Title
Infrastructures of Innovation: Patents, Prototypes, and the resilience of ingenuity

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The question of infrastructure pervades global cities, especially those whose populations have grown and shrunk in the wake of evolving social, political, and economic shifts. The Center for Advanced Urbanism at the Massachusetts Institute of Technology explores this issue in *Scaling Infrastructure*, bringing together leading voices from politics, engineering, and design, whose diverse and distinct disciplinary perspectives combine to form a multifaceted and dynamic commentary on the role of infrastructure in today's fluctuating urban landscapes. Case studies from around the world provide stepping-stones for the development of global solutions. Authoritative, thought-provoking, and optimistic, this volume presents ideas dedicated to the brighter future of the world's metropolitan areas.

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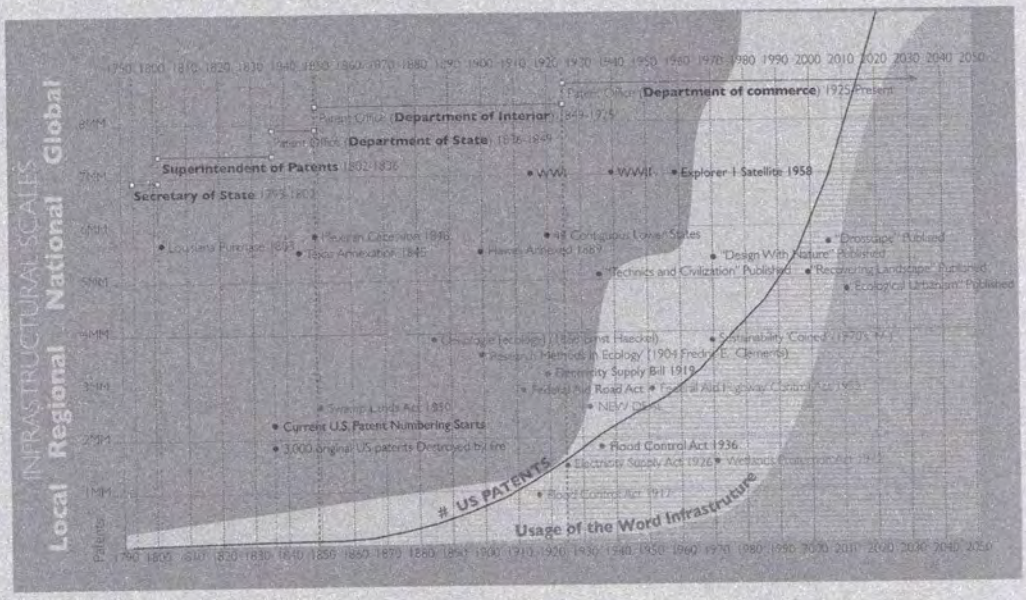


Fig. 1 **History of patents and the origins of national infrastructure (Richard Hindle)**

The title of my talk is "Infrastructures of Innovation: Prototypes, Patents, and the Resilience of Ingenuity." It is structured around the idea that patent innovation played an integral role in the development of early American infrastructural projects and that prototyping and innovation are critical responses to ever-changing environmental imperatives.

To date, approximately nine million patents have been issued in the United States since the Patent Act of 1790. The 224 years of innovation chronicled by the patent archive discloses complex relations among men, environment, and society and offers a window into broad themes related to urbanization, landscape, and the built environment. Of the 9 million or so extant U.S. patents, 5.5 million have transitioned to the public domain. In addition, almost 80 million patents have been granted internationally, an ever-expanding database of shared intellectual property.

Looking back at the history of patents and the origins of national infrastructure, several interesting convergences become apparent. From 1849 to 1925, the Patent Office was housed within the Department of the Interior and therefore played a pivotal role in domestic issues and the development of early national infrastructure. In 1925 the Patent Office transitioned to the Department of Commerce, where it remains currently. This transition loosely coincides with the exponential growth of regional and federal-scale infrastructure and, in the 1920 to 1930s, the consolidation of major engineering works under the federal government. I would like to suggest that what we collectively understand as infrastructure may also be viewed as innovations that achieved a cross-scalar effect, starting as prototypes and patents and eventually being integrated into large-scale social or technical systems.

This cross-scalar potential is evident in analysis of the levee systems of the Mississippi River and California deltas. The process, technology, and logic of levee construction as we know it today have not ostensibly changed since the advent of the dragline excavator. The repetitive pass of the machine's boom and bucket continue to generate a landscape morphology of pits and berms that, for example, typify the Mississippi River watershed, as seen in these images from 1916 and 2013, respectively. This surprisingly resilient and broadly applied building technology is codified in a grant patented to Arsene Perrilliat, state engineer for Louisiana, president of the American Society of Civil Engineers, and expert witness to Congress during the shift of engineering works to the federal government. The core of the Arsene Perrilliat patent, filed in 1916 and granted in 1918, is the choreography of draglines, pit dimensions, and the scale of levee berms. It is unclear if Perrilliat attained his patent for novelty or profit. However, for the sake of this presentation, it is a salient example of the patent process and prototyping transcending scales.

During the late nineteenth and early twentieth century, prior to the consolidation of federal engineering, the methods and machines of levee design and construction were by no means a foregone conclusion. Individual innovators posited their ideas in the Patent Office within the Department of the Interior. Many of the patents that predate Perrilliat's patent of 1918 engage ebb-and-flow processes. The patents shown here are very early examples of levees that could have been if another preferred

process had not been developed. It is interesting to note that the patents on the right are very early examples of bioengineering, utilizing living material in the construction process. Several patents warrant further investigation for their potential to limit damage from later floods and radically transform the American landscape. In 1891 George Boomer of Mount Pleasant, New York, patented a method for constructing a double levee system as a feasible solution to Mississippi River floods. The system mediates water, controls outflow, orchestrates sedimentation processes, and serves as emergency storage capacity during floods. It also allows wetland formation in hybrid or in-between lands between the river system and the adjacent landscape.

A patent from 1918 by Frank V. Wright describes a process by which levees would be built through a cyclical process of cultivating crops and trees, irrigating troughs with sediment and slurries, and repeating the process, thereby growing land and cultivating crops simultaneously: a vanguard process by any landscape standards. Each of the aforementioned methods represents levees that could have been. For me, they are a valuable heuristic for design pedagogy. As a landscape architect, it is hard for me not to see each of these patents as templates for future landscape scenarios or morphologies. To my mind, each represents the seed of an idea ripe with potential.

The existing condition of the California deltas shows the landscape morphology that results from the deterministic motions of the clamshell dredge. A quick

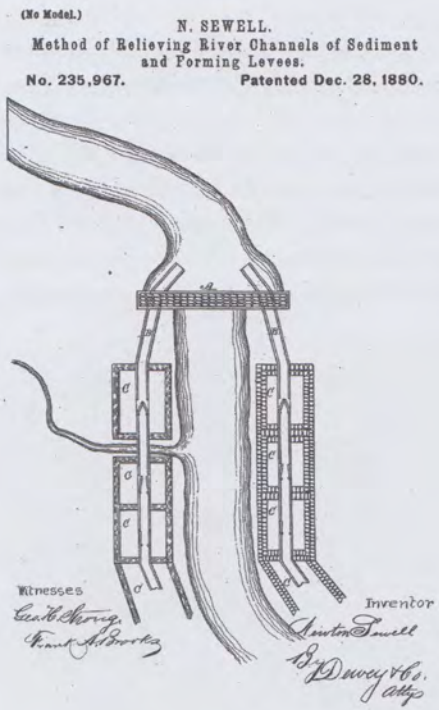
conceptual image of an alternative condition hypothetically created by Wright's patent, shows how regional cultivation systems, levee berms, and the deltaic landscape merge into a hybrid that is simultaneously constructed and cultivated. Many themes in the patent archive have surprising resonance with contemporary urban and environmental issues. Coastal and riverine ecology is a shared issue particularly salient today. The patents here are early examples of technologies that engaged the dynamics of coastal systems. This modular seawall from 1908 was developed to absorb wave energy, dissipate force, and resist the tendency of waves to overtop the wall. Similarly, the second patent by Gorgonio Uriarte of Spain was developed

to progressively divide the forces of wave energy in a diaphragmatic manner, cutting them horizontally and vertically into planes. It therefore mitigates storm surge.

Rich and illustrative templates also exist for water and energy autonomy, predating the wide-scale adoption of municipal and regional-scale infrastructures. One patent of particular interest to my research into ecological technology antecedents was patented by Cleaphas Monjeau in 1902. It's an early living machine,

Fig. 2

Mississippi River, in 1916 and 2013. On the left, 1916 photograph "Operation West 1135" (Little River Drainage District Records, Special Collections and Archives, Southeast Missouri State University), and, on the right, a 2013 photograph by North Lafourche Conservation, Levee and Drainage District.


(No Model.)

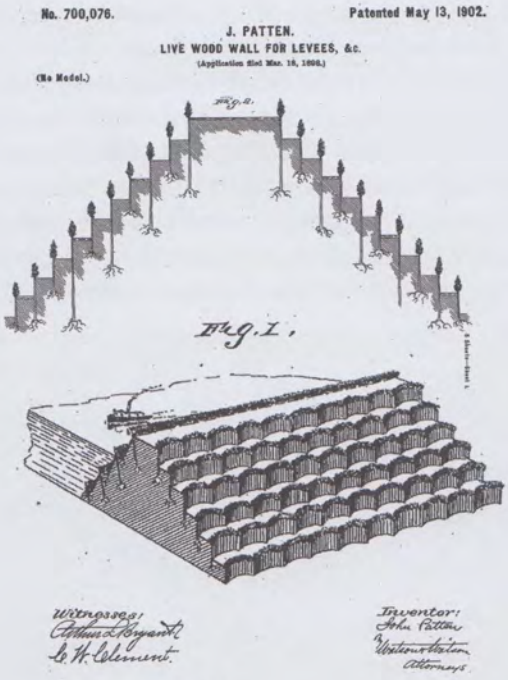
N. SEWELL.

Method of Relieving River Channels of Sediment and Forming Levees.

No. 235,967. Patented Dec. 28, 1880.

Witnesses

Inventor


No. 700,076. Patented May 13, 1902.

J. PATTEN.

LIVE WOOD WALL FOR LEVEES, &c.

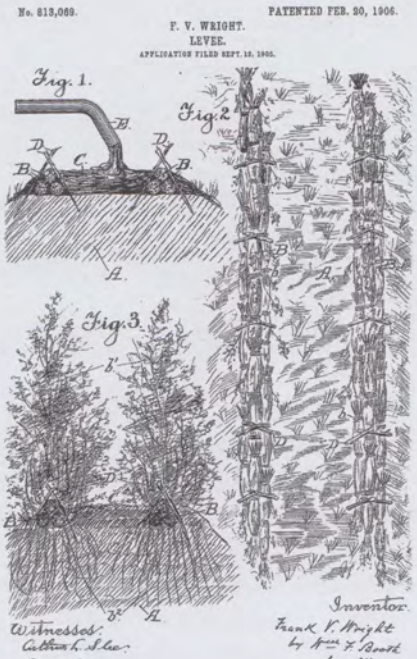
(Application filed Mar. 16, 1896.)

(No Model.)

Fig. 1.

Witnesses:

Inventor:


No. 813,089. PATENTED FEB. 20, 1906.

F. V. WRIGHT.

LEVEE.

APPLICATION FILED SEPT. 13, 1905.

Fig. 1.

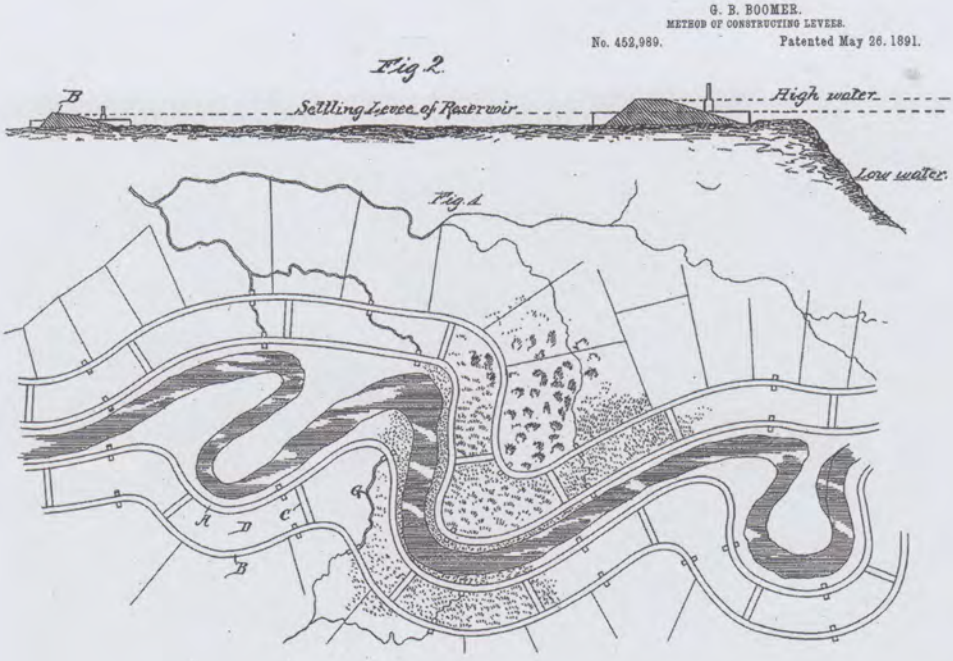
Fig. 2.

Fig. 3.

Witnesses:

Inventor.

Fig. 3 Examples of early levee technology (public domain)



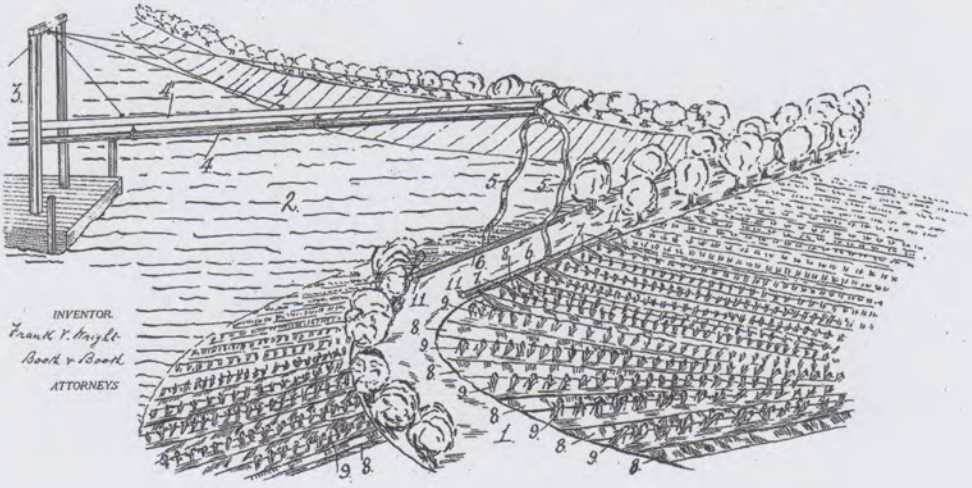
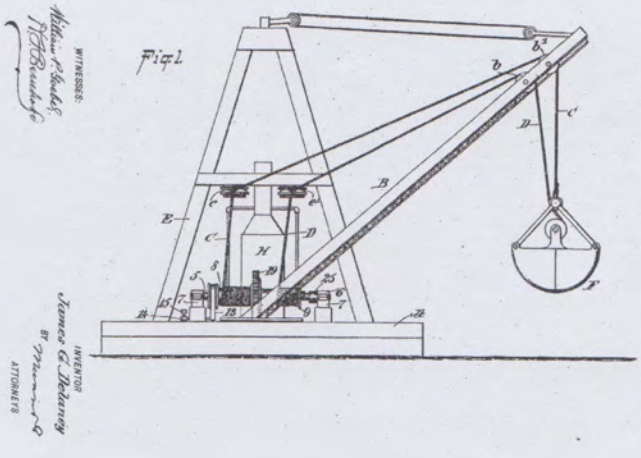


Fig. 4

Above, George Boomer's 1819 patent for a double levee system, and, below, Frank V. Wright's 1918 patent for levee construction through a cyclical process of cultivation (public domain)

Sacramento San-Joaquin Delta (Existing Levee System, Clam Shell Dredge)



No. 780,672. PATENTED JAN. 24, 1905.

J. G. DELANEY.

ENGINE FOR OPERATING CLAM SHELL BUCKETS.

APPLICATION FILED JUNE 26, 1902.

6 SHEETS—SHEET 1.

Fig. 1.

WITNESSES:

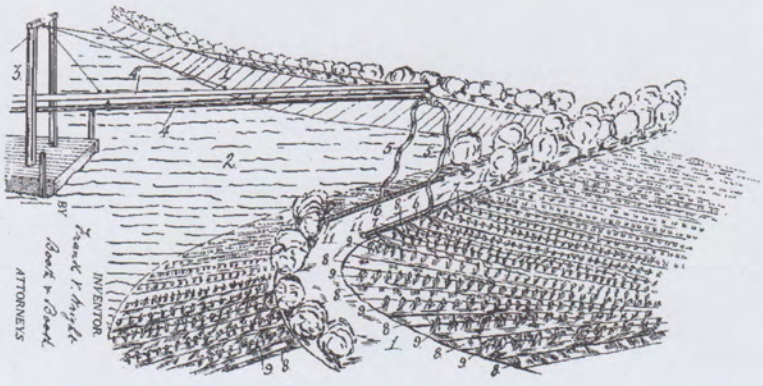
INVENTOR

James G. Delaney

BY

ATTORNEYS

Sacramento San-Joaquin Delta (Cultivated Levee System, US Patent 1,262,898)



1,262,898.

F. V. WRIGHT.

METHOD OF CONCURRENTLY MAINTAINING AND CULTIVATING LEVEES.

APPLICATION FILED DEC. 9, 1916.

Patented Apr. 16, 1918.

Fig. 5

On the left, the existing condition of California deltas, contrasted with a conceptual image of delta levees constructed with Frank Wright's 1918 technology on the right (original delta photograph by David Searls, rendering and composition by Richard Hindle using U.S. patents in the public domain)

W. SMITH.

SEA WALL, BREAKWATER, AND SIMILAR STRUCTURE.

APPLICATION FILED FEB. 6, 1908.

905,596. Patented Dec. 1, 1908.

2 SHEETS—SHEET 1.

Fig. 1.

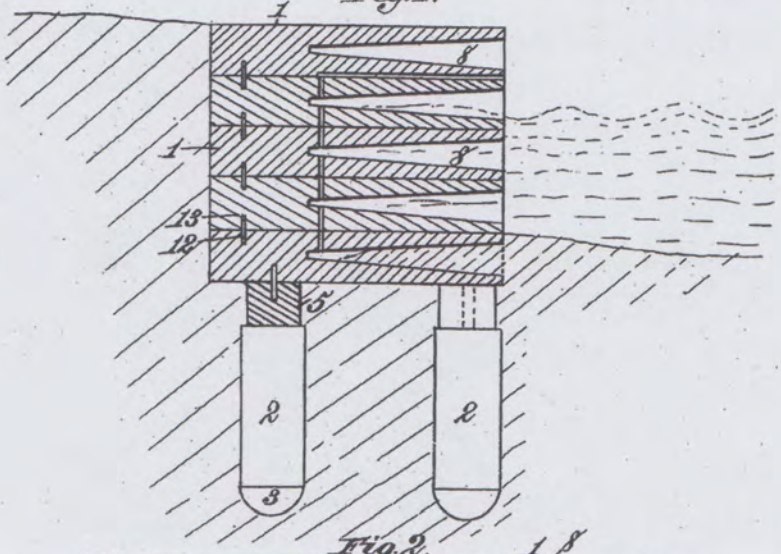
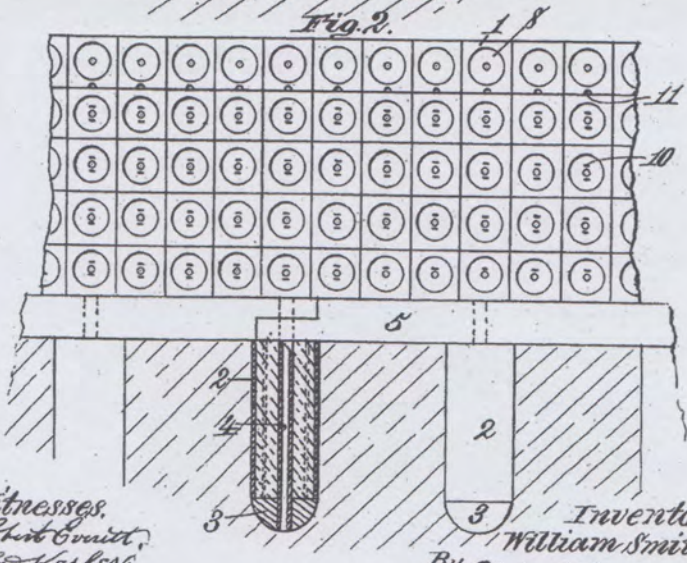


Fig. 2.



Witnesses.
Robt Emmet.
C. E. Keslar.

Inventor.
William Smith.
By Alvin L. Naumyer
Atty.

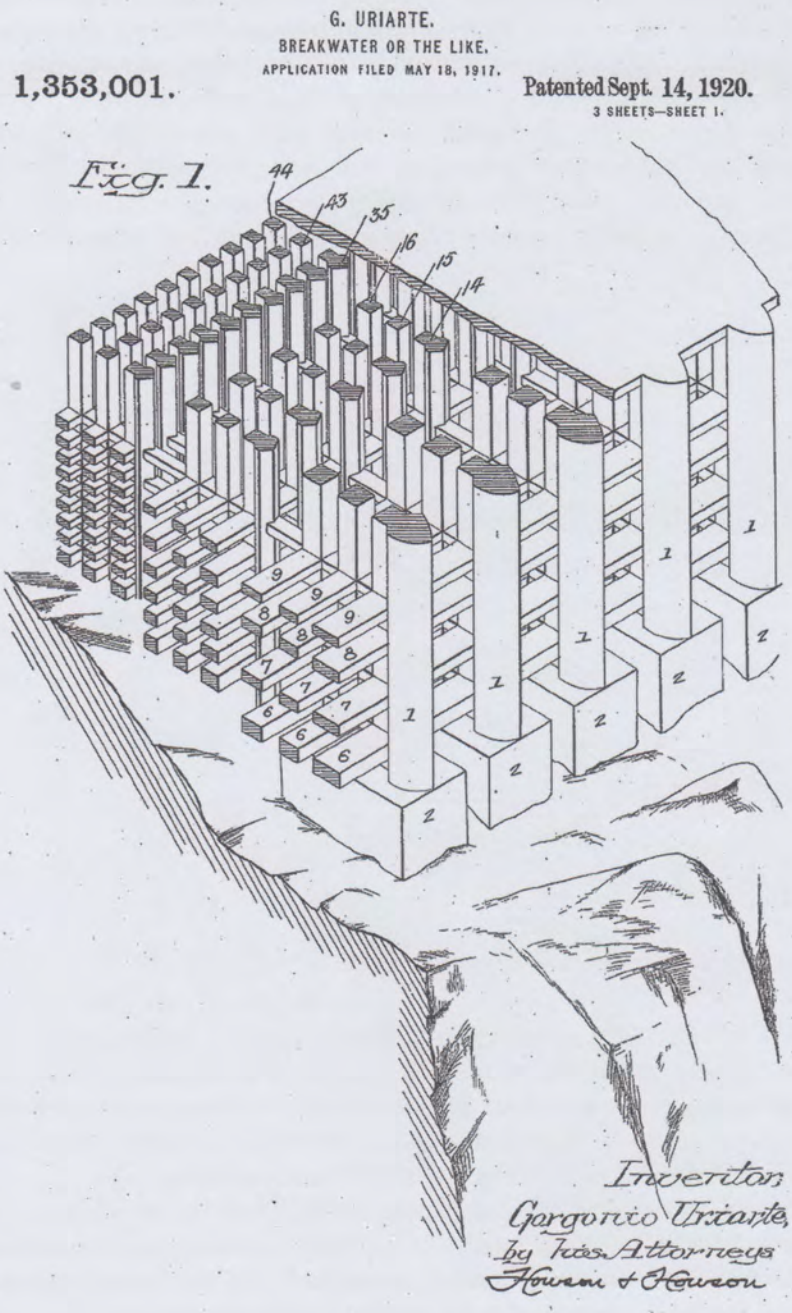
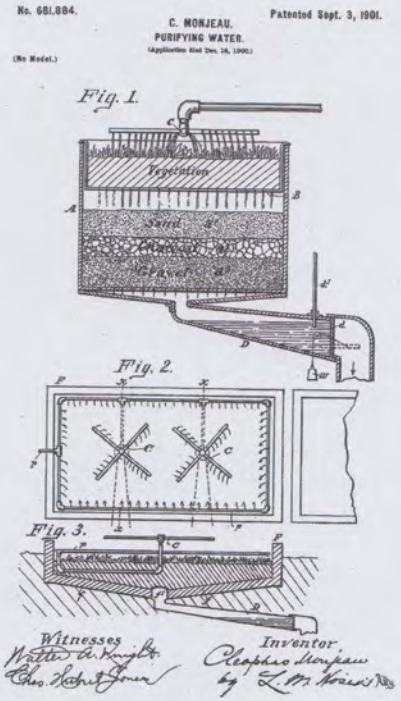


Fig. 6 On the left, the patent for a modular seawall, and, on the right, the patent for a breakwater structure (public domain)

a community-scale water infrastructure. Quoting from the patent, the system "is based on the discovery that growing vegetation under the proper circumstances extracts from water a class of bacteria injurious to the human organism." This patent predates the advent of the living machine, as we know it, by approximately seventy years. In my design research, I focus on ecological infrastructure and vegetated urban systems. The patents shown here are early examples of these technologies and prototypes for green infrastructure. I'm fascinated by these early sustainable and ecological technologies, not only for their prescience and tectonic novelty, but also for their bottom-up, or inductive, view of sustainability and ecological urbanism. The first patent for an engineered, lightweight green roof substrate was patented in 1886 in



Eldora, Iowa. A method for cultivating or anchoring trees to buildings and structures was patented eighty years prior to the construction of the Bosco Verticale in Milan, Italy. A vertical garden system was patented in 1938. Likewise, a permeable turf paver that promotes respiration of tree roots and allows for plant growth was patented in 1874, 130 years prior to the sustainable sites initiative.

The process of prototyping and patent development in response to environmental imperatives is ongoing today. In southern Louisiana, entrepreneurs and environmentalists are developing innovative technologies for coastal restoration in areas around the state where wetland loss is occurring alarmingly quickly, at a rate faster than one football field an hour. ReefBLK—developed by Mark H. Gagliano and his father, Sherwood M. Gagliano—is an early prototype for oyster reef

(No Model.)

C. C. GILMAN.

ROOF GARDEN.

No. 342,595. Patented May 25, 1886.

Attest:

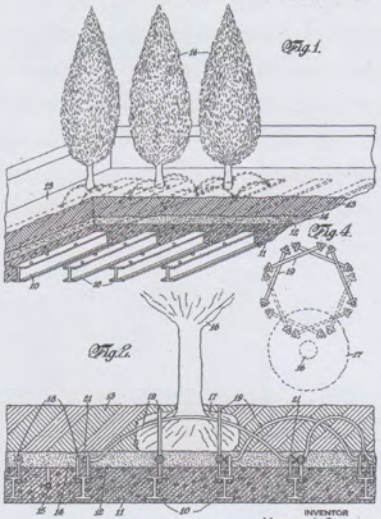
Inventor:

Chas. C. Gilman,

Aug. 30, 1932. M. L. CONDON 1,874,029

METHOD AND MEANS FOR ANCHORING TRANSPLANTED TREES

Filed Oct. 1, 1931 2 Sheets-Sheet 1



INVENTOR

MAURICE L. CONDON

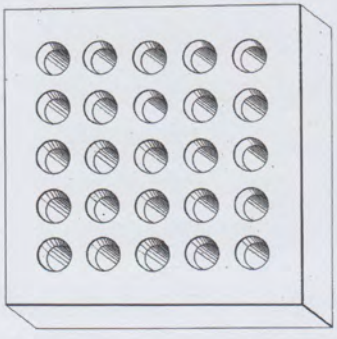
BY

ATTORNEY

J. C. GOODRIDGE, Jr.

Pavement-Blocks.

No. 148,818. Patented March 24, 1874.



Witnesses.

Henry H. Hall

Charles Wauters

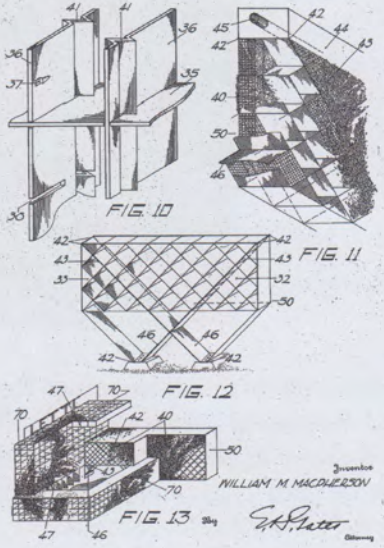
Inventor.

John C. Goodridge Jr

June 21, 1938. W. M. MacPHERSON 2,121,173

VEGETATION BEARING CELLULAR STRUCTURE AND SYSTEM

Filed April 4, 1939 4 Sheets-Sheet 3



Inventor

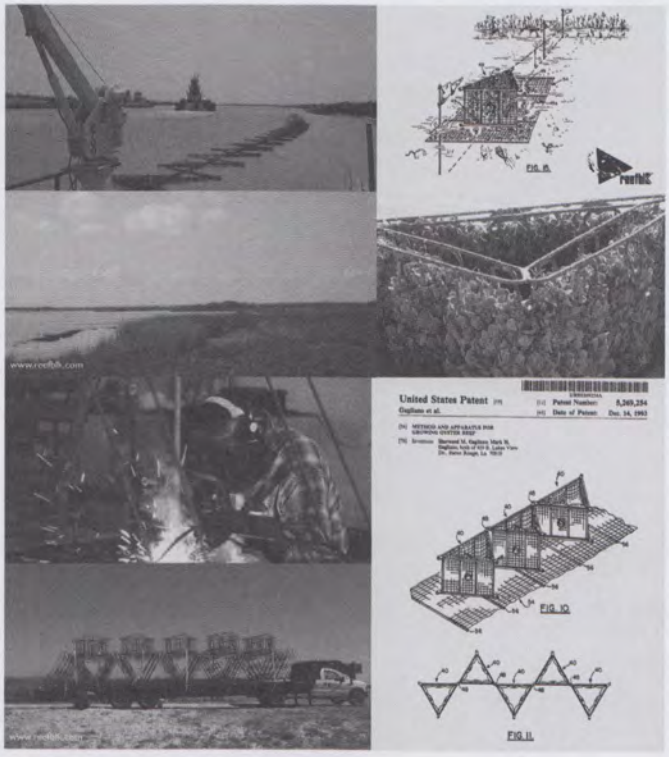
WILLIAM M. MACPHERSON

Fig. 7

(above) Clockwise from top left, the patents for Cleaphas Monjeau's green roofing system, anchoring trees, vertical garden, and permeable turf; (opposite page) his water infrastructure (public domain)

restoration and coastal reclamation, or "oyster-tecture," as we now call it. It was patented in 1992 and designed, fabricated, and built in Baton Rouge, Louisiana. The system utilizes a welded wire frame with internal lattice to hold up oyster shells in triangular voids. These voids are designed to allow free-flowing water exchange, with interior sections for sediment accumulation and with the intention that the resulting oyster colony becomes self-sustaining and continues to protect shores and accumulate sediment. The patent not only represents a viable solution to coastal restoration, but a bottom-up and business-friendly approach to sustainable environmental restoration.

Within the field of landscape architecture, one of the most important precedents of the designer-cum-inventor is Stanley Hart White. He was a professor of landscape

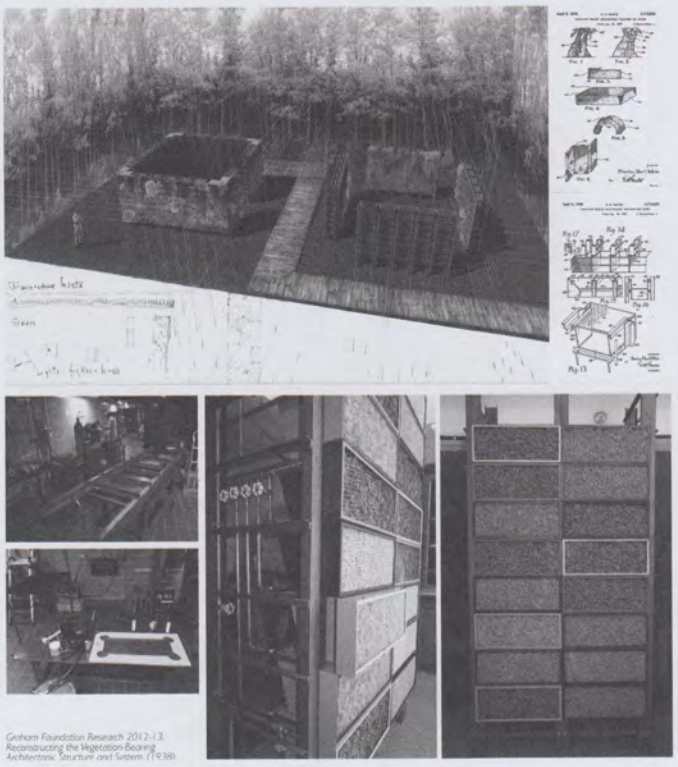


architecture at the University of Illinois from 1922 to 1959, the brother of E. B. White, and the inventor of the vertical garden. Stanley White patented the first vertical garden with integrated hydroponics in 1938 and theorized the garden topology in his unpublished 1931 essays. Some students and I produced the image here as a rendering of a speculative garden I designed and partially constructed using White's vegetation-bearing architectonic structure and system. One important part of this research, supported by the Graham Foundation, is to materialize or reify the origins

Fig. 8 A prototype for an oyster reef restoration project (ReefBLK, Mark H. Gagliano)

of the vertical garden topology. I physically reconstructed this patent to rework an important piece of garden history and to establish a historiographical method using the patent archive as an antecedent of emergent technology. In addition, I wanted to resuscitate an important precedent for the landscape architect-cum-inventor. The physical reconstruction of the patent from folded sheet metal, structural steel, hydroponic substrate, and copper was as much about the object as about the eighty-year gap between its original theoretical origins and its emergence in the built environment.

I want to end with this image, a patent granted to William M. McPherson, a student of White's at the University of Illinois. McPherson also worked at the U.S. Housing Authority, now HUD, under Professor William P. Crane, who bought an early

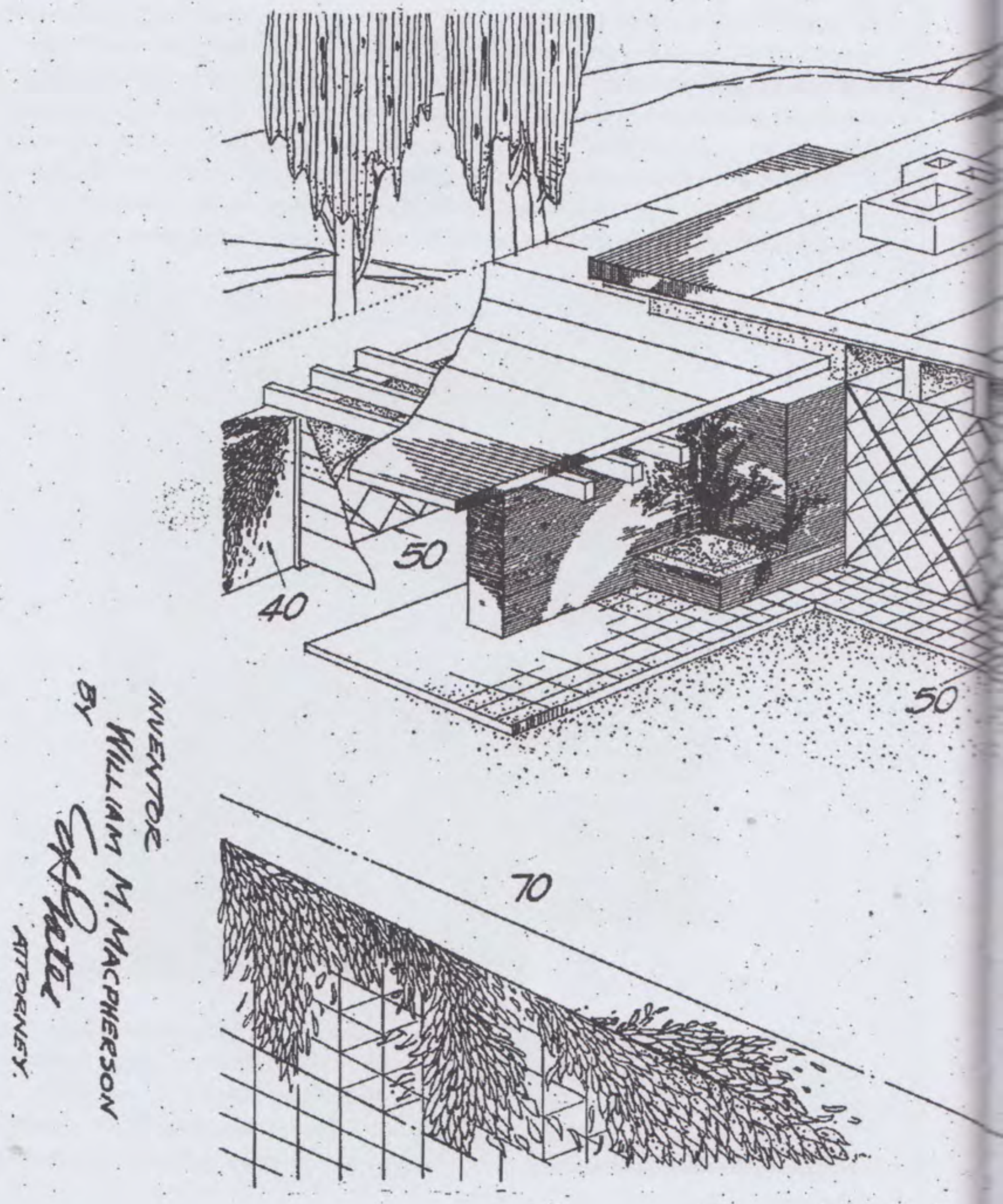


Graham Foundation Research 2012-13
Reconstructing the Vegetation-Bearing Architectonic Structure and System (1938)

prototype of White's vertical garden. This patent is a kind of cellular structure, if you will. It's a structural wall for a building type that allows for a substrate to be inserted and vegetation to grow over the building. What's interesting to me, in the context of this conference, is to imagine that, had the right policies, projects, and technology and social systems converged, maybe all of our buildings and infrastructure would be green today.

Fig. 9

Above, a rendering of the speculative garden with Stanley Hart White's original patent on the right, and, below, a constructed prototype of the speculative garden based on White's patent (Richard Hindle, with funding from the Graham Foundation)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INVENTOR
WILLIAM M. MACPHERSON
BY
ATTORNEY.

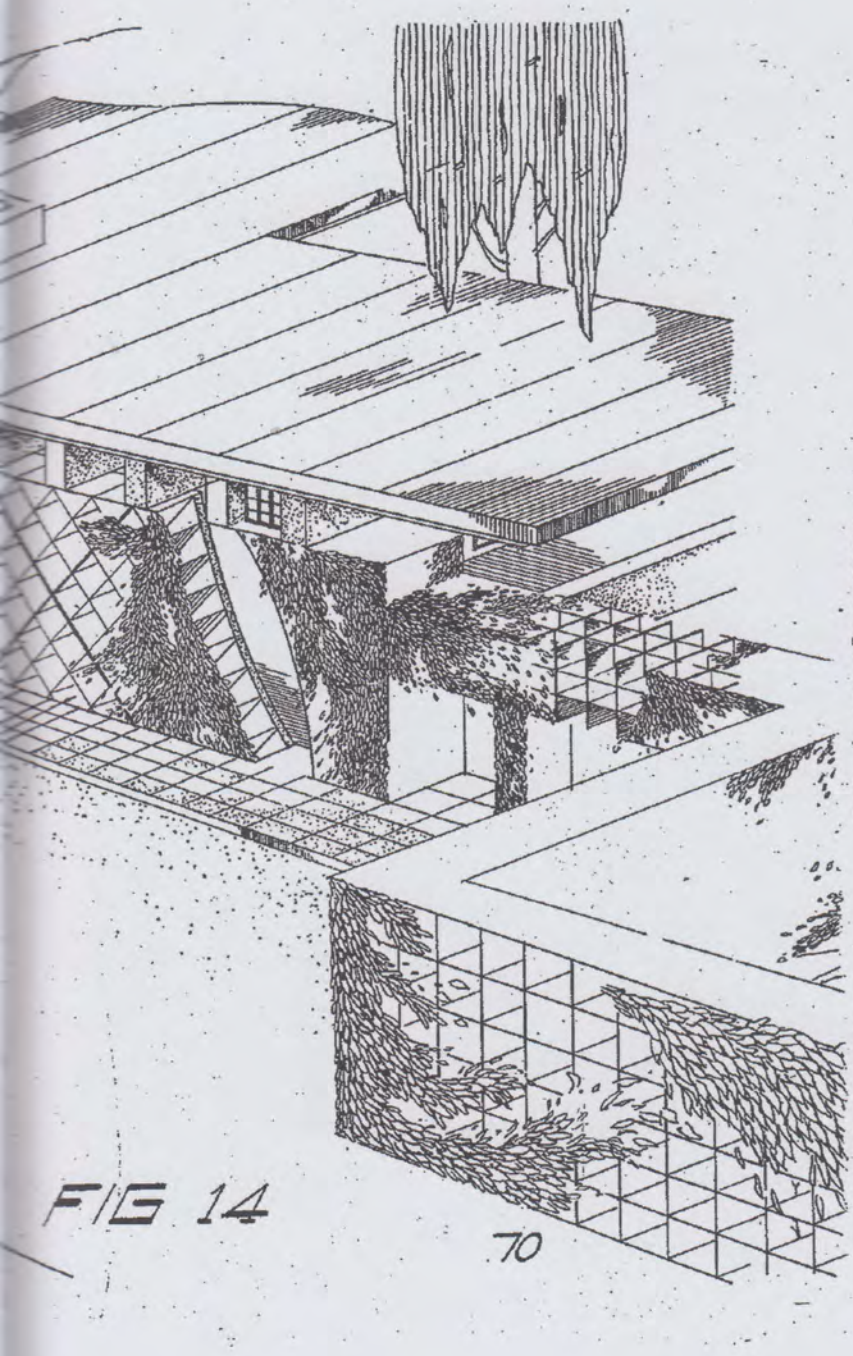

Fig. 10

William M. McPherson's patent for a vertical garden structure (public domain)

Q&A

Nancy Levinson I'd like to pick up on what Professor Wescoat just discussed: common threads and creative tensions. To me, it seemed that Richard Serino was talking about a resilient infrastructure approach focused on response and repair, based on his experience at FEMA. Richard Hindle was thinking about design and anticipation—design, anticipate, and then register your patent. Alfredo Brillembourg was thinking about adaptation and transformation—design and let it go. Finally, Adam Klaptocz was considering documentation, understanding, preparation, and prevention. This made me consider the fact that we know that it's easier to prepare for and *prevent* a disaster, yet in this country we tend *not* to prepare and instead wait to respond when the disaster happens. In other words, we're reactive not proactive. When Hurricane Katrina happens, we're there. However, during decades and decades of large-scale geo-engineering—which essentially made the disaster not only likely, but inevitable—we were not there. One way to frame this question might be, what's the scale and extent of prevention and responsibility? When there's a disaster, the people who are on the ground are asked most intensively to respond. They have to—there's no choice. Yet, arguably, all of us participate in the conditions that make these disasters likely to happen. If the kinds of cars we drive and houses we live in influence the ocean temperature, which causes sea rise, which causes Hurricane Sandy....You see where I'm going with this. What are the things we do every day on a personal scale that have global implications? That's really, really hard to contemplate, to factor into one's daily life. In this sense, it's easier to respond to a disaster that's looming rather than to a more pervasive set of conditions that's causing it to happen in a kind of slow motion—to climate change, say. Alfredo, your phrase was "last-round ecology." How do we make the slow-motion disaster that develops over decades more visible?

> Richard Serino Well, it does come down to the individual. However, I think it's important that the community starts to realize that preparation and prevention actually has a long-term impact. One of the first steps, then, is to listen to the community. But leadership should also educate the community as to where they can and should not build and show that if they build in the correct way, it will have a huge long-term effect. There are countless examples, up and down the East Coast, but also inland in areas that flood routinely.
>
> In this country, you can predict most of the flooding that will happen. I can tell you now, with pretty good certainty, what areas will flood the next four months from the heavy snowmelt. But continually, communities rebuild in those same locations. However, if we give them good alternatives... That's where the people in this room come in. They can help us rebuild in a smarter way.

Levinson Is that where your drone maps come in, Adam?

Adam Klaptocz Absolutely. I think awareness is always the first step, especially from my recent experience in places that don't have the same media access as we do here in the United States. It's important to go out to the communities and explain to them what you're doing. For example: You're in this riverbed. You've been flooded all the time. What can you do to not build that close to the riverbed? What can we do to help? What can you do to not cut down all the trees in certain areas or to replant trees in certain areas to protect yourselves from flooding one to two kilometers down the riverbed? This process starts with having a map and realizing that because you're cutting down trees over there, it's giving you problems down here.

Richard Hindle Thinking about the patent archive as a historical source, I'm always trying to contextualize it in terms of current practice. Being in southern Louisiana, what's been fascinating to me is that there's a very potent ecosystem of entrepreneurs responding to large-scale problems, like sea-level rise, land loss, and disappearing wetlands in coastal Louisiana. There are master plans in response to that, but also a business community poising itself to profit. Businesses are creating innovative solutions to be applied to these new environmental disasters or the ones that are already happening.

This is a technological response to environmental imperatives, but it's occurring at an intermediate scale. A lot of these companies are start-ups, like the oyster-tecture initiative collaborating with the Nature Conservancy. I was at two recent conferences in Louisiana, both dealing with entrepreneurship and coastal issues. People are responding to these challenges and attempting to scale their solutions. I definitely agree that innovation should be open source in an idealized environment. However, there's also this opportunity to capitalize on the existing models in this country that drive innovation. It's an interesting debate. However, I think that the business model has the potential to scale up, like we've seen with other kinds of businesses.

Levinson This raises a question. As I understand, one of the reasons why so much of the Gulf of Mexico is hypoxic—that is, dead—is because of agricultural fertilizers used on farms throughout the Midwest, which are washed down the Mississippi and flow into the Gulf. How could you extend the scale of responsibility for the Gulf of Mexico to the industrial agriculture happening up the river? It's a well-known problem, yet we have trouble linking these things in action, in policy.

Hindle Most definitely. There's a grand challenge at Tulane University that is offering a million-dollar prize to anybody who can solve the hypoxic problem in the Gulf. It's an upstream problem. Tulane is

located in New Orleans, but they'll give $1 million to whoever solves it. They're looking for a device. The solution is also probably going to involve policy and strategic planning. But they want a technology that's deployable at scale. This challenge is a fascinating way to be entrepreneurial. I don't know why it's happening in Louisiana. It might be the state's deep Republican roots and/or its kind of bottom-up, business-friendly atmosphere.

Alfredo Brillembourg Jim's response to our talks was amazing. I admire the subtlety with which he was able to lace all of our speeches together. To me, sharing is at the core of all of this: sharing information and talent, developing new networks. We have the Internet, the great social revolution now, which is made to share. However, we haven't figured out how to turn that revolution into action. My proposition is illuminated by the Schindler Corporation, which owns lots of patterns next to Otis. Schindler said, we're not going to spend thousands of dollars fighting patents anymore. Forget it. The most important thing is who implements first. Universities are the place to incubate everything. Then, let's bring the NGOs, corporations who want to make money, and political actors together. I think architects have been wrongly left out of public policy, because they are very good integrators of disciplines. So, the new model is the universities acting as idea incubators. They bring the actors together and share knowledge across them. Then the ideas are open source, and whatever company takes them and implements them fastest makes money.

Audience Member #1 My company is investing in agriculture in Africa. Scale is needed for efficiency and food security. I wanted to ask about resilient infrastructure. I have an expatriate Western farm management team that works very closely with our local employees. Everybody gets malaria and is exposed to diseases. A young staff member just had a motorcycle accident on a mud road. To me, resilient infrastructure can be reactive, but really needs to be proactive. I am interested in the twenty-first-century mud hut, if you will, that can be built for under $1,000 and mitigate those diseases, whether mosquito/insect or water borne. With clean water and insect protection, you could start to stem the damage from disasters, slum or rural.

Brillembourg I'll respond quickly. We have a show going on in Zurich right now of our Empower Shack. In Khayelitsha, South Africa, there

are a million slum dwellers that the government wants to move to RDP housing. However, they're missing 2.4 million units. So what people really need is an upgrade of their current shack. The Empower Shack includes some innovations on your basic mud hut. The shack is lifted off the ground, so if the area floods, it doesn't flood inside the house. It can be two floors. It costs a little more, but then the residents can rent one room or one floor or start a business. To help with the cost, the lots are smaller than usual. Many people think that Africa will turn into sophisticated hubs, with drone center fly-in and distributed technology, but the rest will be mud huts and organic growth, because no one will be able to tackle that vast continent in a consistent and speedy way.

Hindle I don't know too much about mud hut construction. However, in regard to thinking about the patent archive as a source of innovation in response to humanity's needs, the Patent Office recently had an initiative called Patent for Humanity. They dropped all the fees and made all of the information open source to stimulate innovation. I would recommend getting in contact with politicians that can help innovate, and then using that bottom-up resource and human creativity to start generating ideas. If sustainability and resilience are the problems of the future, we can use the embedded government policies that exist in this country to stimulate innovation. What's interesting about the patent archive is it's an outlier to architecture and landscape. One reason we don't know about some of the technologies that I've shown is they haven't necessarily been part of the core discussion in these fields. We can use the archive as a heuristic and a teaching tool while also moving some of these innovations forward. Whether or not we profit from them is irrelevant. They're there, and they can help us solve problems today.

Audience Member #2 In regard to your new open-source methodology, how do you propose to deal with the possible reality that the innovators are not necessarily the best people to implement? It could be two different typologies.

Klaptocz Open source versus closed source is a tough question. In engineering, open-source can be great. Of course, companies may not be willing to invest millions of dollars into developing technologies that anyone can copy. They want to protect their investment. So I'm not sure. The system you have now is develop it, sell it, and then, once it's paid for (twenty years), go open source. That's where patents

Audience Member #3 Here we're talking about people. To what extent do you see people getting used to the idea that infrastructure doesn't have to be the big, gray, ugly things that Robert Moses rammed through their neighborhoods, but rather part of their neighborhoods?

Brillembourg Two ideas. One, people are infrastructure. The other is about a neighborhood in Holland. Holland has to build polders or dikes all the time. You remember the famous image of the little boy putting his finger in the dike because it's leaking? The polder is an infrastructure. However, it also encompasses an around-the-clock system in which people watch over water levels. The responsibility unites the community. What is the historical effect? They have a discussion and debate system in Holland.

Serino It's key for people in their neighborhoods to be part of that. I'm going to go back to neighborhoods again because they're important. If you listened to Mayor Emanuel and the Flint mayor [Walling] this morning, they said that one of the key things they need is city parks. They also talked about libraries, public safety, public schools, and public transportation. Parks are infrastructure. So, in Boston or Flint, people have the opportunity to see how infrastructure can be attractive in their neighborhoods. Once people realize this, they will demand the infrastructure. Designers can help educate them.

Hindle I think landscape architects are doing a great job of rebranding and reimaging green and biophilic infrastructure. I'm fascinated by the image making coming out of the field and believe it's propelling things forward. I'm interested in the disconnect between the technology and the vision. The more landscape architect/designer-cum-technologists we have, the better it will be. There's a disconnect between image and reality. I don't care how we connect these, but we should. It will improve the visual quality of our cities and the perceptions of infrastructure.

Klaptocz From my experience in the field, people have a desire to take part in their communities. From my point of view, data is always the first step. We worked on the outskirts of Lima, Peru, where new communities are being built in the hills above town with no infrastructure. They can't wait for the big-city government to come build their roads and infrastructure because it's not going to happen. They're on the outskirts, and they're the poor. However, as soon as you fly a drone and make a map and give it to them, the entire community floods in

and says, "Listen, we're going to do this ourselves. This is our town." We see this time and time again. As long as the community doesn't have the data or the means, they can't do anything. If you empower them with data and show them how they can help themselves, they're ready to do it. In the Philippines, we were there with an NGO called Medair. They build shelters. So they went to the south of Tacloban, where 80 percent of the housing was destroyed. The government wasn't coming in to help them rebuild. Medair doesn't come in and rebuild for them, either. Instead, they go in and do half the work. They do intelligent architecture. They put in a cement footing and smart roof so the structure can resist the next typhoon, but they don't build the rest. It's up to the person for whom they built it to do the rest. What's interesting is that this process takes longer. However, it is based on what they learned years ago in Haiti. They came in six months after a disaster and found that some houses were completely destroyed while others were less destroyed. The inhabitants in both houses might have been just as poor, but the people in the less-destroyed houses spent the last six months rebuilding, while the other people didn't. Typically, however, the people with the more-destroyed houses got new ones, while the people who did all this work didn't. The new model is to get people to help themselves: give them data, visualization tools, and house plans, build half of their houses for them, but let them do the rest. You get surprising results. Some people put in walls, a little veranda...They're creative and involved in rebuilding themselves.

Brillembourg Urbanism is frozen politics, so architects have to get into politics. During the 1960s and '70s, architects were engaged in public policy and social housing. However, that was lost when everything went to the private sector. I think architecture has to get more social and political again. But it has to get more active on the ground. The days of waiting for a phone call from this client in the office are over.

Audience Member #4 I'd like to thank Richard Serino for bringing up the issue of people first. In my mind, it's a theme that ties all of this together. We are talking about the resiliency of human resources. To me, as a government employee, the biggest thing that we're reacting to is the damage that some of our well-intentioned institutions and policies have caused the human spirit: making people feel like they don't have control over their future. I think some of the slum projects represent efforts to provide people with a change in vision. I think that is the challenge going forward: to be careful with

our policies and institutional development and respect their impacts on people's self-perception.

Brillembourg I think we do have a responsibility to the global South, because the North has been complicit in what's happened.

Alan Berger Mr. Serino, I was very happy to hear you talk about individuals, neighborhoods, and bottom-up change, because resilience is normally heavily top down. One thing we're impacted by here in Boston is the recent release of the FEMA flood maps, which have been criticized as politically motivated, heavily handed down, and not really able to adjust flexibly over time. In addition, they come out at too-far intervals of time to be helpful. With you here, as well as others with nimble technology, I was wondering if you could give us a candid assessment of the flood maps: the problems with them and/or new ways to do them that could be more helpful.

Serino Just to be clear, I'm not at FEMA anymore. The flood maps are actually mandated by Congress under the National Flood Insurance Program. They are there to educate people about the risks in their neighborhoods, cities, and counties. They're not just done for Boston or Massachusetts, but the entire country. There is somewhat limited budget, so the team does the best that it can. It's not up to FEMA to determine the amount of money that is given for the mapping process. That's also set by Congress, so there is some politics involved. The process is done by engineers that FEMA hires in the different areas, not FEMA. People overreact, not so much because they're in a flood zone, but because of the repercussions: they have to buy flood insurance. The issue is, do you want to have a flood insurance system like every other insurance system, in which people in various areas pay their share based on the risks in these areas? The uproar came when people were charged the market rate. The rate was set by Congress, which then repealed it because of the outcry.

Berger Can you imagine a new and better way to do this in the near future? For example, one thing we dealt with during the Hurricane Sandy Rebuild by Design project was the fact that the most vulnerable housing and socially vulnerable populations are in places where the maps have determined they need insurance.

Serino I think you always can do better. However, I think it also comes down to where people build. Not just individuals, but also the government. The flood maps just give an engineer's view of what will flood. Some people say the flood line should be five feet this way or five feet that way. But it's an estimate of what will happen. Ultimately, the goal is to advise people what their risk is based on where they live.

The insurance part is a separate issue. As far as Boston, they've taken the flood maps seriously in developing plans, because if Sandy had gone just a little more to the east and north, Boston would have been severely affected.

Brillembourg However, you're right about drones and mapping. They are political instruments. They can be used both for benefit and not. If we declare a slum a flood zone, it can be automatically erased—bulldozed—after residents are evicted. That's been happening in India a lot—in Mumbai, for instance. It's a double-sided coin.

Contributors

Sonja Beeck works as a consultant for local authorities on questions of urban development, such as IBA Berlin 2020, Nuremberg, and Bremen. Together with Detlef Weitz she is also CEO of Chezweitz, a scenography firm based in Berlin. She was previously a member of the academic staff of the Bauhaus from 2000 to 2010; she worked there for the long-term laboratory IBA STADTUMBAU 2010 and was responsible for the project development, managing many projects and inventing new spatial development strategies for regions with shrinking populations. She has also taught "City and Landscape" at the University of Innsbruck (2006–8). After the final exhibition of IBA STADTUMBAU 2010, she taught "Urban Development and Management in the International Context" at the University of Kassel, Germany.

Lorena Bello Gomez is lecturer in the department of architecture at MIT, where she teaches students fundamentals of design of the built environment, ranging from the scale of the object and buildings to that of the city and larger territories. She is also a doctoral candidate in urbanism at the Technical University of Catalonia (UPC). Bello Gomez's research focuses on large-scale territorial implications of infrastructure and urbanization as catalysts for design. Her dissertation on this topic began under the guidance of the late Manuel de Solà-Morales and is concluding under Joan Busquets of the Harvard Graduate School of Design. She is also the founder of TERRALAB, in association with MIT's Center for Advanced Urbanism, which aims to continue this research with projects in the United States and Europe.

Alan Berger is professor of landscape architecture and urban design at Massachusetts Institute of Technology, director of P-REX lab at MIT, as well as research director of the MIT Center for Advanced Urbanism. All of his research and work emphasizes the link between our consumption of natural resources and the waste and destruction of landscape to help us better understand how to proceed with redesigning around our wasteful lifestyles for more intelligent outcomes. His most recent publications include *Systemic Design Can Change the World* and *Landscape + Urbanism Around the Bay of Mumbai* (with Rahul Mehrotra). He is a Prince Charitable Trusts Fellow of The American Academy in Rome.

Alfredo Brillembourg is the founding partner of Urban-Think Tank (U-TT) in Caracas, Venezuela, and since 2007 has been the chair for Architecture and Urban Design at the Swiss Institute of Technology (ETH) in Zurich. His research and practice focus on both theoretical and practical applications within architecture and urban planning. Working in global contexts by creating bridges between First World industry and Third World informal urban areas, his work focuses on the education and development of a new generation of professionals who will transform cities in the twenty-first century. He was recently awarded the 2012 Holcim Global Silver Award for innovative contributions to ecological design practices and the 2012 Golden Lion Award in the thirteenth Venice Architecture Biennale.

Richard Hindle is assistant professor of landscape architecture at the University of California, Berkeley. Hindle's research focuses on technology in the garden and landscape with an emphasis on material processes, innovation, and patents. His current research explores innovation in landscape-related technologies across a range of scales, from large-scale mappings of innovation in riverine and coastal patents to detailed historical studies on the antecedents of vegetated architectural and ecological systems. He received a Graham Foundation Award for the reification of the "Vegetation-Bearing Architectonic Structure and Systems" in 2012 and continues to explore the technological origins of other emergent technologies through fabrication, writing, and mining of the patent archive.

Scott Kennedy is former codirector of The Dalai Lama Center for Ethics and Transformative Values at the Massachusetts Institute of Technology, where he was responsible for overseeing program development and operations. Prior to joining the Center, he worked with MIT to establish two new research universities in Malaysia and the United Arab Emirates. Trained in engineering sciences with a doctorate from Harvard University, his research has focused on the investigation and design of complex physical and organizational systems. Kennedy acts as an adviser on various international projects related to sustainable energy and development in Asia, the Middle East, and Africa.

Adam Klaptocz is the Head of Hardware and Mechanical Engineering at senseFly SA. He is passionate about civilian drones and their potential to do good for our planet and all its inhabitants. He splits his time between the R&D department at senseFly, developing the latest generation of drones for the GIS and mapping sectors, and Drone Adventures, traveling the world and flying drones for good causes. His passion was born during his PhD work at EPFL in Switzerland, where he designed several iterations of the AirBurr, a flying robot designed specifically to bounce off obstacles in crowded environments. His goal is now to bring drones out of the lab and into the hands of the people that need it the most, whether in humanitarian aid, conservation, or industry.

Ken Laberteaux is Senior Principal Scientist for the Toyota Research Institute of North America in Ann Arbor, Michigan. In his nineteen years in the automotive and telecommunication industries, Laberteaux has produced twenty-five scholarly publications, eight patents, and fourteen additional invention disclosures. Ken's current research focus is sustainable mobility systems, including grid-vehicle interactions, vehicle electrification feasibility, security and privacy issues of the smart grid, battery-lifetime modeling, and U.S. urbanization and transportation patterns. Earlier in his time at Toyota, he worked on advanced safety systems, leveraging synergies in communication, sensing, and computation.

Judith Layzer investigates the role of ideas—including scientific, economic, and political ideas—in environmental policy making. She also analyzes the efficacy of local and regional environmental policies and policy-making processes. Currently, in collaboration with the Urban Sustainability Directors' Network, she directs the Urban Sustainability Assessment (USA) Project, an effort to determine what kinds of urban sustainability programs yield genuine environmental benefits. In addition, Layzer is the author of *The Environmental Case: Translating Values Into Policy* (CQ Press), now in its third edition; *Natural Experiments: Ecosystem-Based Management and the Environment* (MIT Press); and the forthcoming *Freedom, Efficiency, and Environmental Protection: Conservative Ideas and Their Consequences* (MIT Press).

Nancy Levinson is editor and executive director of *Places* Journal, an award-winning journal of architecture, landscape, and urbanism, published in partnership with Design Observer. Levinson brings to her editorial work experience in academia and practice, most recently as the founding director of the Phoenix Urban Research Laboratory at Arizona State University and as co-founding editor of *Harvard Design Magazine* at the Harvard Graduate School of Design. Nancy is a frequent design juror and lecturer and has contributed to diverse academic and trade periodicals, including *Architectural Record*, *Landscape Architecture Magazine*, the *Journal of Planning Literature*, the *Journal of the Society of Architectural Historians*, *Perspecta*, *The Architect's Newspaper*, and *Metropolis*.

Miho Mazereeuw is a landscape architect and architect and taught at the Graduate School of Design at Harvard University and the University of Toronto prior to joining the faculty at the Massachusetts Institute of Technology. She is also codirector of OPSYS, whose work focuses on disaster reconstruction and prevention, and is currently working in Haiti, Japan, and Chile. As an Arthur W. Wheelwright Fellow, she is completing her forthcoming book, entitled *Preemptive Design: Disaster and Urban Development Along the Pacific Ring of Fire*, featuring case studies on infrastructure design, multifunctional public space, and innovative planning strategies in earthquake-prone regions. Her design work has been exhibited at the Architect's Museum in Tokyo, Japan, University of Texas, Austin, and de Ark Architecture Center in Leeuwarden, Netherlands.

Lawrie Robertson is a strategic planner, urban designer, and architect with experience in strategic regional and city planning, international development, and urban and building design. Robertson joined Happold Consulting in 2006 as Head of Strategic Planning, leading multidisciplinary city-regional planning, urban development, and infrastructure projects. His work has included the twenty-year strategic plan for Detroit, Michigan; Berezniki Solikamsk Usolye Region Masterplan, Russia; King Abdullah Research City for Atomic and Renewable Energy (KA-CARE); the Masterplan Framework for King Khaled International Airport City in Riyadh; the Hercogiste Eco City project in Latvia; and the Gothenburg River City Regeneration project in Sweden, as well as other new city projects in the Middle East, Asia, and Europe.

Brent Ryan is associate professor of urban design and public policy in MIT's Department of Urban Studies and Planning. Ryan's research focuses on emerging urban design paradigms with a particular focus on postindustrial cities and neighborhoods. His book *Design After Decline: How America Rebuilds Shrinking Cities*, was published in 2012 by the University of Pennsylvania Press and was selected by *Planetizen* as a Top Ten Book of 2012. Ryan has published in edited volumes including *The City After Abandonment* and the *Oxford Handbook of Urban Planning*, as well as in the *Journal of Urban Design*, *Journal of the American Planning Association*, *Urban Morphology*, *Journal of Planning History*, and *Urban Design International*.

Richard Serino was appointed by President Obama and confirmed by the Senate as the Federal Emergency Management Agency's Deputy Administrator in October 2009. In this role, he worked directly with Administrator Craig Fugate to promote the "whole community" approach to emergency management, which seeks to build, sustain, and improve the department's capacity to prepare for, protect against, respond to, recover from, and mitigate all hazards. Serino strived to improve FEMA programs and emergency management by hearing directly from disaster survivors, communities, and FEMA employees. These improvements are focused on emphasize financial accountability, improving the use of analytics to drive decisions, advancing the workforce, and fostering a culture of innovation. Under his leadership, FEMA has championed initiatives such as FEMA Corps, FEMA Stat, the FEMA Think Tank, a detailed budgetary process, and a Disaster Workforce Transformation.

Daniel Sperling is professor of civil engineering and environmental science and policy, and founding director of the Institute of Transportation Studies (ITS) at the University of California, Davis. He is recognized as a leading international expert on transportation technology assessment, energy and environmental aspects of transportation, and transportation policy. He has testified ten times to the US Congress and state legislatures and provided keynote presentations and invited talks in recent years at international conferences in Asia, Europe, and North America. In the past twenty-five years, he has authored or co-authored over two hundred technical papers and eleven books, including *Two Billion Cars* (Oxford University Press, 2009). In June 2013, he was named a recipient of the Blue Planet Prize from the Asahi Glass Foundation.

Paola Viganò is an architect and urbanist. She has a PhD in architectural and urban composition and is a professor of urbanism at the Università IUAV of Venice. She is also a guest professor at several European schools of architecture, including the Catholic University of Leuven, EPFL Lausanne, Aarhus, and the Harvard Graduate School of Design. She serves on the board of the European Masters of Urbanism program (EMU) and is coordinator of the PhD program in Urbanism at IUAV. In 1990 Viganò founded Studio with Bernardo Secchi and has won several international competitions. In 2008 Studio was one of the ten teams selected for the Grand Paris

research project and was shortlisted in 2012 for the New Moscow project. Her major publications include *La città elementare; Territori della nuova modernità; Antwerp: Territory of a New Modernity* (with Bernardo Secchi); and *I territori dell'urbanistica*, recently translated into French.

Dayne Walling is serving his second term as Mayor of the city of Flint, Michigan. His vision of a sustainable twenty-first-century community has attracted new investments and energy to the difficult challenge of turning Flint around. He is committed to creating new jobs, making neighborhoods safe, and supporting great schools in Flint and across Michigan. Under his leadership, the city of Flint has adopted its first comprehensive master plan in more than fifty years. Mayor Walling serves on the executive committee for the Michigan Economic Development Corporation and is chairman of the national Manufacturing Alliance of Communities.

James Wescoat is the Aga Khan Professor in the Aga Khan Program for Islamic Architecture, in the Department of Architecture at the MIT. His research has concentrated on water systems in South Asia and the United States from the site to river-basin scales. For the greater part of his career, Wescoat has focused on small-scale historical waterworks of Mughal gardens and cities in India and Pakistan. At the larger scale, he has conducted water policy research in the Colorado, Indus, Ganges, and Great Lakes basins, including the history of multilateral water agreements. With the Water and Power Development Authority (WAPDA), he led a USEPA-funded study of potential climate impacts in the Indus River Basin in Pakistan. More recently, he led an NSF-funded project, "Water and Poverty in Colorado." He is currently conducting comparative research on international water problems. In 2003, he published *Water for Life: Water Management and Environmental Policy* with geographer Gilbert F. White (Cambridge University Press).

Jinhua Zhao is the Edward H. and Joyce Linde Career Development Assistant Professor of Urban Planning at the Massachusetts Institute of Technology's Department of Urban Studies and Planning. He holds master of science, master of city planning, and PhD degrees from MIT and a bachelor's degree from Tongji University. He studies travel behavior and transportation policy, public transit management, and China's urbanization and mobility. He sees transportation as a language to describe a person, to characterize a city, and to understand an institution. His current project examines the interaction between policy making by governments and behavioral response from the public in the context of China's urban development. He very much enjoys working with students.