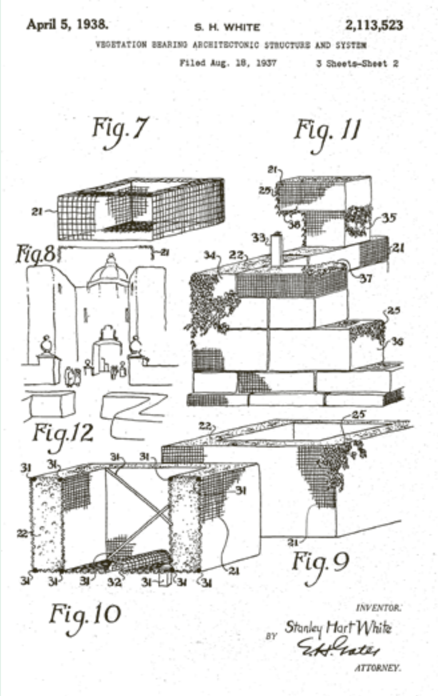
Primary Examiner—John G. Weiss
Attorney, Agent, or Firm—Frijouf, Rust & Pyle

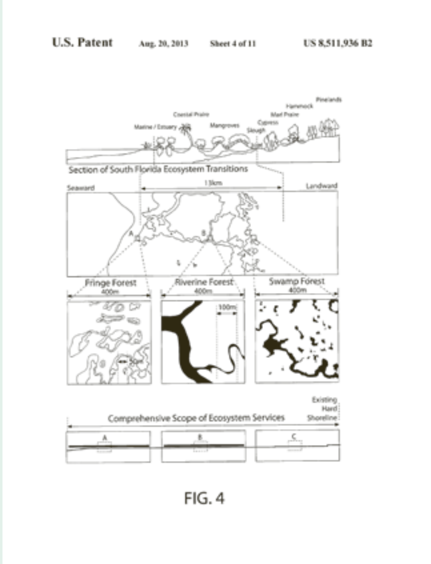
[57] **ABSTRACT**

An improved apparatus and method is disclosed for the development of a marine habitat through the growth of mollusks. The improved apparatus and method comprises a plurality of retaining members with each of the plurality of retaining members having a mesh wall extending between a first and a second end. The plurality of retaining members are interconnected and the first and second ends are closed for retaining adult mollusks therein. The plurality of retaining members facilitate the development of a marine habitat concurrently with the growth of the mollusks when the plurality of retaining members are immersed in sea water.

17 Claims, 4 Drawing Sheets

fig 4 US 5,007,377, "Apparatus And Method For Marine Habitat Development," granted to August A. Muench Jr. on April 16, 1991. United States Patent and Trademark Office





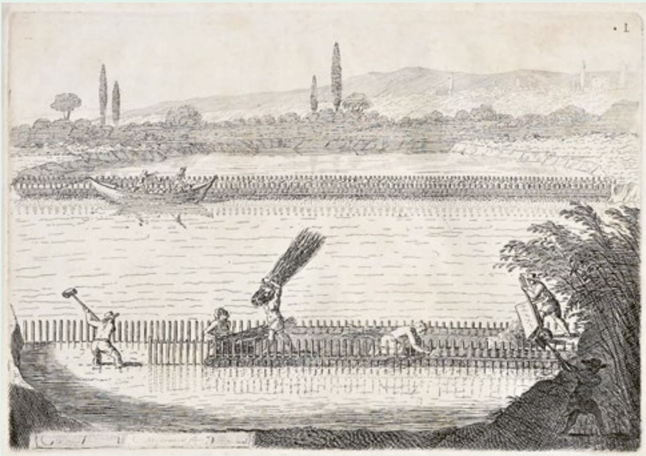


fig 5 Stanley Hart White, "Vegetation bearing architectonic structure and system," US 211,523; Keith Van de Riet, Jason Vollen, and Anna Dyson, "Method and apparatus for coastline remediation, energy generation, and vegetation support," US 8,511,936B2. United States Patent and Trademark Office

fig 6 Cornelius Meijer's perspectival drawings are significant in the history of science as they were often used by the inventor to situate and site new technologies within an environ. In Meijer, *L'arte di restituire* (Rome: Nella Stamperia del Lazzari Varese, 1685); Getty Images preserves scenery and produces power.[39] Following this line of inquiry, the relationship between patented technology and cartography is further confounded by the existence of cartographic devices and methods disclosed in patents that also contain mappings. Prime examples of this are the Dymaxion map and mapping system patented as "Cartography" by Buckminster Fuller and the more recent patent for "Glacial Geomorphic Mapping" by Andreas Laake.

fig 7

Of course, the relationship between patented technology and cartography is more than a representational anomaly or rhetoric. Patents for cartographic inventions span centuries and include technological domains ranging from printing and folding large maps to surveying equipment and global positioning systems.[40] Today the most rapid growth in cartographic technology is in systems that support autonomous vehicles or those integrated with smartphones. However, early warning technology for natural disasters is also in rapid development. Technologies tied to weather forecasting, the mapping of climate change scenarios, remote sensing, and environmental imaging are organized by the Y02A 90/10 patent subclass for innovations that indirectly contribute to climate adaptation and resilience.

fig 8a, 8b

Environmental Knowledge, Infrastructure, and Anticipatory Governance

Patent documents have been archived for six centuries globally and provide a valuable dossier of technological knowledge in every sector of the known *technosphere*—existing simultaneously as a robust form of knowledge infrastructure and a framework for anticipatory governance.[41] The global patent archive now contains approximately 110 million searchable documents. The primary function of this vast repository is the bureaucratic management of sequential innovation in support of legal rights for inventors. But the patent archive also provides deep insights about contemporary inventions, past discoveries, and future trends through its capacity of search, metadata, citation networks, language translation, image, and ever-evolving classification systems that organize extents of human ingenuity disclosed in patents. As a form of knowledge infrastructure, the archiving of patents facilitates discovery and provides information that may be utilized and translated in legal, technical, and non-technical domains alike. As a form of anticipatory governance, the patent system helps predict future trends and gain insights regarding technological trajectories. These core functions of the patent system are integral to the invention and diffusion of environmental technology, including the emerging sectors such as climate adaptation and resilience covered by the Y02A classification scheme and the technical lands they represent.

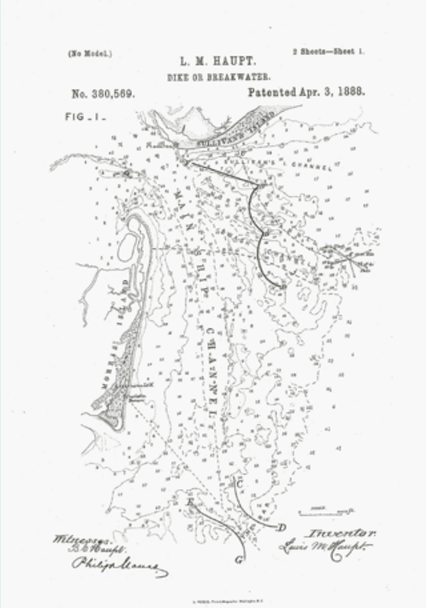
Paul Edwards defines knowledge infrastructure as "robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds."[42] In essence, knowledge infrastructures are complex networks of information intertwined

39 Voorhis, Peter. 1867 "Improved method of obstructing ice in rivers and harbors" US63968
Spangler, Daniel. 1885 "Submarine wall" US325127
Zeitinger, Christian. 1890 "Device for utilizing the water-power of falls" US442000

40 Mark Monmonier, "Patents and Cartographic Inventions: A New Perspective for Map History," 2017, http://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=4832532.

41 *Technosphere* refers to the technological component of earth systems created by humans, comprising "our complex social structures together with the physical infrastructure and technological artifacts supporting energy, information, and material flows that enable the system to work." For an expanded discussion and additional references, see Jan Zalasiewicz et al., "Scale and Diversity of the Physical Technosphere: A Geological Perspective," *The Anthropocene Review* 4.1 (2017): 9–22.

42 Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010).



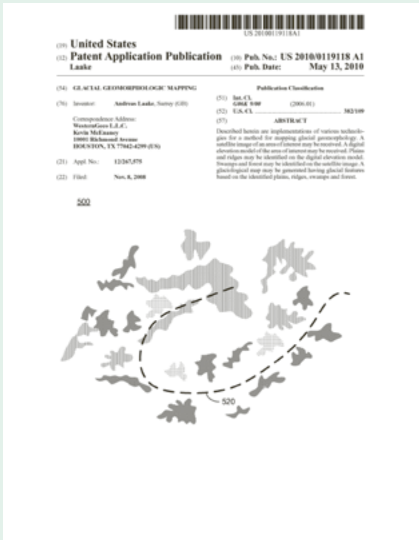


fig 7 Patent for “Dike or Breakwater (US 380,569, April 3, 1888) by Lewis M. Haupt uses precise bathymetry and technical specifications to describe a self-dredging “reaction” breakwater system. United States Patent and Trademark Office

fig 8 Dymaxion Map, patent for “Cartography” (US 2,393,676, January 29, 1946) by Buckminster Fuller; “Glacial geomorphic mapping” (US 8,280,116B2) by Andreas Laake. United States Patent and Trademark Office with social, technical, and environmental systems and therefore have radical implications for the way society perceives and manages the world. As methods of the Anthropocene, knowledge infrastructures are also linked to planetary processes. Through the evolution of the technosphere, they can contribute to "large-scale, long-term, anthropogenic environmental change," making them essential for future planetary management.[43] The global patent archive exists as one such form of knowledge infrastructure built on the disclosure and representation of new technology by inventors, and the management, archiving, and legal protection of sequential innovation by government institutions—a process complicit in the creation of the extractive economies of the past but also the networked, resilient, and adaptive ecologies of today.

The word "infrastructure" implies that these knowledge systems serve as substructures supporting other systems and are enmeshed with society, economy, energy, material use, politics, and the management of a complex environment. Climate change data, for example, reveals the ongoing relationship between the technologies used to map and model the environment and our understanding of a changing planet. The interrelation of data, technology, science, and society represents the "climate knowledge infrastructure" that shapes our environmental management. Similarly, in the allied fields of environmental design, planning, and engineering, geographical knowledge infrastructure is essential and widely integrated with research and praxis. Geographical knowledge infrastructure, such as geographical information systems (GIS), spatializes data and is also the necessary infrastructure for building smart cities and territorial intelligence, etc.[44] These dynamics operate at multiple scales, from the individual actor/organization to vast territorial networks.[45]

The global patent system is a knowledge infrastructure created to stimulate innovation. The system's core capacities of archiving, searching, categorizing, and citing also serve as an infrastructure that supports other uses.[46] As a form of innovation-knowledge infrastructure, the patent archive is essential in tracking progress in technical fields. It chronicles developments and establishes a precedent of prior art, archiving specifications, claims, and drawings while providing metadata for research, interpretation, and discovery. Beyond merely describing a particular invention, a patent is theorized to serve as a "carrier" of innovation, leaving "footprints" for the development of new technology through a combinatory process that evolves through knowledge of prior inventions in a specific sector.[47] In emergent sectors such as climate adaptation and resilience, this combinatory process is precious.

A general theory of invention suggests that searching is the essential framework for discovery, often involving the iterative and recursive stages of stimulus, net casting, categorization, linking, and discovery.[48] It is hypothesized that in the process of searching, inventors gather information inside and outside of their domains to create mental schemas to link ideas, build context, and make discoveries. As Eugene Furgeson argues in "Engineering

43 Paul N. Edwards, "Knowledge Infrastructures for the Anthropocene," *The Anthropocene Review* 4, no. 1 (2017): 34–43.

44 Robert Laurini, *Geographic Knowledge Infrastructure: Applications to Territorial Intelligence and Smart Cities* (Amsterdam: Elsevier, 2017).

45 Frank Moulaert and Abdelillah Hamdouch, "New Views of Innovation Systems: Agents, Rationales, Networks and Spatial Scales in the Knowledge Infrastructure," *Innovation: The European Journal of Social Science Research* 19, no. 1 (2006): 11–24.

46 Yo Takagi, "WIPO's New Strategies on Global Intellectual Property Infrastructure," *World Patent Information* 32, no. 3 (2010): 221–28.

47 Hyejin Youn et al., "Invention as a Combinatorial Process: Evidence from US Patents," *Journal of the Royal Society Interface* 12, no. 106 (May 2015).

48 Patrick G. Maggitti, Ken G. Smith, and Riitta Katila, "The Complex Search Process of Invention," *Research Policy* 42, no. 1 (2013): 90–100.

US 20100252648A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2010/0252648 A1**

Robinson (43) **Pub. Date: Oct. 7, 2010**

(54) **CLIMATE PROCESSOR**

(76) Inventor: **Nicholas Paul Robinson**, Cottingham (GB)

Correspondence Address:
Nicholas Paul Robinson
17 West End Road
Cottingham, E. Yorkshire HU16 5PL (GB)

(21) Appl. No.: **12/698,848**

(22) Filed: **Feb. 2, 2010**

(30) **Foreign Application Priority Data**

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Oct. 17, 2007	(GB)	0720463
Feb. 19, 2008	(GB)	0802955
Aug. 20, 2008	(GB)	2 452 152 A

Publication Classification

(51) **Int. Cl.**
A01G 15/00 (2006.01)

(52) **U.S. Cl.** **239/14.1**

(57) **ABSTRACT**

A climate processor having virtual estuaries which enable large strips of land to act like real water estuaries thereby providing a means of climate control overhead. Said estuaries are also used to prevent polar isotherm migration, melting ice shelves, vertical storm formation and migration from lateral coastal airflow. Said estuaries are formed between two parallel-laid thermal belts formed from artificial surface whitening and jet contrails. The surface whitening can be laid down as a foam or gel and deployed overhead as a high level aviation propellant. The belts may be applied daily and dissipate as the day progresses and subsequently warms. Commercial aircraft flights may be readjusted based on the placement of the artificial estuaries. Also claimed are an aerial deployment system for the foam, a high-level aviation propellant system, a carbon trading system for commercial airlines, a "Russian Doll" gas mixing device and a range of suitable foams.

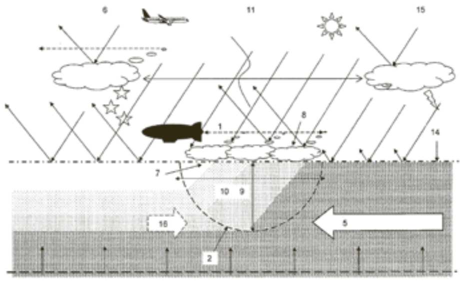

fig 9 The "Climate Processor" (US Patent Application 20100252648A1) by Nicholas Paul Robinson archives, categorizes, cites, and publishes the invention helping to map and organize the extents of the technosphere. United States Patent and Trademark Office

and the Mind's Eye," this complex process involves not only the interpretation of data, text, and equations but also the visual communication of ideas from which new ideas and technologies can be developed. Furgeson points out that Edison's automatic-printing telegraph was simultaneously an invention and a drawing, each integral to the communication of his idea and the establishment of a new sector.[49] Because the allied fields of environmental design and planning address broad questions of climate adaptation and resilience, a vast visual and technical repository exists within the patent archive for the technologies to structure, build, sense, and design adaptive and resilient landscape systems. This knowledge infrastructure can serve both heuristically to help problem-solve and as a technological database to develop frameworks for innovation. For example, during the 2017 Resilience by Design Bay Area Challenge, the Common Ground Team coupled patent-innovation studies with a heuristic process to develop innovative strategies for coastal resilience. Each landscape condition was linked to an innovation citation network of patented technologies that might structure the site. In certain instances, specific site assemblies were suggested and integrated into the design, showing how each technology would impact the site and future scenarios for the region. The team adapted existing technologies to the design framework and then made informed suggestions for future needs based on these innovation studies. This led to novel design strategies at the site-detail and regional scales while linking geographical contingencies to a technological dossier.[50]

Anticipation of the future has become a common theme in governance, especially in the context of science and development of sociotechnical fields dependent on anticipatory copractices between inventors, intuitions, and broader societal assemblages.[51] Theorists claim that in an ideal world,

> [anticipatory governance] would register and track events that are barely visible at the horizon; it would self-organize to deal with the unexpected and the discontinuous; and it would adjust rapidly to the interactions between our policies and our problems. In anticipatory governance, systems would be designed to handle multiple streams of information and events whose interactions are complex rather than linear.[52]

Beyond the technological, anticipatory governance is integral to social-ecological resilience and suggests that effective management of this process can increase ecological knowledge.[53]

A central tenant of anticipatory governance is the recognition of values associated with emergent technologies and their role in society in sectors ranging in scale from nanotechnology to geoengineering.[54] Foresight is integral to anticipatory governance as institutions establish future trajectories for investment and innovation.[55] Technological innovation and patent trends offer distinct insights about future environmental scenarios while simultaneously revealing the patent system's role of adaptive governance

49 Eugene S. Ferguson, *Engineering and the Mind's Eye* (Cambridge, MA: MIT Press, 1993).

50 "Common Ground_The Grand Bayway_Final_Design_Roadmap.Pdf – Google Drive," accessed April 4, 2019, https://drive.google.com/file/d/1rigcTd_IHx-0WnCvKeJCqtTJmtfsbr2ci/view.

51 Carla Alvial-Palavicino, "The Future as Practice: A Framework to Understand Anticipation in Science and Technology," *TECNOSCIENZA: Italian Journal of Science & Technology Studies* 6, no. 2 (2016): 135–72.

52 Leon Fuerth, "Operationalizing Anticipatory Governance," *Prism* 2, no. 4 (2011): 31–46.

53 Emily Boyd et al., "Anticipatory Governance for Social-Ecological Resilience," *Ambio* 44, no. 1 (2015): 149–61.

54 Risto Karinen and David H. Guston, "Toward Anticipatory Governance: The Experience with Nanotechnology," *Governing Future Technologies* (Heidelberg: Springer, 2009), 217–32; Rider W. Foley, D. Guston, and Daniel Sarewitz, "Towards the Anticipatory Governance of Geoengineering," *Geoengineering Our Climate*, 2015.

55 Jose M. Ramos, "Anticipatory Governance: Traditions and Trajectories for Strategic Design," *Journal of Futures Studies* 19, no. 1 (2014): 35–52.

and new knowledge infrastructures. Knowledge and anticipation of these trajectories have planetary implications, as evident in evolving discourse and debate on geoengineering. Few laws or government entities are in place in the emerging geoengineering sector to manage developments given the extraterritorial nature of the proposals and global impact, making foresight of future trends imperative. According to a recent paper on the subject, "in the absence of a governance framework for climate engineering technologies such as solar radiation management (SRM), the practices of scientific research and intellectual property acquisition can de facto shape the development of the field."[56] In this speculative technological space, new frameworks for patent law are also being proposed, including patent pools that ensure the free use and diffusion of technologies to "save the planet."[57] Irrespective of the validity of existing geoengineering technology, it is interesting to take note, just in case these projections of future climate solutions take shape.

[56] Paul Oldham et al., "Mapping the Landscape of Climate Engineering," *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 372, no. 2031 (December 2014).

[57] Anthony E. Chavez, "Exclusive Rights to Saving the Planet: The Parenting of Geoengineering Inventions," *Northwestern Journal of Technology and Intellectual Property* 13 (2015): 1.

fig 9

Conclusion

Leveraging the distinct agency of patented technology and the patent system offers one strategy for the invention and production of technical lands, engaging broad sociotechnical processes and bureaucratic infrastructure in the transformation of sites and geographies. The systems, modules, machines, sensors, materials, and maps that will be invented have significant implications for future planetary management through their integration with urban sites and large-scale environmental systems. A reliance on technology to solve future environmental problems has its limits and is inherently paradoxical, as innovations of the past have contributed widely to environmental decline, as is evident today. However, as environmental systems and designed urban landscapes become more technologically advanced, networked, logistical, and integrated, a cohesive strategy is required for the allied disciplines of environmental design, planning, and engineering to engage the processes that produce the technical lands of the future.

Patents and the patent system will play an increasingly important role in this space by managing sequential innovation, developing knowledge infrastructure, projecting future imaginaries, and transferring technology in this emerging sector. Significantly, these processes may be leveraged to help build a more sustainable, adaptive, and equitable environment. Like other landscape strategies, the operationalization of the patent system represents "a highly organized plan (spatial, programmatic, or logistical) that is at the same time flexible and structurally capable of significant adaptation in response to changing circumstances."[58] Many questions remain regarding the invention, prototyping, testing, and implementation of the future's environmental technologies. Nevertheless, this work is imperative, and these questions must be answered. If the allied profession of environmental design and planning does not invent and project the new technological strata that define the sites and geographies of tomorrow, who will?

[58] James Corner, "Not Unlike Life Itself: Landscape Strategy Now," *Harvard Design Magazine* 21 (2004).

Contributors

Caitlin Blanchfield is a PhD candidate in architectural history at Columbia University's Graduate School of Architecture, Planning, and Preservation and visiting assistant professor at the Pratt Institute.

Neil Brenner is an urban theorist, sociologist, geographer, and Lucy Flower Professor of Urban Sociology at the University of Chicago.

Jay Cephas is an architectural and urban historian and assistant professor of history and theory of architecture at Princeton University School of Architecture.

John Dean Davis is an environmental and architectural historian and assistant professor at the Knowlton School of Architecture at Ohio State University.

Billy Fleming is a landscape architect, city planner, founding Wilks Family Director of the Ian L. McHarg Center at the Weitzman School of Design, and cofounder of the Climate + Community Project.

Peter Galison is a historian and philosopher of science and is the Joseph Pellegrino University Professor in history of science and physics at Harvard University.

Swarnabh Ghosh is a critical geographer, architect, and a PhD candidate at Harvard University.

Rania Ghosn is an architect, geographer, associate professor of architecture and urbanism at the Massachusetts Institute of Technology and cofounding partner of Design Earth.

Stephen Graham is an academic, author, and professor of cities and society at the School of Architecture, Planning, and Landscape at Newcastle University.

Florian Hertweck is an architect, professor, and chair of the Master in Architecture at the University of Luxembourg.

Richard L Hindle is a designer, innovator, educator, and associate professor of landscape architecture and environmental planning in the College of Environmental Design at the University of California, Berkeley.

Eric Robsky Huntley is a geographer and designer who is currently a lecturer in urban science and planning in the Department of Urban Studies and Planning at the Massachusetts Institute of Technology and a visiting lecturer in landscape architecture at the Harvard Graduate School of Design.

Nikos Katsikis is an urbanist and assistant professor of urbanism at the Delft University of Technology and affiliated researcher at the Urban Theory Lab in Chicago and Future Cities Laboratory in Zurich.

Marija Marić is an architect, researcher, and postdoctoral research associate of the Master in Architecture at the University of Luxembourg.

Shannon Mattern is an educator, theorist, and professor of anthropology at The New School for Social Research.

A L McCullough is a landscape architect and member of the Climate + Community Project.

Jeffrey S Nesbit is an architect, urbanist, and assistant professor in history and theory of architecture and urbanism at Temple University.

Robert Gerard Pietrusko is an architect, landscape theorist, and associate professor of landscape architecture at the University of Pennsylvania.

Roi Salgueiro Barrio is an architect, urbanist, and founder of the design office RSAU, and a lecturer at Massachusetts Institute of Technology School of Architecture and Planning.

Desiree Valadares is a landscape architect, architectural historian, and assistant professor in the Department of Geography at the University of British Columbia.

Charles Waldheim is an architect, urbanist, and John E. Irving Professor at the Harvard University Graduate School of Design where he directs the Office for Urbanization.

Matthew W Wilson is a cultural and political geographer, researcher, and associate professor of geography at the University of Kentucky and associate at the Center for Geographic Analysis at Harvard University.

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