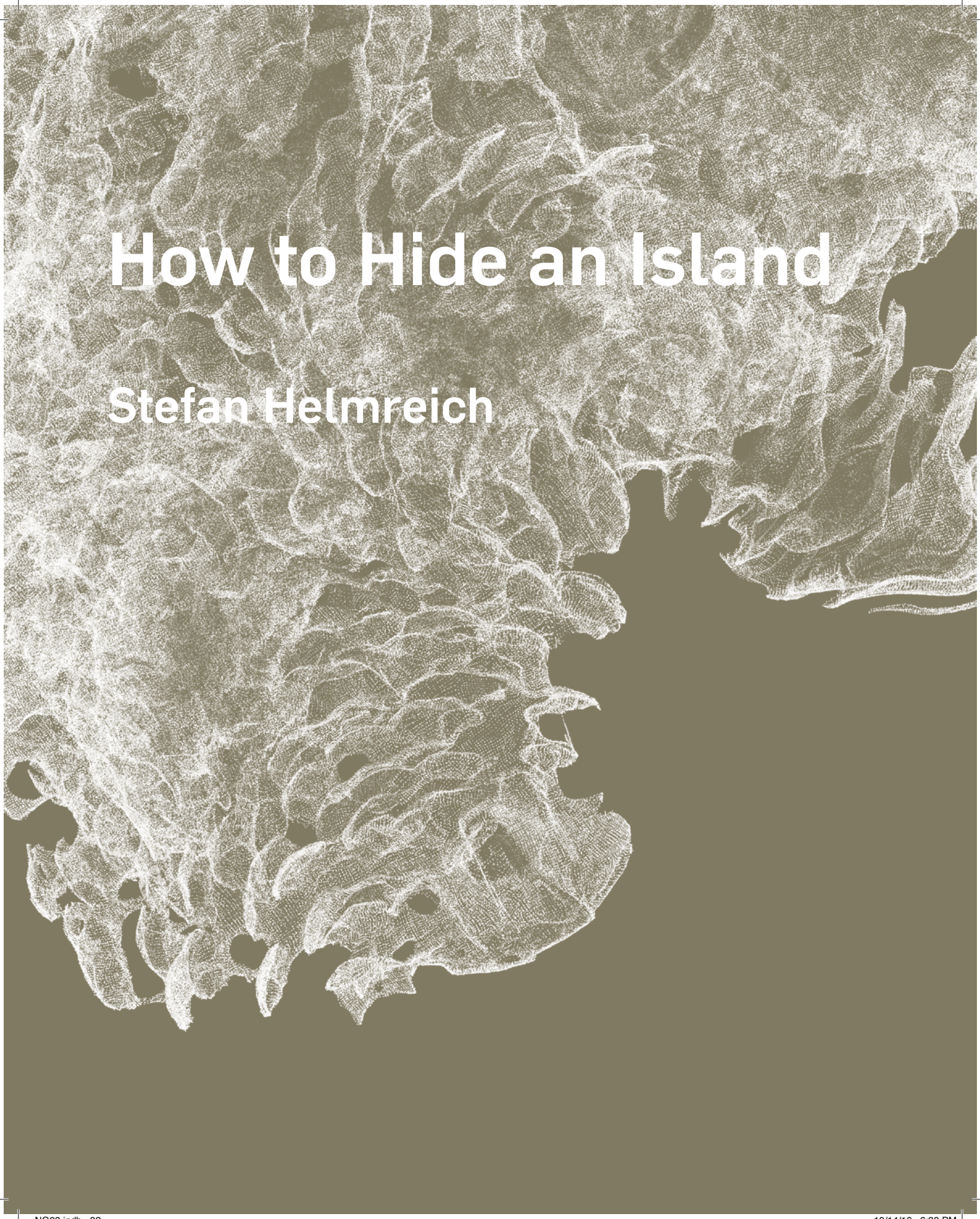


How to Hide an Island

Stefan Helmreich

What happens when waves, moving across the sea, encounter an island? In the language of physical oceanography, wave fronts refract, bending as they approach an island, owing to underwater contours that signal shallowing water depths. Waves also diffract, curving around islands, as around obstacles. The interference patterns that result are sorts of shadows—rippling phantoms that outline or point inward toward the islands that create them.[01]

The structure of such shadows can enter navigational apprehension in a range of ways, from naked eye assessments to radar renderings. One notable capture of wave shadows comes in the form of Marshall Islands "stick charts," diagrams of wave and swell patterns used by Marshallese navigators until about World War II to plan canoe travels around the islands of Micronesia. These diagrams, made of coconut fronds and shells, come in lots of varieties, including ones centered on wave patterns around single islands. Anthropologist John Mack offers that these are "less representations of space" than "representations of *experience* of space"[02]—experience emanating from and embodied in the habits of practiced wayfinders who are trained to feel, in their bodies and boats, the analog materiality of wavy motion. (Mack's opposition between representations of space and experience of space is perhaps too stark. Latitude–longitude charts, sextant-enabled navigation, and radar readings of seascapes all enable and assume specific sorts of mariner experience—particular conjunctures of perception and cognition.)

If emanations of wave patterns can reveal the existence of an island, might technological tinkering with such shadows—perhaps canceling out radiating waves through the production of overlapping waves of opposite phase (creating destructive interference)—hide such islands? Such a possibility is at the center of recent investigations into cloaking, a technique that naval engineers have been exploring to engineer ships that can hide their own wakes, and with which coastal engineers have been experimenting in order to generate surface calm around buoys (making buoys less subject to the turbulent roil of rough seas).[03] Cloaking techniques may also be applied to modulating wavescapes around islands.

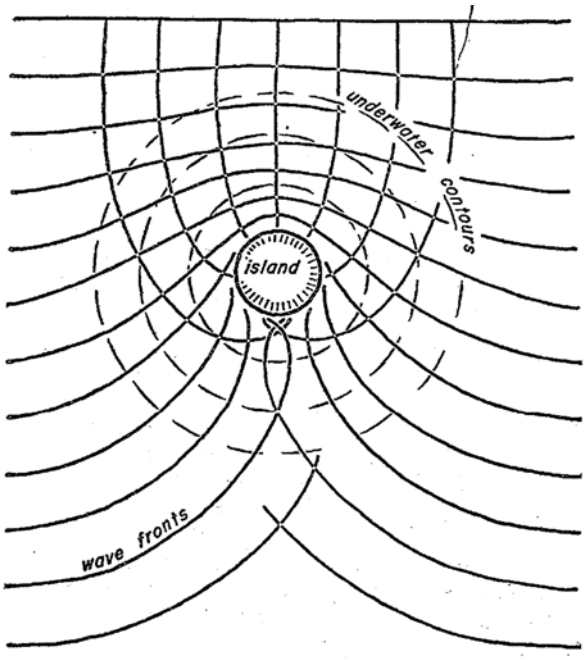
Hiding islands, of course, is an enterprise that recalls a range of mythic maritime and science-fiction fantasies about islands as places of isolation and seclusion, as vanishing paradises and utopias, as zones of illicit activity, and as sites of secret scientific and social experimentation.[04] Poet and novelist James Hamilton-Paterson, in an appreciation of islands, writes that, "One seldom looks at an island without also imagining it disappearing behind a bank of fog or storm clouds which at length clear to reveal an empty ocean."[05] Cloaking an island would seem to materialize a long literary tradition of imagining islands as temporary, enchanted way stations in time, as lost worlds, or as figments of maritime imagination.[06] Cloaking, of course, has a more recent pop cultural resonance: it was first named in the 1960s science fiction television program *Star Trek*, which dreamed up the "cloaking device" as a mechanism that could render spaceships invisible in deep space.[07]

What do scientific projects of maritime cloaking look like? It begins with scientists at the Institut Fresnel in Marseille, France, who, along with colleagues in Liverpool, published a paper in 2008 entitled "Broadband Cylindrical Acoustic Cloak for Linear Surface Waves in a Fluid."[08] In this research report, the authors propose a system for bending liquid waves around land obstacles in ways inspired by experiments in electromagnetic and acoustic cloaking, in which electromagnetic and acoustic waves are bent around solid objects.[09] The authors propose a cloaking infrastructure that might be made of specially shaped and sized pillars submerged in concentric rings around the circumference of an island. The pillars themselves would be made of a metamaterial, a composite of metals (and possibly plastics) engineered to have built-in properties not found in naturally occurring materials, such as the capacity to block, absorb, bend, or amplify very specific wavelengths of electromagnetic or other radiation.[10] The ring infrastructure proposed by the Fresnel-Liverpool team guides waves coming toward an island into a whirlpool that spirals around the island, dissipating and then redirecting the waves energy back outward, canceling out incoming waves. (Think of this as something like providing islands with noise cancelling headphones.) In imagining the uses of such a structure, the authors remark, "our design could be used to protect off-shore platforms or coastlines from ocean waves such as tsunamis." A popular science report on the paper and its experimental model promises readers, "Hiding Islands and Platforms from Tsunamis, Now a Possibility."[11]

A 2014 paper by Massachusetts Institute of Technology (MIT) mechanical engineer J. N. Newman, "Cloaking a Circular Cylinder in Water Waves," elaborates on the Fresnel-Liverpool model and offers a streamlined explication of the theory and aim of cloaking:

> In the diffraction of water waves by fixed bodies, the scattered waves propagate outward in the far field and attenuate with increasing distance from the structure. "Cloaking" refers to the reduction in amplitude or complete elimination of the scattered waves. . . . This may have practical applications, particularly to reduce the mean drift force on offshore structures.[12]

The Fresnel-Liverpool and MIT cloaking projects stage islands not so much as sites of secrecy but as places to be kept stable, safe, and secure. Here, cloaking is not so much (or only) meant to hide islands from people but (also) from



the sea itself. Islands become doubly isolated. Far away from the mainland as well as sheltered from the very sea that once emplaced but now ignores them, it is as though the cloaking device has played a Jedi mind trick on passing waves: "This is not the island you're looking for." In such enterprises, waves—already treated (along with wind, currents, upwellings) as part of an oceanic infrastructure (for travel, commerce, or energy exchange)—are sculpted into further infrastructural form.

Waves become candidates for recruitment into projects in what Pierre Bélanger calls "landscape as infrastructure," where infrastructures, defined by this landscape architect as collective systems of managing "water, waste, food, transport, and energy" are tuned to take account of and explicitly incorporate preexisting "biophysical resources, agents, and services" such as geothermal processes, wildlife migrations, and watershed flows.[13] Waves become physical processes folded into systems of communication and control.

But something more complex is going on in the case of cloaking, since the physical properties of waves are not simply being harnessed but are being engineered into new forms. In cloaking projects, waves become components in "environmental infrastructures." Anthropologist Casper Bruun Jensen writes that environmental infrastructures are "assemblages where the 'natural' and the 'social' mix and take new shape." He offers rivers as one example, which, as environmental infrastructures, operate, in shifting ratios and for different constituencies and at different times, as organic machines for distributing energy and wealth, as mobile lattices for multispecies encounters, and as channels for the fluvial transformation of what will count as habitable islets, marshlands, and more.[14] For environmental infrastructures, what is artificial and what is natural is beside the point: more consequential are the new sorts of things and powers that emerge from shifting arrangements of materials, bodies, ideas, and agents.

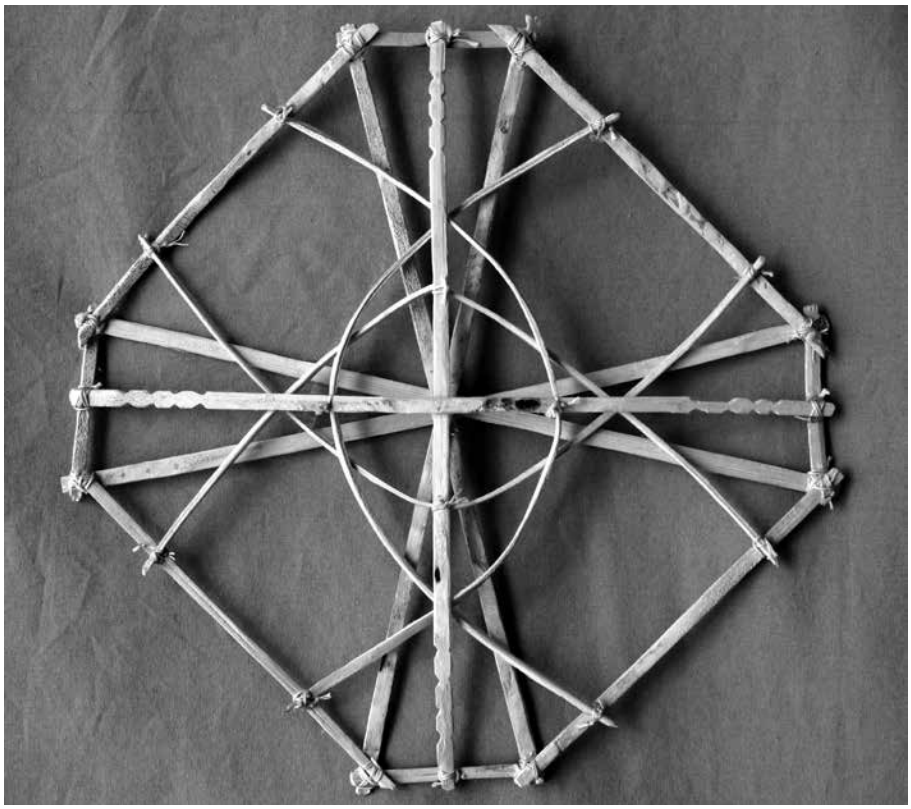
The making of wavescapes into environmental infrastructures is something I want additionally to call the creation of *infranature*. Whereas environmental infrastructure describes and tracks the generation of novel and unpredictable natural/cultural forms and captures the undoing of divides between the artificial and natural, infranature keeps analytically audible the continued durability of the concept of nature, especially as it may exist for many scientists, engineers, and architects. For people outside academic conversations about the shifting ontologies of nature and culture, the making infrastructural of waves will not fully yank these entities out an order of nature. Infranature names those processes commonly understood to be organic, biological, meteorological, geological, and oceanic that, tailored to social projects and endeavors, may be only partially lifted out of the realm of the implicitly natural. With *infranature*, nature as organic "first nature" is not superseded by the "second nature" of the built environment: rather, second nature becomes recursively folded back into first nature. If the supernatural is that which is transcendent—above nature, outside of history—then the infranatural names that which becomes immanent—inside the putatively natural order of things.[15]

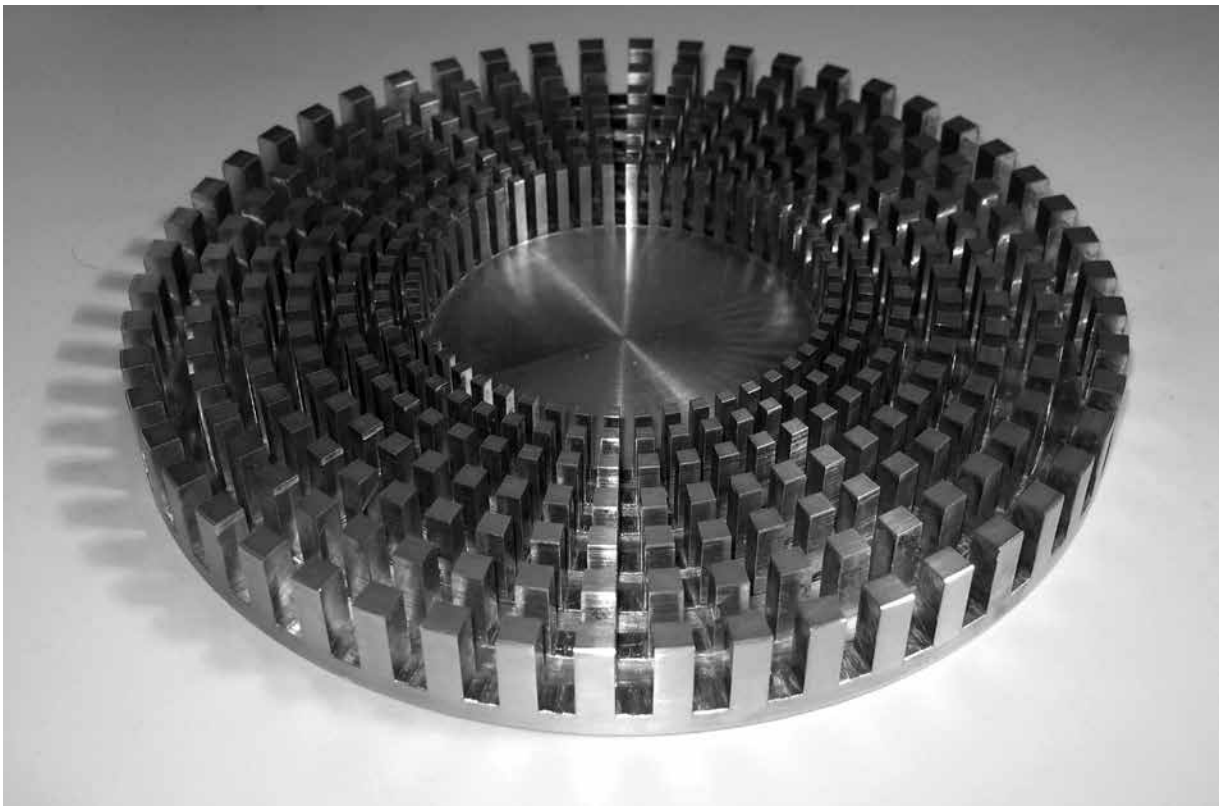
In other words, wavescapes become technologized even as they are still at home in a naturalized world. They become a channeled kind of "subnature," that genre of nature that often stands as antithetical to architectural endeavor (the zone of "dust, mud, gas, smoke, debris, weeds, and insects") but that might be reclaimed, repurposed, even domesticated.[16] Waves become architectural materials—materials that, conjoined with metamaterials, might be employed to create new kinds of spaces, places, and experience.

The kinds of islands imagined by cloaking scientists are ideal-typical islands. Indeed, they are mostly artificial islands—engineered structures such as offshore platforms. One can imagine cloaking-device/artificial-island packages pitched as maritime engineering planning units, packages that might be used to create new kinds of oil-drilling platforms, ocean-sited resorts, or airports.

In *The Invisible Islands*, a 2013 artwork by MAP Office, artists Laurent Gutierrez and Valérie Portefaix offer a map of 33 islands ringing Hong Kong, islands that historically have been home to "surveillance and port defense (from China to the U[nited]K[ingdom]), storage of all sorts (opium, guns, and gold), aqua- and agriculture, refugee communities (drugs addicts, escapees), etc."[17] Gutierrez and Portefaix's

Top: A Marshallese "stick chart" called a wappepe, representing wave patterns around a central island. Bottom: Farhat et al., metallic model of a cloaking infrastructure. Opposite page: Wave refraction around a circular island (waves are moving down the page).





Stefan Helmreich

islands have been invisible—administratively, legally, and culturally. Cloaked islands would add a physical, oceanographic manifestation to this array of invisibilities, with kinetically modified waves modulating what can serve as experiences of space.[18]

In their call for submissions, the editors of *New Geographies* ask after "the new limits of islandness." I suggest that, with cloaking, the surrounds of islands—the water and the waves—may be getting pulled into the domain of the infrastructural, or infranatural, as waves become shaped, through cloaking, into artificial sculptures designed to negate themselves. What kind of *islandography* (to play on Marc Shell's coinage of *islandology*) is in the making here?[19] If the word *geography* points to "earth writing" and *oceanography*, to "ocean writing," reckoning with "wave writing"—call it *undulography*[20]—seems necessary in fashioning a new kind of cloaked islandography. But this is an undulography that cancels itself out, an ~~undulography~~ that, rather than marking a "shift towards the fluid and the continuous that seems to spell the dissolution of the fundamental boundedness, isolation, and determination of the island,"[21] in fact reinforces island boundaries, bending natural phenomena such as waves into media that fortify, rather than dissolve, island isolation.

01. Willard Bascom, *Waves and Beaches: The Dynamics of the Ocean Surface* (Garden City, NY: Doubleday, 1964).
02. John Mack, *The Sea: A Cultural History* (London: Reaktion Books, 2013), 118, emphasis in the original. See also Joseph Genz, Jerome Aucan, Mark Merrifield, Ben Finney, Korent Joel, and Alison Kelen, "Wave Navigation in the Marshall Islands: Comparing Indigenous and Western Scientific Knowledge of the Ocean," *Oceanography* 22, no. 2 (2009): 234–45.
03. Adrian Cho, "Proposed Cloaking Device for Water Waves Could Protect Ships at Sea," *Science* 2 (March 2, 2012), http://www.sciencemag.org/news/2012/03/proposed-cloaking-device-water-waves-could-protect-ships-sea. See also Mohammad-Reza Alam, "Broadband Cloaking in Stratified Seas," *Physical Review Letters* 108 (February 24, 2012): 084502, which suggests a mode of canceling water waves beneath buoys by sculpting portions of the ocean floor so that they realize shapes that attenuate wave action underwater.
04. John Gillis, *Islands of the Mind: How the Human Imagination Created the Atlantic World* (New York: Palgrave Macmillan, 2004).
05. James Hamilton-Paterson, *Seven-Tenths: The Sea and Its Thresholds* (London: Faber and Faber, 2007), 64.
06. Think also about the case of islands which appear on maps but turn out not to be there. From the elusive islands of old sea-charts to today's phantom islands of Google Earth (which sometimes turn out to be digital artifacts), these have a long maritime history. See http://www.dailymail.co.uk/sciencetech/article-2236952/Phantom-island-shown-Google-Earth-does-exist-Australian-scientists-discover-outcrop-Pacific-voyage.html.
07. The term *cloaking device* was coined by D. C. Fontana in her screenplay for an episode of *Star Trek* called "The Enterprise Incident," which first aired on September 27, 1968.
08. M. Farhat, S. Enoch, S. Guenneau, and A. B. Movchan, "Broadband Cylindrical Acoustic Cloak for Linear Surface Waves in a Fluid," *Physical Review Letters* 101 (September 26, 2008): 134501.
09. See Colin Barras, "Invisibility Cloaks Could Take Sting out of Tsunamis," *New Scientist*, September 29, 2008, www.newscientist.com/article/dn14829-invisibility-cloaks-could-take-sting-out-of-tsunamis; and Dan Talpalariu, "Hiding Islands and Platforms from Tsunamis, Now a Possibility," *Softpedia*, September 30, 2008, http://news.softpedia.com/news/Hiding-Islands-and-Platforms-From-Tsunamis-Now-A-Possibility-94486.shtml.
10. On cloaking objects at microwave frequencies, see D. Schurig, J. J. Mock, B. J. Justice, et al., "Metamaterial Electromagnetic Cloak at Microwave Frequencies," *Science* 314, no. 5801 (2006): 977–80; and Michael Selvanayagam and George V. Eleftheriades, "Experimental Demonstration of Active Electromagnetic Cloaking," *Physical Review X*, vol. 3, no. 4 (2013): 041011. On acoustic cloaking, see L. Zigoneanu, B. I. Popa, and S. A. Cummer, "Three Dimensional Broadband Omnidirectional Acoustic Ground Cloak," *Nature Materials* 13, no. 4 (2014): 352–55. The intended applications of these cloaking projects are left general in these articles, although funding from the Office of Naval Research and the Army Research Office suggests interest in their development from military quarters.
11. The term *metamaterials* first appears in print in Rodger M. Walser, "Electromagnetic Metamaterials," *Proceedings of SPIE*, vol. 4467, *Complex Mediums II: Beyond Linear Isotropic Dielectrics*, July 9, 2001, 10.1117/12.432921. In 2001, the U.S. Defense Advanced Research Projects Agency founded the Metamaterials program. One institutional anchor for this program is at the University of California, Berkeley. The University's Multidisciplinary Research Program of the University Research Initiative (MURI): Scalable and Reconfigurable Electromagnetic Metamaterials and Devices describes metamaterials on its website as a "new class of ordered nanocomposites that exhibit exceptional properties not readily observed in nature. These properties arise from qualitatively new response functions that are: (1) not observed in the constituent materials and (2) result from the inclusion of artificially fabricated, extrinsic, low dimensional inhomogeneities. At the heart of the metamaterial advantage lies the physics of 'small-scale.' The physics at small scale is different than in bulk owing to, for instance, quantum confinement, exchange-biased ferromagnetism, and effective media responses, which can result in enhanced electromagnetic properties." http://xlab.me.berkeley.edu/MURI/muri.html. One may now await the adaptation of critical theory of the "new materialism" to this metamaterial moment; see for example, Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, NC: Duke University Press, 2009).
12. J. N. Newman, "Cloaking a Circular Cylinder in Water Waves," *European Journal of Mechanics–B/Fluids* 47 (2014): 145–50.
13. Pierre Bélanger, "Landscape as Infrastructure," *Landscape Journal* 28 (2009): 1–9. Compare with Gary Strang, "Infrastructure as Landscape," *Places* 10, no. 3 (1996): 8–15. Strang discusses how artificial constructions such as canals and telecommunications networks might themselves be imagined as given parts of the biophysical environment.
14. Casper Bruun Jensen, "Experimenting with Political Materials: Environmental Infrastructures and Ontological Transformations," *Distinktion: Scandinavian Journal of Social Theory* 16, no. 1 (2015): 27. Jensen's discussion of rivers draws from Richard

White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995); and Hugh Raffles, *In Amazonia: A Natural History* (Princeton, NJ: Princeton University Press, 2002). See also Sara B. Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (Cambridge, MA: Harvard University Press, 2011). For further critical discussion of how organic process and landscape are enlisted into projects of infrastructure, see Ashley Carse, "Nature as Infrastructure: Making and Managing the Panama Canal Watershed," *Social Studies of Science* 42, no. 4 (2012): 539–563. For a discussion of the functionalism assumed by some studies of infrastructure (consider Bélanger, above), see "Andrea Ballestero on Infrastructure, Sponges, and Aquifers," Center for Energy and Environmental Research in the Human Sciences @ Rice, blog, January 19, 2016, http://culturesofenergy.com/andrea-ballestero-on-infrastructure-sponges-and-aquifers. Thanks goes to Caterina Scaramelli for thinking with me on this point.

15. For one influential articulation of "first nature" as the biophysical, organic world and "second nature" as the built environment, see William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton, 1991).
16. David Gissen, *Subnature: Architecture's Other Environments* (New York: Princeton Architectural Press, 2009).
17. Laurent Gutierrez and Valérie Portefaix, "Islands and Other Invisible Territories," in *Art in the Anthropocene: Encounters among Aesthetics, Politics, Environments and Epistemologies*, ed. Heather Davis and Etienne Turpin (London: Open Humanities, 2015), 223. Compare with Angus Peter Campbell, *Invisible Islands* (Glasgow: Otago Publishing, 2006), a collection of Calvinoesque and Borgesian fables about imaginary islands off the coast of Scotland.
18. Building on the Marshallese materials with which Mack develops the notion of an "experience of [wave] space," we should recall what happened to the Marshallese after World War II. The 1954 detonation of a hydrogen bomb at Bikini Atoll by the United States left generations of Marshallese—particularly in the Rongelap and Utirik atolls—sick from exposure to radioactive fallout. A history of Marshallese wave experience will look different when it takes into account the history of the hydrogen bomb shockwave and its terrible genealogical consequences. See Holly M. Barker, *Bravo for the Marshallese: Regaining Control in a Post-Nuclear, Post-Colonial World* (Belmont, CA: Wadsworth Learning, 2004).
19. Marc Shell, *Islandology: Geography, Rhetoric, Politics* (Stanford: Stanford University Press, 2014).
20. The Greek-derived word kymography, which might suggest itself, is already taken, used to describe the tracing of cardiac pulse waves. On undulography, which mixes Latin and Greek elements, see Stefan Helmreich, "Old Waves, New Waves: Changing Objects in Physical Oceanography," in *Fluid Frontiers: New Currents in Marine and Maritime Environmental History,* ed. John Gillis and Franziska Torma (Cambridge: White Horse Press, 2015), 76–88.
21. Daniel Daou and Pablo Pérez-Ramos, call for papers, *New Geographies 08—Island*, October 2015.

Image Credits

084 : Willard Bascom, *Waves and Beaches: The Dynamics of the Ocean Surface* (Garden City, NY: Doubleday, 1964), fig. 28.

085 top: Dan Talpalariu, "Hiding Islands and Platforms from Tsunamis, Now a Possibility," *Softpedia*, September 30, 2008.

085 bottom: Courtesy of Joseph H. Genz.