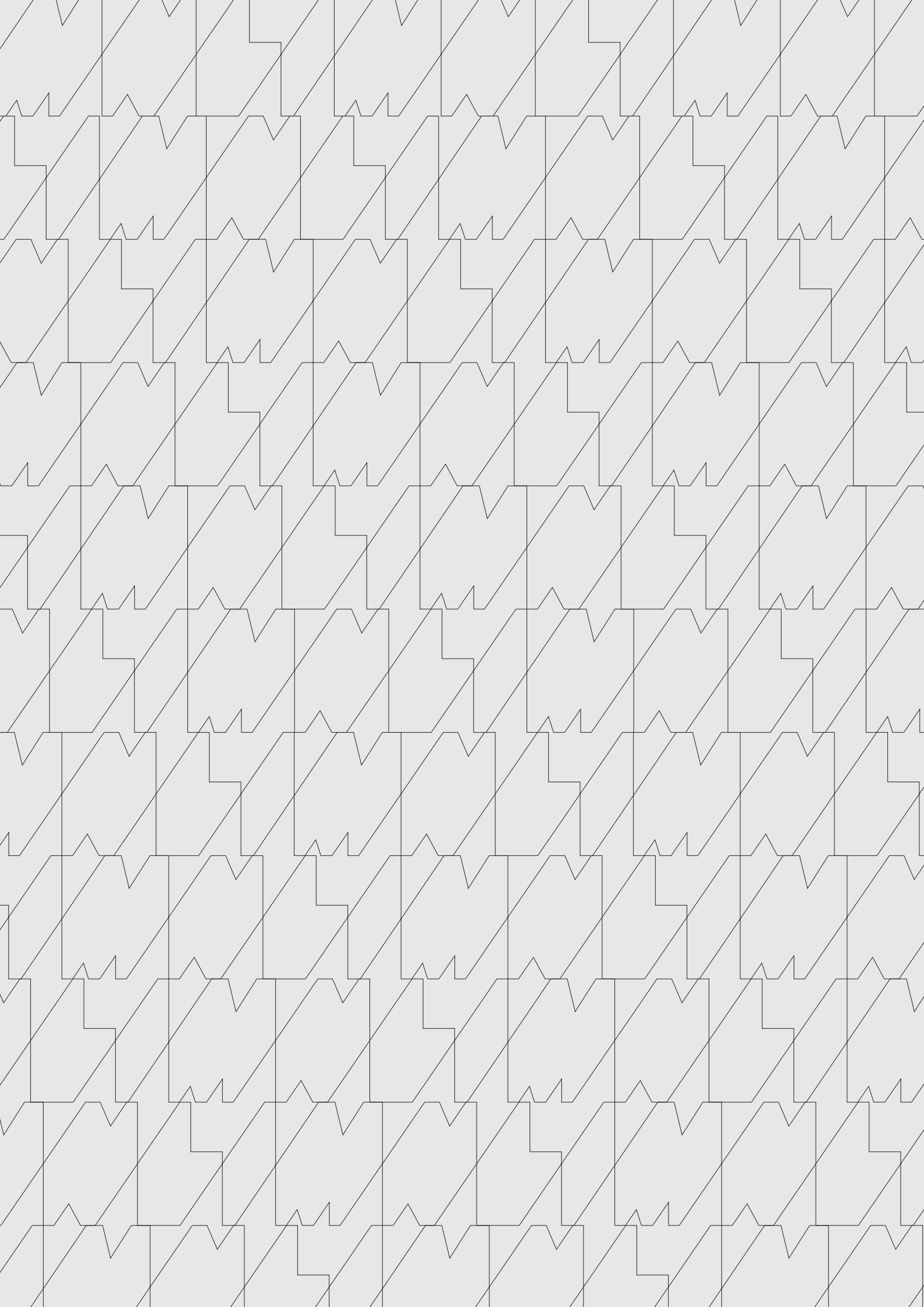

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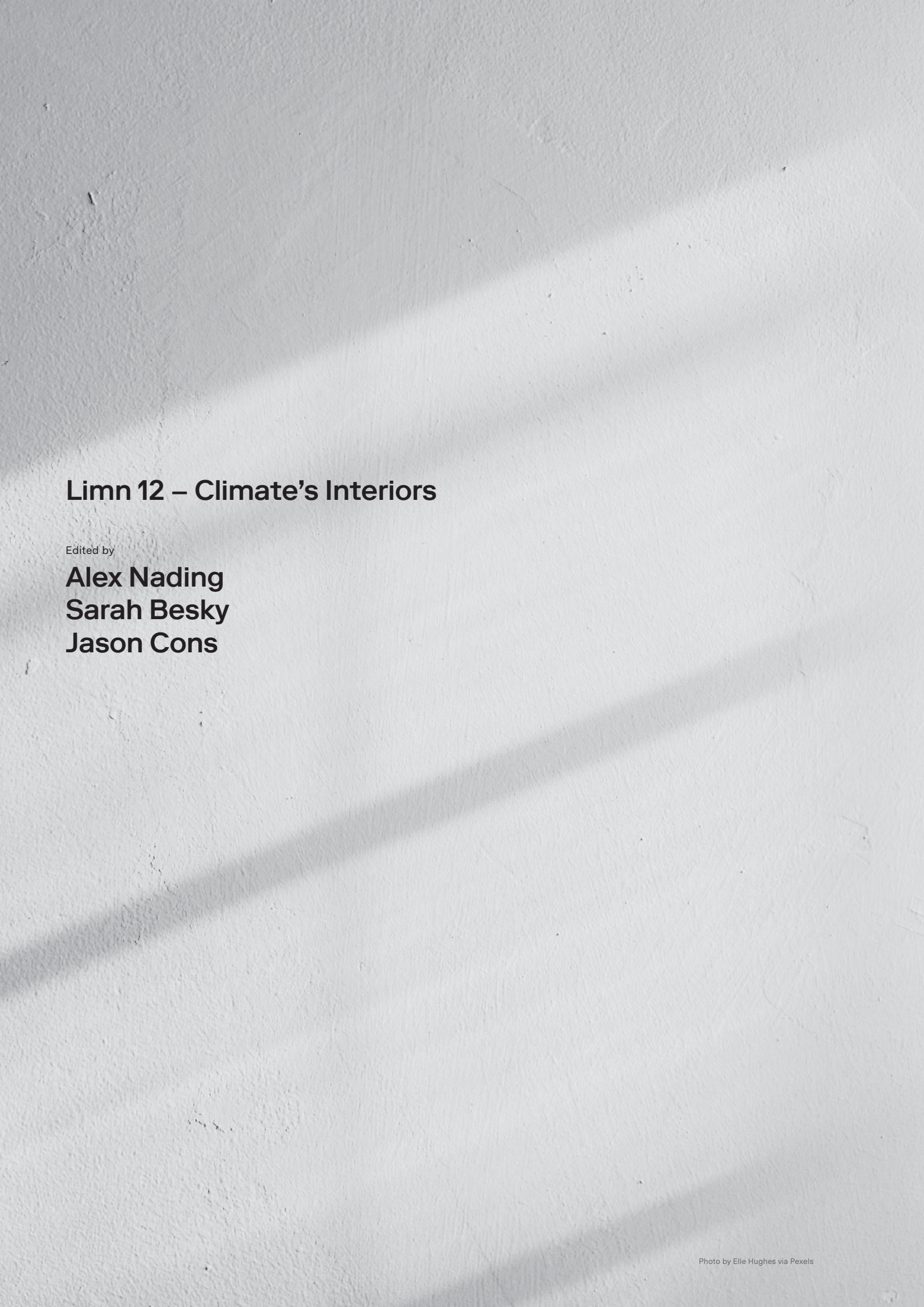
Cover image: Marja Pirilä, *Speaking House #8*, 2006

***Limn* is an experiment in collaborative inquiry. Published in print and open-access online editions, the journal gathers scholars, artists, and activists to illuminate—or limn—problems emerging at the interface of technology, politics, and contemporary life.**

# Limn 12 – Climate's Interiors

Edited by

Alex Nading
Sarah Besky
Jason Cons



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*Preface: The Impossible Interior*
by Alex Nading, Sarah Besky, Jason Cons

# In this issue, *Limn* tells climate stories from the inside out.

**We've become accustomed to telling stories about the climate from the outside.**

Glaciers melt, oceans acidify, sea levels rise, systems fail, and peasants become refugees. These are the predictable figures of climate change—a shorthand through which we make sense of a shared experience of threat and loss. We also think about climate solutions from the exterior. Mitigating emissions, climate-proofing crops, erecting solar panels and windmills.

But what happens when we shift our perspective? What if we think of climate change from inside cells, bodies, buildings, and systems?

This issue of *Limn* takes the interior as a counterintuitive starting point for thinking about planetary change. Our proposition: Thinking from the interior fundamentally shifts how we understand our warming world and, crucially, the stories we tell about it.

The house is perhaps the paradigmatic interior. Feminist scholars have long pointed out that the home mediates between the interior and exterior. Work inside the household props up all the economic and political activity that goes on outside. Extreme weather and shifting access to resources like drinking water have only made this situation more acute. This means that climate change exacerbates the class, caste, gender, and racial divisions of labor that have long been lodged in the home. For many, home is not a refuge from the ravages of climate crisis. Home is its front line.

What stories might we tell from other interiors? The mind, the body, the underground, the greenhouse, the warehouse, the refrigerator, and the football stadium all turn out to be apt lenses for unsettling our view of climate change. They might even change the way we imagine challenges, responses, and justice in its midst.

Over the long twentieth century, the modernist drive to create new kinds of interiors—from space suits to air-conditioned rooms to Biosphere 2—helped give shape to the very idea of a "climate." Not yet three decades into the twenty-first century, novel interior designs—from underground carbon capture, to zero-carbon cities, to aquaponic greenhouses—are being positioned as tools for planetary survival. Consider the automobile, an interior that serves as a second home to many people around the world. That interior is being rethought amid the shift from internal combustion engines to high-capacity batteries built with rare earth elements. Troublingly, the replacement of gas-guzzlers with battery-powered vehicles seems to require a return to many of the same interior projects that fueled capitalist expansion and environmental crisis—the mine, the aquifer, the landfill. As always, new interiors are formed in relation to the exterior. Interiors, then, are never discrete or isolated. They are always nested, scaled, in dialogue with one another.

Interiors are good to think with, but they are also good to think from. A view of the Anthropocene from inside buildings, technical systems, homes, organisms, and body-minds can challenge the norms of community and immunity, expansion and defense, that have guided projects of capitalist accumulation, empire-making, healing, and, indeed, ecology itself. But we also see the interior as a platform for designing climate futures—as much a container as a space of imaginative and critical possibility.

How then to understand the relationship between climate and interior space? The contributors to *Limn 12* explore a range of different interiors. However, read together, some core principles emerge:

1.

*Porosity is both a feature and a bug of the interior.*

Envelopes, bubbles, thresholds, membranes, filters. Across this issue, the terms authors and their interlocutors use to name the separation of inside from outside all have in common a sense of fragility and ephemerality. For the scientist seeking to model climate change, the inability to make a model discrete becomes a challenge both of materials and social relations. The model cannot keep reality from intervening in it. But porosity can also be constructive. Consider the brick. Its solidity connotes permanence, yet as hard as the brick might seem, it is a malleable form—one that might engender new ways of imagining the inside and outside. Broadening our frame of reference, we might then think of aquifers. Aquifers are where water is stored inside the Earth, yet they only exist thanks to the permeability of soils and bedrock.

2.

*The work of the interior is one of conditioning.*

In one sense, conditioning means regulating what goes inside and what gets cast outside. High-efficiency air conditioners contain compressors that automatically adjust their intensity based on indoor conditions, condensing warm air and sending it back as cool air. Cheaper, old-school compressors just run full blast until they hit the thermostat's target, then shut off. This is why they emit so much heat into the exterior. These technologies condition the relationship between inside and outside. But conditioning also means setting the terms by which the interior is defined. Such terms may be aesthetic; they are also often biophysical. When employers refuse to take up the costs of conditioning industrial spaces, workers' bodies must adapt—or else.

3.

*Interiors are spaces of both knowledge-making and occlusion.*

Many of the interiors featured in this issue are models for a larger exterior world. This means that thinking of the climate through the interior translates the goings on inside to those outside, with all the potential pitfalls of oversimplification that entails. Is the anxiety you're feeling a result of climate change, or is that anxiety climate change itself? Can the ecology of the deep ocean be replicated inside a plastic bag hung from the side of a dock? Axiomatically, interiors are about sealing people and things off from the outside, but interiorization is never just about protection. Interiorization hides enduring systems of patriarchy and segregation.

When we turn our attention to the interior, the familiar ways of knowing and interacting with the climate—mitigating, adapting, even observing—start to lose their purchase. The interior is where secrets are buried, where waste is trapped, where suffering is hidden away, where knowledge is both power and threat. Attention to interiors shows us that despite the temptation in social science to identify singular causal drivers for social suffering, or for social action, those drivers (heat, pharmaceuticals, mold, mosquitoes) never work alone. Interiors are not so much containers as they are points of dense convergence—never stable, always leaky. Approaching climate interiors by considering their porosity, their conditioning, and their affordances and occlusions opens new spaces of possibility.

So, we invite you to step inside *Limn 12*—but don't get too comfortable. These interiors are full of surprises. ⊙

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PHOTO CREDIT

p.6: Photo by Alex Nading.

# NARRATING THE INSIDE

*That was the brief: go to Kolkata and see if you can find the climate story. That's pretty much what I do.*
—Anant Gupta

A touchstone in the conversations that generated this issue of *Limn* was a remarkable story published in September 2023 by *The Washington Post*, titled "The Inequality of Heat."[1] The story details life during a late spring heat wave in Kasia Bagan—a working-class, largely Muslim neighborhood in Kolkata, India that abuts Quest Mall, the city's largest and most exclusive shopping mall. "The Inequality of Heat" uses data visualization to dramatically illustrate the heat generated by bodies in windowless apartments, and the ways that air conditioners create blooms of hot air that accumulate in Kasia Bagan's narrow and windless alleys. It draws remarkable visual contrasts between the interiors of neighborhoods like Kasia Bagan and those of more wealthy suburban spaces such as Kolkata's tree-lined Salt Lake neighborhood.

But at the heart of the story are narratives. The first is the story of a peaceful sit-in staged by residents of Kasia Bagan at the air-conditioned Quest Mall. The second is an ethnographic portrait of Sana Mumtaz, a divorced mother of three living in Kasia Bagan. These twinned narratives dramatize not only the challenges for poor and working-class families living through South Asia's increasingly frequent and intense heat waves, but also the ways in which climate injustice infuses interiors—from the atrium of a shopping center to the intimate space of a family apartment.

A year after "The Inequality of Heat" was published, *Limn* had a chance to sit down with Anant Gupta, a native of Kolkata and one of the reporters who worked on the story. We discussed his experiences reporting for the piece, his friendship with Sana and others in Kasia Bagan, and the politics of writing about climate change and its various interiors. Our conversation covered a range of themes addressed by other authors in this issue. Rather than edit it into a single narrative, we intersperse fragments throughout the issue, accompanied by photos Anant took while reporting this piece.

1 Annie Gowen, Niko Kommenda, Simon Ducroquet, Anant Gupta, and Atul Loke, "The Inequality of Heat," *Washington Post*, September 22, 2023.

**ANANT GUPTA** is the political correspondent at Scroll, an Indian digital news publication founded in 2014.

PHOTO CREDITS

p.14,40,64,102,140: Photos by Anant Gupta.

F R I

D G E

*We were all committed to the narrative spine of the story—and much of that was how compelling Sana was as a person, as a character. Her own story, her family, her energy, her spirit. I think it was just too compelling to look away from. In fact, some of the visuals I remember to this day are of spending time in her house.*

*Her kids would open the fridge every now and then just to take in the cool air, because they don't have an air conditioner. They would do it saying that they were looking for Coke or some fruit juice, whatever was in the fridge. But they did it again and again. And every time they did it, all the bottles in the fridge would come tumbling down. And the women in the house would get super cranky about this happening again and again, because the kids would just create that mess and run off, and they had to assemble it all again, put it back in the fridge and shut it. These were ways in which people were cooling themselves throughout the day in the neighborhood and in that home.*

—Anant Gupta


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*The Art of Enclosure*
by Jiat-Hwee Chang & Sharad Pandian

# What does it take to air-condition an open-air event?

## In 2022, Qatar hosted the FIFA World Cup.

A central challenge of the games was the question of temperature: what would it mean to play World Cup football matches—and watch them—in an open-air environment where summer temperatures often exceed 40°C/104°F?

The answer was to construct a series of air-conditioned stadiums. In March 2024, two years after the World Cup, we visited "Qatar 2022: Journey & Legacy," an exhibition at the Qatar National Library commemorating the event. Two objects caught our attention. The first was a row of scale models of the eight air-conditioned stadiums built for the tournament. The second was a cooling suit designed for the migrant workers who built them. What was being celebrated in this exhibition was not just the football tournament itself, but the triumph of a certain kind of interior engineering: the art of enclosure, or putting people into bubbles.

While air-conditioning in closed stadiums is now commonplace, Qatar's World Cup sites were open-air. The engineering challenge therefore was to construct venues that still *felt* enclosed. The cooling suits were integral to that project. Qatar's hot climate makes the physical demands of construction labor potentially lethal. The suits, as the National Library display shows, made it possible for construction workers to survive these extreme conditions. What viewers are not told is how those suits made it possible for a rentier state whose economy depends upon both carbon-intensive fossil fuel extraction and low-paid migrant labor to create a bubble around the tournament—to insulate it from environmental and ethical scrutiny.

It's no secret that artificial air conditioning is a major contributor to climate change. Air conditioning doesn't just separate the interior from the exterior. It exacerbates the differences between the two. The vapor compression technology of air conditioning cools interiors while heating

exteriors, both directly with its waste heat and indirectly with its carbon emissions. In addition to these externalities, air conditioning has socio-sensorial costs. Conditioned air lowers the capacities of bodies to cope with thermal conditions outside a narrowly defined thermal comfort range. This deepens their addiction to mechanical cooling and, like all addictions, puts users in a bubble. It physically and ethically separates them from those who do the arduous physical labor of extracting fossil fuels and building climate-controlled buildings. The bubble makes invisible the rhythmic changes in the exterior climate, making it easier to defer recognition that the planet itself is slowly overheating.[1]

Qatar's choice to air-condition stadiums has a history. In the 2000s, Qatar began leveraging the unprecedented revenues of an oil and gas price boom to make itself into a geopolitical and cultural player. In 2007, Qatar made a bid to host the 2016 Summer Olympics but failed to make the shortlist. Qatar had suggested holding the games in October, arguing that this was when temperature and humidity levels would allow for optimal comfort and sporting performance. The International Olympic Committee, however, regarded the proposed shift as unacceptable.

Qatar blamed its environment for this failure. As one official remarked, "The weather was the main reason we were left off the shortlist."[2] In 2008, Qatar made its bid for the 2022 World Cup, this time acceding to the international expectation to host it during summer. To combat the heat while keeping stadiums open-air, it promised to deploy cutting-edge carbon-neutral cooling systems at stadiums, training sites, and fan zones. At their final bid presentation, the Qatari team promised that "heat is not, and will not be an issue."[3]

To convince FIFA of the feasibility of its techno-ambitions, in 2010, Qatar hired the engineering consultant Arup to rapidly build a five-hundred-seat prototype net-zero-carbon stadium, cooled by solar-powered air conditioning and protected from the hot sun with a double-layered roof. This prototype stadium, named "the Showcase," demonstrated to a visiting FIFA delegation that Qatar's promises were credible.

After Qatar was officially awarded the bid later that year, scientists from Qatar University including Dr. Saud Ghani (nicknamed "Dr. Cool") were awarded research funding by the state to turn the prototype into actual, energy-efficient, mechanically cooled, open-air stadiums. Through computational fluid dynamics simulations and wind tunnel tests, Dr. Cool and his team provided input to architects and helped to fine-tune the geometries of the stadiums. They also tested various positions and types of diffusers to choreograph airflow patterns, as Dr. Cool explained to us, such that each building would behave aerodynamically like "a microclimatic bubble," despite the fact that each would have a large hole in its roof. He proudly described how, during one of the preparatory events at the Khalifa Stadium, FIFA president Gianni Infantino remarked that the atmospheric conditions inside the stadium felt like "spring in Switzerland."

1 Hsuan L. Hsu, *Air Conditioning* (Bloomsbury Academic, 2024); Nicole Starosielski, *Media Hot and Cold* (Duke University Press, 2021).

2 Karolos Grohmann, "Olympics-Four Cities Chosen as 2016 Games Candidates," *Reuters*, June 4, 2008.


3 Andrew England, "How the Unlikeliest World Cup Ever Came to Be," *Financial Times*, November 10, 2022.

↑ A model of Al Thumama Stadium at a Qatar National Library exhibition, 2024.

← Local league match in the microclimatic bubble of Al Thumama Stadium, 2024.

Despite the extreme desert heat, in Qatar, it already feels like a temperate spring in most indoor spaces. A nearly constant air-conditioned life has become possible thanks to the state's funneling of petrodollars from the sale of hydrocarbons into free water and electricity for all its citizens, and into luxurious climate-controlled bubbles for its affluent visitors.

The extension of air conditioning to other visitors, particularly migrant workers, has been more uneven. The award of the World Cup to Qatar drew immediate condemnation for the country's long-standing ill-treatment of migrant workers from organizations like Amnesty International and Human Rights Watch, foreign newspapers like *The Guardian*, and labor groups like the International Trade Union Confederation. Criticism centered on the *kafala* system, which gives employers who sponsor migrant laborers in the Gulf almost total control over them, with little oversight, resulting in wage theft, physical hardship, and abuse. Critics also drew attention to a track record of migrant deaths and chronic illness caused by working in Qatar's outdoor heat.

↓ Prototype of a cooling balaclava designed for construction workers at the National Library of Qatar, 2024.

→ A cooling suit on display at the National Library of Qatar, 2024.

**"While 51,000 StayQool suits and 13,000 specially designed balaclavas were distributed, the number of migrant workers in the construction sector in 2019 was estimated to be around 850,000."**

Qatar had previously made some moves toward protecting workers from its climate. For example, in 2005, the government began requiring that employers provide adequately air-conditioned accommodations for workers. But in the wake of the backlash, the government body responsible for the World Cup, the Supreme Committee for Delivery and Legacy, released its own set of Workers' Welfare Standards with which all contractors working on World Cup stadiums had to comply. They mandated air conditioning in every enclosed space that workers would find themselves in, including dormitory bedrooms, social rooms, dining halls, and medical facilities; all buses used to transport workers to construction sites; and all habitable buildings that workers used on construction sites. After 2021, a rule was added mandating that work must stop any time the "wet-bulb globe temperature" rose above 32.1°C/89.8°F.

As for open workspaces that could not be air-conditioned, Qatar introduced technological innovations to enclose the bodies of migrant workers in their own heat-modulating bubbles. In 2017, the British company Techniche worked with scientists from Qatar's Hamad Bin Khalifa University to develop the StayQool suit. The suit incorporates chilled phase-change materials along the cuffs, collars, and groin area to target points on the body where blood runs closest to the skin. Internal studies supposedly showed that this reduces skin temperatures up to 8°C/14°F. In this manner, a cooling suit functions like an air-conditioned stadium. It allows


The SC's Workers' Grievance Hotline allowed workers to report concerns anonymously, in 10 languages, 24/7.
يستطيع العمال الإبلاغ عن الشكاوى دون الكشف عن هويتهم من خلال الخط الساخن للشكاوى التابع للجنة العليا للمشاريع والإرث. وهو خط مفتوح على مدار الساعة طوال أيام الأسبوع وبـ 10 لغات مختلفة
Revolutionized workers' healthcare management through comprehensive medical screenings complemented by a first-of-kind electronic medical records system in the construction sector.
نظام مبتكر لإدارة الرعاية الصحية للعمال من خلال الفحوصات الطبية الشاملة المدعومة بنظام السجلات الطبية الإلكتروني والذي يعد الأول من نوعه في قطاع الإنشاءات.
Training and upskilling program to develop technical and soft skills of workers.
برنامج التدريب والتأهيل لتطوير المهارات التقنية والشخصية للعمال.
Ground-breaking reimbursement scheme introduced by the SC to combat global malpractice of charging recruitment fees.
خطة السداد الشاملة التي أطلقتها اللجنة العليا للمشاريع والإرث للتصدي للممارسات غير القانونية حول العالم والمرتبطة بفرض رسوم التوظيف.
First-of-its-kind comprehensive due diligence program implemented for the hospitality sector.
برنامج تقييم الالتزام الشامل الأول من نوعه في قطاع الضيافة.
Addressing workers' mental health through a dedicated pathway.
توفير طرق علاجية مخصصة لمعالجة المشاكل النفسية لدى العمال.
المشاريع الاستراتيجية
Strategic Projects
استطاعت اللجنة العليا للمشاريع والإرث أن تأخذ بزمام المبادرة في عدد من المشاريع الاستراتيجية التي انعكست إيجابياً على الحياة اليومية لعمالنا وزادت من سبل رعايتهم طوال فترة عملهم بمشاريعنا.
The SC pioneered a number of strategic projects that improved workers' daily lives and ensured their welfare throughout the employment cycle.
Stop Smoking
Stop Chewing Tobacco
Nutrition Program launched to encourage healthier lifestyles among workers.
أطلق برنامج التغذية لتشجيع العمال على اتباع نمط حياة صحية.
Are you OK?
Mental health affects us all – you are not alone.
Poster advertising mental health hotline.
ملصق إعلاني للخط الساخن للصحة النفسية.

↙ Exhibit panel featuring a smiling migrant construction worker at the National Library of Qatar, 2024.

↓ Label from a protective vest on display at the National Library of Qatar, 2024.


the wearer (like the spectator or the football player) to be enclosed and exposed at the same time.

While activist groups lauded the improvements in occupational conditions, they drew attention to two important limitations. First, the labor reforms and technological innovations introduced to protect construction workers applied only to those workers engaged in World Cup projects—only around two percent of all migrant construction workers in Qatar. While 51,000 StayQool suits and 13,000 specially designed balaclavas were distributed, the number of migrant workers in the construction sector in 2019 was estimated to be around 850,000.

Second, Qatar still refused to include "diseases caused by exposure to extreme temperature" in its list of recognized occupational diseases, thereby refusing to take accountability for workers past and present harmed by working outdoors.[4] As a result, deaths of workers continue to be chalked up to vague reasons such as "natural causes" or "cardiac arrest," preventing workers' families from receiving compensation, and deepening the precarity of those already suffering injury and bereavement.

The StayQool suits thus not only protected World Cup construction workers from the heat; they deflected attention from the structural exploitation and risk that are a feature, rather than a bug, of the Qatari system, and of a rentier economy that redistributes fossil fuel wealth into aerodynamic, air-conditioned bubbles.

The bodysuit was thus as much a spectacle as a technology of cooling. Not surprisingly, a suit—pristine, new, unsoiled, and without any signs of wear—was prominently displayed at the National Library exhibition. In fact, it took up more display space than the scale models of the stadiums. Downplaying the stadiums at the exhibition is perhaps understandable. After all, the stadiums are still in use, and their grandeur is more effectively experienced through a visit. By contrast, the protective suit is an element of the tournament's history, and of its host country's ethical claims, that would—like so many other pieces of engineered infrastructure—be otherwise invisible to the visitor.

In the exhibition, the migrant workers that the suit was originally intended to protect now play a supporting role. Those workers appear as nameless, smiling faces clad in protective suits on the photo panels illustrating, in the words of the exhibit, the Supreme Committee's "strategic projects that improved workers' daily lives and ensured their welfare." These gleaming images provide a testament to the ethical and environmental wisdom of the Qatari authorities and the experts they hired to make the World Cup into an engineering marvel.

To showcase an object often entails enclosing it—encasing it in something transparent that allows the object to be displayed and protected. On the one hand, the display cases containing the StayQool suits did precisely this. Like the suits themselves, they kept their contents separated from the dirt, dust, and elements of the atmosphere around them. On the other hand, the cases produced another link in a chain of bubble-like enclosures that both produced the physical stadiums in which the 2022 World Cup was played and also rendered Qatar an ethical, air-conditioned steward of the event. These air-conditioned bubbles mediated interior and exterior atmospheres, both climatological and political. They thus enacted thermopolitics as an art and an aesthetics of enclosure. ⊙

4 *"In the Prime of Their Lives": Qatar's Failure to Investigate, Remedy and Prevent Migrant Workers' Deaths* (Amnesty International, 2021).

**JIAT-HWEE CHANG** is Dean's Chair Associate Professor of Architecture at the National University of Singapore. He is the author of *A Genealogy of Tropical Architecture: Colonial Networks, Nature, and Technoscience* (Routledge, 2016).

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PHOTO CREDITS

p.16–20,22–23: Photos by Jiat-Hwee Chang.
p.21: Photo by Sharad Pandian.

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*The Interior Frontier*
by Rebeca Ibáñez Martín

# Are greenhouses the solution to the global food crisis?

**In January, I joined a group of artists and researchers on a tour of industrial greenhouses in the Westland region of the Netherlands.**

The tour was organized by a Dutch foundation that aims to familiarize the public with the world of greenhouse horticulture. The Netherlands is a relatively small country, with a total area only about twice the size of the state of New Jersey. However, the country is now one the world's largest produce exporters, thanks in part to climate-controlled greenhouse infrastructure, and in Westland, new greenhouse designs are being prototyped to retrofit rural spaces for intensive climate-proof agriculture.

Westland's landscape is an eerie mix of the bucolic and the industrial. Its narrow roads are shared with cyclists; its landscape dotted with houses built along ditches and canals. These stand side by side with huge glass and steel greenhouse complexes. The terrain juxtaposes capitalist production facilities with well-kept domestic lawns.

Westland has long been an agricultural space, referred to as the "garden of Europe" in Dutch atlases and history books.[1] The region once produced grapes and other sundries for The Hague, Delft, and the English market. Greenhouses in Westland are not new. Glasshouses—the historical antecedent to the more controlled greenhouse—have brought vegetables into broader markets since the eighteenth century.[2] What is new here is an imaginary of Westland as a solution to the global food crisis through hyper-controlled indoor cultivation.

Westland exemplifies a key dynamic of climate interiors. It turns the idea of agriculture as an exterior problem—governed by the unpredictability of temperature, rain, soil fertility, and air quality—on its head, or rather inside out. Here, greenhouses are conceived as a means of insulating fragile crops from climate's increasingly unpredictable outside. Yet, this seemingly simple inversion turns out to be surprisingly complex in practice. The interiorization of agriculture produces new interspecies relationships, sensory complications, and ethical conundrums that complicate the binary of inside and out.

1 Marcel IJsselstijn and Yvonne van Mil, *Atlas van het Westland: 10.000 jaar ruimtelijke ontwikkeling* (Uitgeverij Thoth, 2016); Jaap van Duijn, *Geschiedenis van het Westland: van Romeinse nederzetting tot tuin van Europa* (Amsterdam University Press, 2020).

2 Luke Keogh, *The Wardian Case: How a Simple Box Moved Plants and Changed the World* (University of Chicago Press, 2022).

↑ Greenhouses, as seen from the road in Westland, Netherlands, 2021.

## THINKING THROUGH TOMATOES

The tomato is a year-round staple in Dutch supermarkets and beyond. Dutch consumption practices have come to depend upon the industrial stabilization of the tomato, unmooring it from seasonality and rendering it omnipresent in the supermarket.

On a cold day in February 2024, I visited a commercial tomato greenhouse facility of over twenty hectares (or about fifty acres). Tim was my host that day. An experienced manager of horticultural greenhouses, Tim is now retired, but he hasn't been able to tear himself away from the world of greenhouses.

Visitors like me are potential carriers of disease and are rarely allowed inside tomato greenhouses. To protect the fragile ecology inside, we wash our hands with soap, dry them well, put on disposable overalls, cover our heads with disposable hats, disinfect the soles of our shoes, and cover them in plastic.

A walk inside the greenhouse makes the materiality of "climate" readily apparent. Greenhouse tomatoes grow not in soil but in a rockwool substrate, fed by nutrient-rich water solutions, and pollinated by bumblebee colonies sold by global biological control companies. Pink LED lights create a futuristic atmosphere while we move through rows and rows of tomato vines. Music plays loudly. The air is difficult to breathe. The greenhouse is sealed, with little ventilation, so that the heat stays trapped and stable inside. To stimulate plant growth, that same air is supplemented, via a pipeline from Rotterdam, with carbon dioxide—a by-product created by various petrochemical facilities.

"This heat is perfect for tomatoes, encouraging the fruit to ripen," Tim explains. "We aim to mimic a mild subtropical climate, where the nights are a bit cold, around 15°C [59°F]. During the day, there's lots of light," hence the bright LEDs. During the day, "it's good to reach 25–26°C [77–79°F]. That makes tomatoes very happy." Growers carefully manage all these factors—light, air, humidity—to ensure optimal tomato growth. But even in these anthropogenic, monocropped ecologies, complexity abounds.

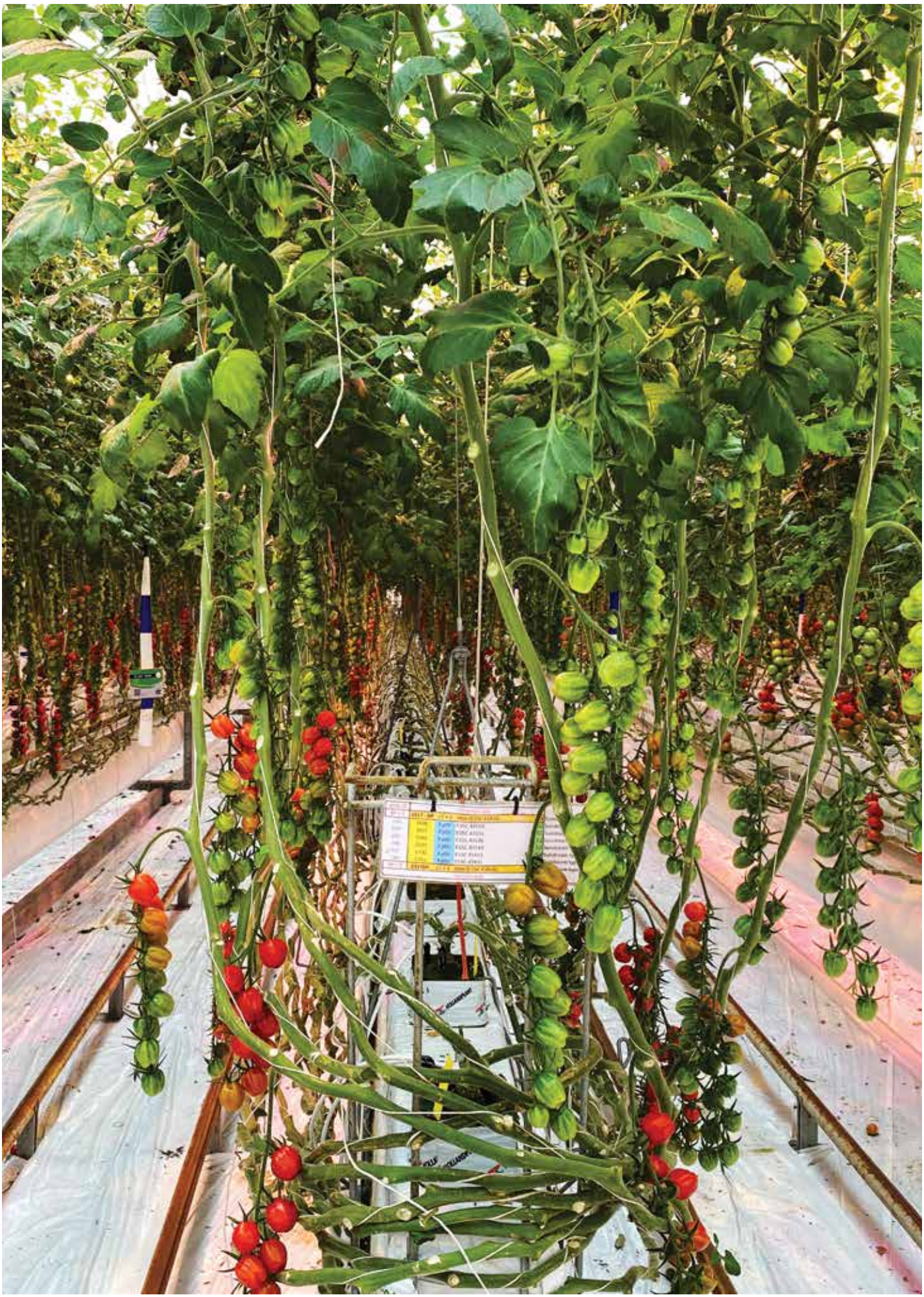
↑ LED light pollution in Westland, 2025.

Take light. Tomatoes love light. Light serves as the energy source for photosynthesis, and its intensity and duration play a crucial role in plant growth and ripening. Under low-light conditions during the short days of the Dutch fall and winter, plant growth is hindered. Natural sunlight is not enough, so growers supplement it with artificial light. Up to eighteen hours a day of artificial light boosts tomato growth, but it also creates challenges for another vital greenhouse actor: the bumblebee. As Tim notes, "With the LED lighting, the bumblebees become confused and less active." Fewer active bumblebees mean fewer pollinated flowers, and ultimately, less fruit. "The bumblebees weren't flying well; they were getting disoriented and getting lost," Tim explains.

Initially, the solution seemed simple: get more beehives. But as Tim pointed out, "Sure, we could bring in five times as many hives every week, but that's not the goal." Buying more commercial beehives would have been costly and wasteful. Instead, they discussed the problem with the biological control company that provided them with the hives. Together, they developed an automatic system to close the hives in the early afternoon, allowing the bumblebees to fly only in the morning. This protected them from the overstimulation and disorientation caused by the lights, which would otherwise lead to mass bumblebee death.

Tim and his colleagues also came up with a way to help the bumblebees navigate the huge greenhouse. Greenhouse workers hung yellow and black T-shirts on poles to guide the bumblebees back to their hives. On another of my visits, a representative from the biological control company explained how they had developed yet another solution for disorientation. They adorned new hives with a flower painted in the entrance which can only be seen with UV light—similar to the type of visual signal, invisible to humans, that bumblebees in the wild use to navigate. Now, the bumblebees can more easily locate the entrances to their hives and get some respite from the onslaught of the greenhouse environment.

← Tomato vines in a commercial greenhouse in Westland, 2023.



**“Greenhouses are a capitalist frontier, but their very means of expansion—the carefully regulated indoor climate—produces new threats.”**

## CAPITALIST ECOLOGIES

The biological and political intimacies of greenhouse infrastructure are evident in how care for different living organisms must be coordinated to maximize productivity. The Netherlands houses some of the world’s most powerful seed breeding and research companies, especially for tomatoes. This is no accident; it directly serves the needs of the massive indoor agriculture industry, to fight against the viral diseases, fungal infections, and pesticide resistance that imperil these fragile environments. This vulnerability drives the constant development of new seed varieties that can withstand pathogens—a race against financial and crop loss that threatens a highly profitable market for seed companies. Greenhouses are a capitalist frontier, but their very means of expansion—the carefully regulated indoor climate—produces new threats. Fungi and pests develop resistance to control measures. Bumblebees die. New pathogens emerge. But the business must go on.

Unlike more familiar climate-controlled interiors such as hospitals, office buildings, or shopping centers, greenhouses resist easy categorization. Situated in enclaves like Westland, they are detached from people’s everyday experiences, yet they remain vital to humans’ most essential everyday action: eating. Designed as a sealed “world interior,” the greenhouse simulates existing “natural” climates, but as capitalist and industrial goals intensify, that world becomes increasingly detached from any natural exterior. The techno-utopian vision of greenhouses is that climate-modulated interiors are the future of food production. While this may indeed be feasible, that doesn’t mean it’s unproblematic. The promise of limitless growth and replicability obscures labor demands, energy demands, and pesticide resistance. Such simplified ecologies are a new frontier in capitalism’s vision of endless expansion.

The fragility and complexity of the greenhouse highlight the ethical conundrums at the center of climate interiors. Which lives are worth supporting? Which vegetables are worth growing? The greenhouse reminds us not only of the financial and ecological stakes of climate engineering, but also of the limitations in thinking of climates as manageable interiors. The greenhouse is thus a paradigmatic space of interiorization—a zone where the ethical and practical complexities of a warming world are not erased, but rather thrown into stark relief. ⊙

← Ripening tomatoes in a Westland greenhouse, 2023.

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PHOTO CREDITS

p.24,28-30: Photos by Rebeca Ibáñez Martín.
p.26: Photo by Clemens Driessen.

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*Mold Chains*
by Jamie Cross

# How is refrigeration mobilized against fungal life?

**In November 2024, the winners of Prince William's Earthshot Prize, which aims to "search for and scale the most innovative solutions to the world's greatest environmental challenges," were announced on a stage in Cape Town, South Africa.**[1]


↑ Publicity photo for Earthshot Prize winner "Keep it Cool".

Among the five recipients were a team of Kenyan entrepreneurs who had designed a solar-powered refrigeration system, dubbed "Keep it Cool," for farmers and fishing communities. This was the latest in a spate of awards for cooling technologies in Africa, in competitions whose sponsors included the World Bank, the Ikea Foundation, and an international trade association for the cooling industry.

Cold storage facilities for food are quintessential climate interiors. Without them, supply chains for perishable goods risk collapse, with potentially devastating financial impacts for producers, regional economies, and food security. These novel interiors are celebrated for helping to keep products fresh for longer as they move from fields, farms, and fishing nets to markets and mouths. UN agencies, charities, businesses, and investors in Africa frame new cooling technologies as solutions to the logistical and public health challenges posed by a steadily warming environment. They also see such technologies as a means of bringing farmers on the continent into global markets—both as food producers and as paying clients of the companies that build, sell, lease, or rent these digital and solar devices.

In all the talk about the potential of new cooling devices to open markets, there is surprisingly little mention of the microbes that cause food spoilage or food-borne disease. Technologies for cold storage of food are also technologies for managing the growth of fungi and bacteria. Yet the policy documents, corporate presentations, and marketing materials that present artificial cooling as a new development technology are silent about the microbial life inside these refrigerated worlds.

The production of new climate interiors for the African continent's food is also, fundamentally, about mold—or rather, efforts to control, manage, and live with mold. Refrigerated interiors provide a graphic illustration of the ways that human futures are entwined with those of microbes in a warming world.

Mold is a generic, non-scientific term for over a hundred thousand species of multicellular, filamentous fungi that live all around the globe. Mold spores are ubiquitous in air, water, and soil. When vegetables, fruit, or meats are placed inside a refrigerated unit, they carry spores into this new environment. Inside these dark, cold spaces, spores absorb moisture and gradually create the long, branching, microscopic filaments that biologists call *hyphae*. These threads eventually become visible to the human eye as they overlap into a complex network, the *mycelium*.

1 "The Earthshot Prize: Our Vision and Mission," The Earthshot Prize, accessed March 22, 2025, https://earthshotprize.org/our-vision-mission/.

Molds are dangerous because they produce toxic by-products, or mycotoxins, that can have harmful effects on human health when they are inhaled or ingested, particularly by people with preexisting vulnerabilities. The current consensus among environmental scientists, agronomists, and mycologists is that rising temperatures across Africa will increase the susceptibility of crops to mold and lead to an increase in mycotoxin contamination.

Over three hundred known species of mold belong to the genus *Aspergillus*. *Aspergillus* molds offer a distinctive entry point for studying climate interiors. They can be found inside damp and poorly insulated housing for refugees and students in the UK, where they provoke increased political interest in the quality and safety of low-cost rental housing. And they can be found in almost every food crop across the African continent.

Biology and food science journals contain detailed, country-specific studies—from Nigeria to India—documenting the risks of human exposure to *Aspergillus* from cereals, nuts, fruits, vegetables, and spices and seeds, as well as every meat and dairy product derived from animals that consume these crops as feed. The mycotoxins produced by *Aspergillus* molds as they convert organic matter into energy have been linked to lung disease, respiratory disease, and cancer.

↑ *Aspergillus* mold on onions.

A longstanding method of controlling pathogenic mold is the use of biochemical treatments, or fungicides, to eradicate spores. Fungicides destroy mold spores from the inside, breaking down their cellular structure. But a growing number of studies indicate that climate change is blunting the efficacy of some of the most common fungicides on the African market. Extreme heat, it seems, can increase the fungicide resistance of *Aspergillus* spores.

By contrast, cold chains are technologies of preservation. They keep microbes alive, even as they afford humans greater control over them. Unlike freezers for seeds or embryos that operate at sub-zero temperatures, refrigerators do not keep mold spores in a dormant state of cryogenic suspension. Instead, operating between 3°C and 6°C (between 38°F and 42°F), they simply slow the rate at which molds absorb moisture.

Of course, temperature is not the only factor controlling mold growth inside the fridge. Some foods—like those that are rich in proteins, carbohydrates, and fats—provide additional protection from the cold for microbial cells. Meanwhile, every time the door is opened, the rush of air causes spores to circulate, crossing between foods and adhering to rubber seals and plastic surfaces. Neither is temperature itself a given. Constant cooling inside an electrically powered refrigerator depends on a steady energy supply and ongoing maintenance. Such challenges are driving innovation in cold chains.

In October 2024, a trade fair for the off-grid solar industry took place in the Kenyan capital, Nairobi. The fair featured a raft of new appliances designed to help people living in low- and middle-income countries meet their needs for cooling without creating new carbon emissions. Products on display ranged from fans to refrigerators to evaporative air coolers, from milk chilling units to vaccine refrigerators—all powered by renewable off-grid solar energy.

These kinds of trade fairs have their roots in nineteenth-century commercial exhibitions held across the colonial tropics, which showcased technologies for storing and transporting ice, and opened up new markets for cold drinks and foods.[2] From South Asia to the Pacific, markets for cooling were defined by the thermal imaginaries of settler colonialists, who saw the heat of the tropics as an environmental force capable of shaping bodies and minds—both those they sought to subject to new rule, as well as those in power. In the early twentieth century, research into mold from food imported from Britain's colonies in Africa led mycologists to advocate for new methods to control temperature and humidity in cold-stored meats. Such arguments provided a basis for mass investments in artificial refrigeration.

2 H. I. J. K. Hobart, *Cooling the Tropics: Ice, Indigeneity, and Hawaiian Refreshment* (Duke University Press, 2023).

↑ Aspergillus mold cultures in a laboratory in India.

At trade fairs like the one in Nairobi, marketing for novel cooling technologies promotes prospects for the increased economic productivity and viability of exported goods. The solutions suggested in these spaces of techno-optimism present a familiar narrative of freedom from scarcity through technology. For farmers who have limited access to electricity and thus a high risk of food spoilage and exposure to dangerous mycotoxins, it would seem, the answer is solar-powered.

Off-grid, solar-powered cooling technology now makes up one of the fastest-growing segments of investment and innovation in renewable energy across Africa.[3] New companies like Keep it Cool or Sure Chill appeal to international investors and policymakers on several registers. They materialize a teleology of clean energy transition; they offer scalable solutions, apparently capable of achieving the same results regardless of geography; their products vary in size, from small solar-powered refrigerators and freezers to large cold storage facilities or cold rooms capable of cooling cubic tons of food.

*Aspergillus* spores provide the rationale for investment in the continent's new climate-controlled interiors, and in the companies that build them. These spores traverse supply chains for grains, cereals, fruit, and vegetables. In response, the threat of mold is leveraged across other supply chains, increasing demand for the imported silicon-based materials, metals, electronics, batteries, and plastics that are used to encase and insulate Africa's food products from a warming world.

**"Refrigerated interiors provide a graphic illustration of the ways that human futures are entwined with those of microbes in a warming world."**

The aspirations and ambitions for climate-controlled storage facilities in Africa have shifted in recent years. Ten years ago, business models promised to focus on local manufacturing and construction, and promised job creation. Today, they tout smart devices, assembled largely outside the continent, with sensors to monitor temperature and humidity, microprocessors to collect and store user data, and SIM cards that allow for mobile connectivity. In this new model, customers do not pay an upfront cost for cooling technology, but they sign a long-term pay-as-you-go agreement.

According to one nongovernmental alliance established to promote this model, "clients benefit from high quality cooling at better prices, and don't need to distract any budget to acquire the system. Technology providers benefit from a continuous income stream and can establish long-term relationships with their clients."[4] "Cooling as a service" is also cooling as a twenty-first-century surveillance system. Smart fridges and freezers allow companies to harvest data on real-time cooling practices. They also create a structure for carbon trading schemes, in which traders offset the use of high-emitting cooling technology in high-polluting markets with the use of clean technology in low-polluting ones.

The emergence of this new market-based intervention is just the latest chapter in a "biology of history," a century-long story of food scares and market-making that is written inside the cell walls of mold spores.[5] Today, ethically motivated entrepreneurs are helping to design new interior infrastructures for food storage on an irrevocably changing planet. As Rebeca Ibáñez Martín notes in this issue of *Limn*, the basics of these infrastructures are quite familiar: the modern greenhouse is built upon a nineteenth-century template, just as the twenty-first-century solar refrigerator echoes decades of anxiety about the effects of tropical air and humidity on food safety.

The refrigerated interiors being rolled out across the African continent promise to further integrate farmers into global markets. Knowingly or not, they also promise to rearrange the Earth's moldy ecology. ⊙

3 *Off Grid Solar Market Trends Report* (World Bank, International Bank for Reconstruction and Development, 2024).

4 "Cooling as a Service Initiative: How it Works," Basel Agency for Sustainable Energy, accessed March 22, 2025, https://www.caas-initiative.org/how-it-works/.

5 Hannah Landecker, "Antibiotic Resistance and the Biology of History." *Body & Society* 22, no. 4 (2016): 19–52. https://doi.org/10.1177/1357034X14561341.

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PHOTO CREDITS

p.32: Still from *Wrought*, a showcase of techniques for photographing and aestheticizing the microbial life of mold. CBS 2018, directed by Joel Penner.
p.34: Keep it Cool Corporate Publicity Photo.
p.35,36: Photos by Jamie Cross.

MORB

BIDITY


PEPSI

*Once it became clear that the story was going to be about extreme heat and its impact on people's health, then I think by instinct I started playing with the limits of what I imagine somebody's health to be. And again, on the lower end, the limits of what I imagine impact to be. Because the most drastic impact is, of course, death. And there is a preoccupation in journalism with death.*

*When I was a student of journalism, we were taught about these death equations—how the foreign press calculates whether a story is worth doing strictly by the number of deaths in any place, and the number of deaths [required] increases as you move further and further away from the West. For something to be story-worthy, the number of deaths has to be high enough.*

*And even with this story, we tried to find evidence of death. People on the ground kept telling us that four people died this summer. This is chatter in any neighborhood in India that you go to. When you ask people at the end of the summer how many people died because of extreme heat, they will say five people died this summer, or six people died this summer. No death certificate will ever spell that out. But this is what people ascribe as the cause of death in their own conversations.*

*We tried to sit down and have conversations with the families, get them to say to us that it was the heat that caused it. So, there was that traditional journalistic impulse guiding this story to some extent. But we couldn't find any clinching, compelling narrative about a death that happened because of heat. There was just community gossip.*

*Why I bring that up is to tell you that those outdated, boring impulses of journalism still guide us very much. The search for morbidity, the search for a very typical, classical story. For me, Sana being on edge multiple times throughout the day was a health impact angle. Just how much energy this extreme heat extracts out of her. How many times she finds herself at her wits' end, whether it is because of her children, whether it is because of neighbors, whether it is because of road rage—or is it just the physical exhaustion of not having running water available at home?*

*Water comes into the neighborhood twice a day. She has to go out and fill every container she can find in her house, of every size you can think of. You know, there are those giant barrels that look like they store crude oil, and there are these small, tiny plastic canisters that have been repurposed to store water. And she will find anything that she can get her hands on and fill it up with water and keep it because you never know how much water you need. Even with the limited space that she has, she's holding as much water as she can, and she's doing it all alone for nine people.*

*And that is what drew me to Kasia Bagan. To convince my colleagues that this is also part of the health impact. This is also part of climate, keeping people on their edge.* —Anant Gupta


EXP: 12/2
KANA

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*Climate in My Mind*
by Julie Livingston

# How does anxiety become an environmental relationship?

## Why is absolutely everything in this supermarket wrapped in plastic?

What if it rains so hard and long that the mountain collapses and buries my home? What is the actual carbon and chemical footprint of Israel's ever-expanding, genocidal war? Will the white pine-lined coves and rocky tide pools that I love survive the warming in the Gulf of Maine? If the veld catches fire in Botswana, how will people escape? What if one day there are no more lemons?

Anxious thoughts and images of the environment loop ceaselessly through my mind—some drawn directly from Bong Joon Ho's film, *Snowpiercer*—accompanied by a cascade of feelings. When it gets to be too much, I take a half a Xanax. It quiets the inside of my person, allowing me to tolerate what's happening out there in the polycrisis.

I am not alone. Climate grief. Eco-anxiety. Solastalgia. The mental health community is proliferating new terms and new diagnoses to capture widespread feelings of nostalgia for a lost landscape, fear, outrage, and profound sadness about the environment. The human mind, it turns out, is a key climate interior. Americans like me often experience such feelings as internal, located in a mind inside a body that is yet another form of private property. What could be more interior, more private, than anxiety or despair, even if that despair is about the external environment? But, on closer examination, so-called "eco-emotions" are rooted in what sociologist Jackie Orr calls "psychopower."[1] In her book on panic disorder in the US, she showed how public feelings of anxiety and panic are cultivated as personal and attended to as pathologies at the confluence of pharma, state, and science.

So, maybe I am internalizing what is rightly a public feeling. My Xanax is antipolitics, mediating the emergence of a collective political environment of ecological rage and despair. Shouldn't I feel anxious about the environment? Shouldn't I feel rage at how it manifests through fault lines of race and class, of political abandonment even as the profit-making continues? Shouldn't I feel despair at our collective failure? Shouldn't we all?

**"My Xanax is antipolitics, mediating the emergence of a collective political environment of ecological rage and despair. Shouldn't I feel anxious about the environment?**

Xanax is Pfizer Pharmaceutical's brand name for its most commonly prescribed benzodiazepine (now manufactured by Pfizer spin-off Viatris). With about fifteen million prescriptions annually, there are over three million Americans like me who rely on it with some regularity. And of course, Xanax is but one of many commonly consumed psychiatric medications. Nearly one in four Americans over the age of eighteen is taking a prescribed psychotropic drug, the culmination of a decades-long escalation in diagnostic creep and prescription response. The global market in psychopharmaceuticals had a projected value near $50 billion in 2020 and continues to rise.

So while I am grateful for the relief, turning to drugs to manage public feelings as private pathologies is both depoliticizing and widespread. And my turn to Xanax is not simply antipolitics. It is also a biochemical event, one that scales up through the external environment just like my feelings of anxiety and despair.

Following psychopharmaceuticals from production onward scrambles any clear separation between the exterior and interior environments of catastrophe—in a very material sense. People in the US have many reasons to be anxious besides the environment. Housing precarity and consumer debt abound, as does political abandonment. Children grow up with active shooter drills and the pressure to craft a public self. But whatever brings someone to seek relief in Xanax, the pill itself brings them into an environmental relationship.

Pharmaceutical production is a major global industry, and it is a dirty, loosely regulated one. Making drugs is more emissions-intensive than making automobiles. Now, a few leading pharma firms are making efforts to reduce carbon emissions in manufacturing (and greenwashing their profits by promoting those efforts). Yet the environmental impact of the drug industry goes far beyond just its carbon footprint.

Take Puerto Rico.[2] There, despite protest from community groups, tax breaks to pharma totaling $14.5 billion annually (more than the Puerto Rican government's

operating budget) have helped make the island into the world's third-largest biotech manufacturer. Currently, more than fifty pharmaceutical plants operate in Puerto Rico, producing a range of top-selling drugs for cancer, arthritis, heart disease, autoimmune disorders, and more, including psychopharmaceuticals like Prozac and Ativan, another benzodiazepine. Pharmaceutical manufacturing has produced fifteen EPA Superfund sites on the archipelago. Pharmaceutical runoff flows into freshwater systems feeding into the sea, where it has led to significant die-offs of fish stock in local waters, in turn hampering livelihoods. Toxic waste from the production process has also polluted the aquifer, tainting the well water that many rely on. This reliance became more acute in the wake of Hurricane Maria—itself a climate change catastrophe—which destroyed the island's water system.

Even far from the site of production, the drugs we ingest in our internal environment find their way back out into the external one. As humans consume psychotropic drugs at escalating rates, we excrete these chemicals and their metabolites back into the environment, where they persist and accumulate over time. And it is not only humans. Antianxiety drugs grease the wheels of industrial meat production, sedating cows and pigs and sheep, so that the stress of the breeding pen or slaughterhouse doesn't negatively impact the quality of their flesh. Animals, too, excrete the drugs and their metabolites back into the environment. Water treatment plants vary in quality and do not clear all these chemicals. Besides, on a day of heavy rain in New York City, where I live—the kind of day that is becoming more common—stormwater and wastewater mix and pour directly into the Hudson and East Rivers. The Xanax I take when the conditions in my inner environment become unbearable will find its way into the river and out to the Atlantic estuary, where it will be taken up by algae, phytoplankton, insects, mollusks, and fish.

Psychiatric drugs now abound in aquatic ecosystems, sedimented into sludge, soil, and the tissues of aquatic life. They are in the plankton that forms the foundation of the marine food chain; they are in the fish. Even in extremely low concentrations these drugs inhibit the stress response in fish, making them more aggressive, altering their feeding behavior. They affect the locomotor and reproductive systems of mollusks and crustaceans. In other words, efforts to blunt internal feelings through drugs have knock-on effects on the external environment that harm our fellow species on this planet—a grim irony.

The external environment also re-enters the internal one as these same drugs and their metabolites feed back into our own human biochemistry. They are in the sludge that becomes agricultural fertilizer. They are in the food we eat and the soil in which it grows. They are in our drinking water. In New York City, as elsewhere, trace amounts of antianxiety drugs, barbiturates, and mood stabilizers have been found in the tap water. One secondary analysis of pharmaceutical residue in drinking water in Europe and North America found that if a pregnant person drank an average of two liters of tap water per day, they would have a cumulative ingestion of five percent of a clinical dose of Valium (diazepam) over the course of the pregnancy.[3] Public health authorities reassure us that these are very small concentrations, an order of magnitude below the therapeutic threshold, and that they pose no significant threat to human health. But the science that governs the dispensing of these drugs does not account for potential bioaccumulation in fish, exposure in utero, or other subclinical registers of accumulation or chronic exposure, much less how these chemical agents interact with one another.

So the drugs leak back and forth between internal and external environments in ever-decreasing quantities. There is no magic bullet, it seems, only a pharmakon. We cannot hope to medicate our way out of the polycrisis—neither I with my Xanax nor you with yours. Identifying points of intervention in this vicious cycle I've sketched is difficult. There is no single entry or exit door, no golden thread to pull that would unravel the system of harm. But perhaps a first step is a collective recognition of widespread psychic pain—of despair, rage, and anxiety as shared political feelings, rather than private pathologies. ⊙

1 Jackie Orr, *Panic Diaries: A Genealogy of Panic Disorder* (Duke University Press, 2006).

2 Alexa Dietrich, *The Drug Company Next Door: Pollution, Jobs, and Community Health in Puerto Rico* (New York University Press, 2013).

3 Abby C. Collier, "Pharmaceutical Contaminants in Potable Water: Potential Concerns for Pregnant Women and Children," *Eco Health* 4, no. 2 (2007): 164–71.

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PHOTO CERDIT

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NIVEA
sun
intense &
bronze
6
125ml
ANTI
MANCHAS

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*Skin Deep*
by Alex Nading

# What if skin care is really planetary care?

# Say what you will about Florida Governor Ron DeSantis, but the man has got a nice tan.

He's got that youthful, coppery hue that signifies virility and prosperity in the modern white male. I'm not sure anyone has ever asked him about his skin care routine, but we do know a bit about his skin care politics.

Back in 2020, DeSantis and the Republican-led Florida legislature overturned a measure by municipal authorities in Key West that would have banned the sale of sunscreen that contained oxybenzone. Oxybenzone is an aromatic ketone that is a highly effective absorber of both UVA and UVB radiation. It is commonplace in plastic toys, food packaging, paints, and most anything that can be damaged by long-term exposure to sunlight. But oxybenzone, the same substance that helps keep Governor DeSantis's skin just white enough, has also been suspected of contributing to the bleaching of coral reefs.[1] The Key West sunscreen ban was passed to protect coral, and it was modeled on a 2018 ban on oxybenzone-containing sunscreens in Hawai'i . Bans were later approved in the US Virgin Islands, Aruba, Palau, Thailand, and Bonaire.

The controversy over oxybenzone reminds us that, as Mél Hogan puts it, "Life is sun in the skin."[2] The skin is not the hard border of the body's interior, but a porous membrane, a surface of radiochemical encounters where climate becomes body and body becomes climate.

Sunscreen is a chemical supplement to the dermal membrane, a kind of second skin. It's not the only one we use. The body that is kept warm and dry on one day in "waterproof, windproof, breathable" Gore-Tex (which often contains carcinogenic per- and polyfluoroalkyl substances, or PFAS), might on another day be insulated from UV radiation by a sunscreen containing oxybenzone. Substances like oxybenzone and PFAS leech into bodies via the skin, but like psychopharmaceuticals (see Livingston, this issue) they also leak out into water, air, and soil.

1 Irus Braverman, *Coral Whisperers: Scientists on the Brink* (University of California Press, 2018).

2 Mél Hogan, "Skin," in *Solarities: Elemental Encounters and Refractions*, ed. Cymene Howe, Jeff Diamanti, and Amelia Moore (Punctum Books, 2021), 43–48.


→ Widespread knowledge about the health costs of "fun in the sun" has blurred the lines between cosmetic marketing and public health.

## THE POROUS MEMBRANE

Oxybenzone is sometimes referred to as a "UV filter." It doesn't so much block dangerous UV rays as prevent them from penetrating the inner layer of the skin, the dermis. As a Stanford University study explains, oxybenzone works by first absorbing UV light and then deflecting "light energy as heat."[3]

Coral reefs are filtration systems, too. Corals support filter feeders like sponges, which form another sort of membrane, one that absorbs and expels pollutants from seawater. But as the Stanford study found, when oxybenzone is metabolized inside corals, "the resulting substance [forms] damaging radicals when exposed to sunlight." When it is absorbed into reefs, oxybenzone makes sunlight *more* dangerous for corals, contributing to the process known as bleaching, a sign that a reef is in critical condition.

The irony is obvious. Some fourteen thousand tons of sunscreen are washed off of swimmers' bodies and into reef systems every year. The temporary chemical membrane formed by sunscreen permits nature lovers to cultivate a youthful appearance and to prevent unsightly burns, while gazing with wonder upon the dazzling color spectrum of coral reefs. But when it breaks down in the water, this very same membrane helps destroy that color. The upshot is that ecotourism kills its object.

The idea that more attention paid to reefs from well-intentioned, affluent, mostly white tourists may do more harm than good is not news. Such Anthropocene leisure activities have shaped economic development projects in small island states for some time.[4] So it is not surprising that the first calls to ban oxybenzone in the US came from Hawai'i. There, a sensitivity to the continued settler exploitation of natural resources exists alongside a recognition of the economic reality that ecotourism means jobs and tax revenue.

Scientists advocating for the ban in the medical journal *Lancet Planetary Health* quoted the Hawai'ian proverb, "Though the sea be deep and rough, the coral rock remains standing."[5] This is as much a statement about the enduring presence of Indigenous islanders as it is about the extraordinary longevity of corals, whose colonies can last for thousands of years. Reconciling the use of cosmetics to preserve the fleeting appearance of youthful skin with the effort to sustain ecosystems whose lifespans transcend hundreds of human generations is no easy task.

3 "Stanford Report: Understanding How Sunscreens Damage Coral," Stanford University, May 5, 2022, https://news.stanford.edu/stories/2022/05/coral-killing-sunscreens.

4 Amelia Moore, *Destination Anthropocene: Science and Tourism in the Bahamas* (University of California Press, 2019).

5 Jayden Galamgam, Natalia Linou, and Eleni Linos, "Sunscreens, Cancer, and Protecting Our Planet," *Lancet Planetary Health* 2, no. 11 (2018): e465–66. https://doi.org/10.1016/S2542-5196(18)30224-9

**"The skin is not the hard border of the body's interior, but a porous membrane, a surface of radiochemical encounters where climate becomes body and body becomes climate."**

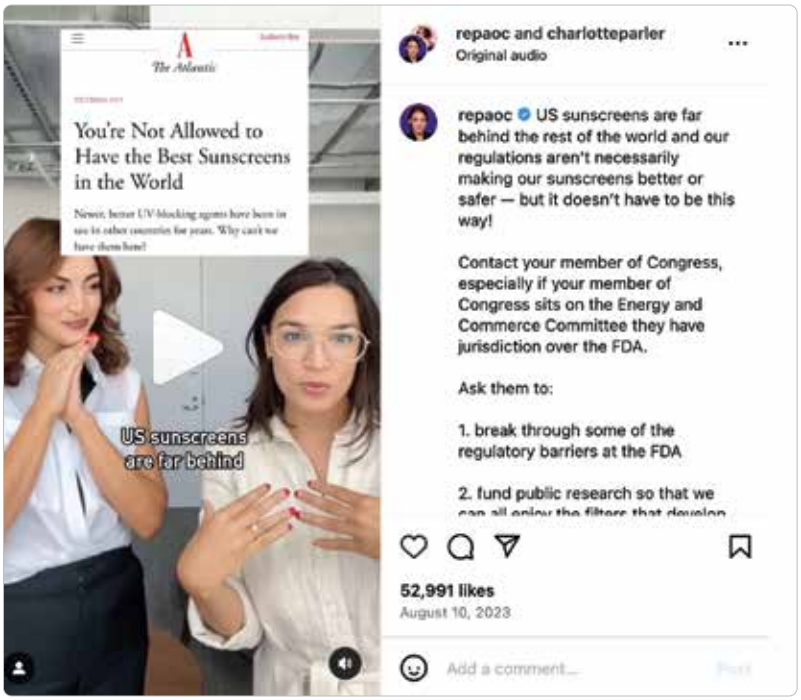
## COSMETIC SOLUTIONS

← Sunscreen enables close encounters with coral reefs, even as it potentially accelerates coral bleaching.

↓ Alexandria Ocasio Cortez discusses sunscreen with Charlotte Palermino.

Sunscreen is designed to mediate between inside and outside. It seeps into the pores to the point of invisibility, and its intended effect is to modulate a body's exposure to UV rays. *Modulate*, not *eliminate*. Sunscreen allows users to imbibe the sun without overdosing. Products tend to be formulated with synthetic fragrances that mimic coconuts, bananas, and flowers, as if to reinforce the dominant assumption that a communion with sunlight is a communion with tropical nature itself.

Sunscreen looks and smells like a cosmetic, but its value is in its efficacy as a tool for securing health. Sunscreen is promoted by its corporate makers and government regulators as a means of preventing both skin cancer, undeniably a health issue, and the visible signs of aging, an issue that crosscuts health and aesthetics. A coral reef's glowing beauty is a sign of its health, too, but corals age at a radically different pace, forming the structure of reefs over thousands of years—which is countless epochs of changing beauty standards.

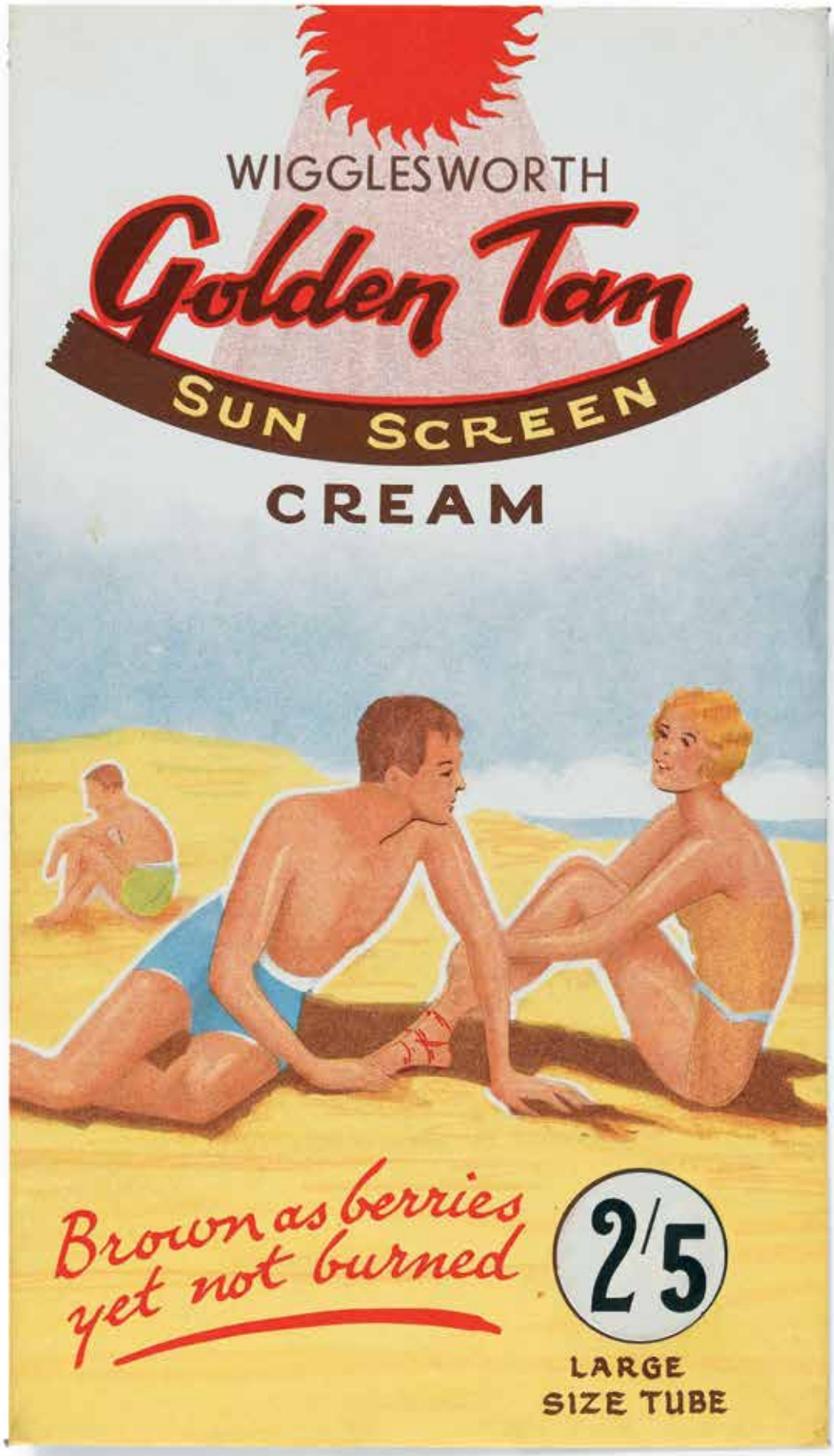



Around the time of the DeSantis and Key West dustup, US Representative Alexandria Ocasio-Cortez of New York took to social media to point out that the sunscreens on American markets—laden with ingredients like oxybenzone—were obsolete. In a video that was part policy brief and part skin care vlog, Ocasio-Cortez appeared with Charlotte Palermino, Chief Brand Officer of Dieux Cosmetics. Together, they informed viewers that in Korea and Europe, consumers have access to "better" UV filtration creams, with newer and safer ingredients.

The reason for this gap in innovation, Ocasio-Cortez explained, is regulatory. Since the 1970s, the US government has regulated sunscreen via the Food and Drug Administration as an over-the-counter drug; most other countries regulate it as a functional cosmetic. Ocasio-Cortez won the support of some of her Republican colleagues when she called for an end to the bureaucratic red tape that was hampering Americans' access to safer sun protection alternatives. Just as DeSantis was criticized by environmentalists in the Florida Keys for his shortsighted stance on oxybenzone, Ocasio-Cortez was pilloried as a "sellout" by members of the Democratic Socialists of America, who saw her call for the deregulation of skin care as an unserious neoliberal detour from the progressive cause.[6]

But maybe Ocasio-Cortez was onto something. Skin care—care about both the youthful glow of the epidermis and the internal integrity of the dermis—can be a kind of political action. When anxious parents insist on coating their children's skin in oily chemical membranes, they are helping to instill a sense of bodily responsibility. Children resist (I certainly did), but over time, most come to embrace sun protection as a good thing, partly because it permits sustained communion with nature.

6 Wilfred Chan, "Sunscreen Socialism: AOC Divides the Left with Call for Better Skincare Options," *Guardian*, August 17, 2023.


WIGGLESWORTH
Golden Tan
SUN SCREEN
CREAM
Brown as berries yet not burned
2/5
LARGE SIZE TUBE

↙ A 1930s British advertisement for sunscreen links skin tone, lifestyle, and health.

That communion begins with the skin. This insight should be no surprise to the millions of people, from Hawai'i to Australia to India, who experience the eco-anxieties of coral bleaching alongside the racial anxieties of skin bleaching and enduring colorism. The science of UV radiation, skin, and health is thoroughly bound up with that of race. As early as the 1820s, tests were hypothesizing a relationship between skin pigmentation and the risk of sunburn. Even today, dermatology tends to treat "fair-skinned" bodies as the primary targets of sun protection measures, among other interventions.[7] In the early twentieth century, sunbathing and tanning were growing in popularity, and during the World Wars, exposure to excessive sun became a security concern, because sunburns hampered the efficacy of fighting forces, particularly in the Pacific and North Africa. To calibrate the amount of UV radiation they admitted under their skin, holidaymakers and soldiers alike made temporary membranes out of everything from chestnut oil to benzyl salicylate to veterinary petroleum to the synthetic silk known as Celanese fabric.[8]

This membrane-making was not solely oriented to tropical exposure. In fact, the first modern sunscreen was marketed as "Glacier Cream." It was invented in the 1950s by the Swiss chemist Franz Greiter, who also created the metric by which most people still gauge their lotion's protective power—the Sun Protection Factor, or SPF. Sunscreen did not really become commonplace until the 1970s, around the time of the rise of the automobile safety belt (and the tanning parlor). The FDA did not begin regulating it in the US until 1978. Oxybenzone was widely integrated into most products in the 1980s, when I was a child (squirming, hiding, screaming, throwing a tantrum at the first sign of the Coppertone bottle in my mother's hand).

It was while I was mounting my bratty resistance, sometime in the middle of the Reagan administration, that skin care and care for the planet merged. In 1983, there were nearly half a million cases of nonmelanoma skin cancer reported in the United States. By 1992, that figure had doubled.[9] Midway through this alarming rise, in 1987, the Montreal Protocol was enacted to phase out chlorofluorocarbons and protect the ozone layer, which experts sometimes call "Earth's natural sunscreen."

Sunscreen enables a direct encounter not just with heat and light, but with the world's most sensitive ecosystems, from the sunny Alpine slopes where Greiter got the idea for Glacier Cream, to the Atlantic beaches and reefs that attract thousands of visitors to Florida. When divers and snorkelers gaze upon coral reefs—as I once did at age thirteen, rebelliously un-sunscreened, leading to a second-degree blister on my shoulder—they cannot directly see the complex living infrastructure in which microbes, algae, fish, sponges, and, yes, chemicals circulate. What they see, and what they care about, is the beauty on the surface.

Applying sunscreen is one means of controlling the human aging process—of stemming the onset of wrinkles and blemishes that might turn into cancers. Bleaching, cancer, and aging are all results of the absorption and dissipation of radiation across natural and artificial membranes. The colors corals display, and which disappear due to human disturbance, are signs of a vitality that does not correspond to human conceptions of "youth." Coral disease is not a sign of their aging, so much as a sign of an all too human desire to stave off the march of human biological time and extend the experiences of capitalized leisure. If we contemplate what gets filtered and what gets metabolized, what metastasizes, what bleaches, what wrinkles, and how, maybe we can begin to think of planetary health as a question of growing old gracefully. ⊙

7 Angela Reyes "Real Fake Skin: Semiotics of Skin Lightening in the Philippines," *Anthropological Quarterly* 93, no. 4 (2020): 653–78, https://doi.org/10.1353/anq.2020.0073; Andrea Ballestero and Yesmar Oyarzun, "Devices: A Location for Feminist Analytics and Praxis," *Feminist Anthropology* 3, no. 2 (2022): 227–33, https://doi.org/10.1002/fea2.12108.

8 Christopher M. Rudeen, "Securing a Place in the Sun: Clothing, Exposure, and Health," in *Wearable Objects and Curative Things: Materialist Approaches to the Intersections of Fashion, Art, Health and Medicine*, ed. Dawn Woolley, Fiona Johnstone, Ellen Sampson, and Paula Chambers (Springer International Publishing, 2024), 133–59.

9 Eva Rawlings Parker, "The Influence of Climate Change on Skin Cancer Incidence—A Review of the Evidence," *International Journal of Women's Dermatology*, Special Issue on Climate Change & Dermatology, 7, no. 1 (2021): 17–27, https://doi.org/10.1016/j.ijwd.2020.07.003.

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*Twilight Shift*
by Bharat Jayram Venkat

# How does global shipping deliver thermal inequality?

**Several days a week, John Ormiston clambers into his truck and delivers packages across California's San Fernando Valley.**

John has been at UPS for thirteen years. The first decade was spent not behind a wheel, but in a warehouse hub, where dangerous heat exposure has become almost as common as bad traffic. He primarily worked the twilight shift, from about 5:30 in the evening until about 11 o'clock at night. "We worked in a building that was not air-conditioned," John told me. "On hot summer days, the building would be hot, and it would stay hot well into the night."

On a consistently clear day, the amount of solar radiation that reaches the Earth's surface peaks around noon. Back in 1931, the playwright Noël Coward famously asserted that only "mad dogs and Englishmen go out in the midday sun." But for those who work indoors, the hottest part of the day can arrive far later. Warehouses like the one that John worked in, which provide employment for people across the United States, absorb heat throughout the day and slowly release it into their environs as ambient temperatures drop. In turn, the working bodies in these warehouses absorb this heat. The problem for American warehouse workers is not going out at midday, but staying inside at twilight.

Those evenings were so hot, John explained, "you'd still be sweating just kind of standing around." And he was never just standing around. "Throughout the whole ten years, every job that I've had has been extremely labor-intensive and physical. I've loaded, unloaded, but predominantly, I was a sorter. Sorting is a fast-paced job where you take boxes that are unloaded off of one conveyor belt and you put them onto a system of other conveyor belts. And that's a *very* fast-paced job."

From the perspective of commercial logistics networks, Los Angeles is a city of warehouses connected by highways and roads that facilitate the movement of boxes within boxes. Each day, shipments arrive at warehouses where they are stacked, sorted, and loaded into the cargo holds of trucks by human workers. If all goes to plan, other human workers drive these trucks across the city, delivering packages to their destinations.

But not everything always goes to plan. On July 25, 2022, Esteban Chavez Jr.—"lil Stevie" to his friends and family—was found slumped behind the wheel of his delivery truck in Pasadena, unconscious, packages undelivered. Chavez had returned to work a week earlier after convalescing from a shoulder injury, just in time for a heat wave that saw temperatures across Pasadena hitting the high 90s°F/30s°C. And only a day before, he had celebrated his twenty-fourth birthday.

→ Warehouses accumulate heat over the course of the day, making the twilight shift the hottest time for workers.

Shortly after Chavez's death, UPS drivers began taking temperature readings inside their trucks, especially in the cargo area, revealing temperatures far above 100°F/38°C. As these readings were likely taken with off-the-shelf temperature guns, they have been criticized as measuring only surface temperature—of packages, the metal walls of the cargo area, etc.—rather than the heat stress experienced by workers. Nevertheless, it's fair to say that these cargo holds were and are dangerously hot.

Delivery trucks are like warehouses in that they're metal boxes that absorb and radiate heat. But they're also like bodies, in that they both absorb heat and produce their own as they ply the streets. They are mobile architecture, a mass noun that's always on the move, an indispensable part of the urban fabric (and the modern economy) as we currently live it.

None of this was news to the management at UPS. Back in 2019—three years before Chavez's death—NBC News reported that temperatures in delivery trucks were climbing as high as 140°F/60°C. In response, the Vice President of Public Relations at UPS, Steve Gaut, insisted that air conditioning was an "ineffective" solution. Delivery vans, like the one in which Chavez would die a few years later, stopped and started too frequently to achieve adequate coolness.

↓ Boxes out for delivery in trucks that get hotter as the day progresses.


**"In the United States, those who are made most vulnerable to the heat, whose bodies and lives are rendered expendable, tend to be working-class people of color. Drivers, and *not* executives. Those who work in trucks, and *not* those who work in the C-suite."**

In a social media post from August 2, 2022, a faction of Teamsters juxtaposed their working conditions with that of the managerial class: "UPS CEOs would never accept working in 120 or 130-degree offices [49°C or 54°C]. Drivers shouldn't have to either."

What their post laid out is a key dimension of what I've described elsewhere as *thermal inequality*: the unequal distribution of the negative effects of heat, in ways that frequently overlay and exacerbate preexisting forms of social harm.[1] As part of a larger project, I've been focusing on how climate change, and heat specifically, is experienced from the vantage point of our bodies, enmeshed as they are within an economic system in which some people are made to sacrifice their health, their bodies, their very lives—what Zoé Hamstead has described as a kind of "institutionally-sanctioned violence"—precisely so that others don't have to.[2]

And it's not just any lives. In the United States, those who are made most vulnerable to the heat, whose bodies and lives are rendered expendable, tend to be working-class people of color. Drivers, and *not* executives. Those who work in trucks, and *not* those who work in the C-suite. And, to some extent, those who deliver consumer goods, and *not* those who receive them at their front door. Of course, certain goods—medications, foods, technologies—must be kept in cold storage throughout the transport process to maintain their efficacy or freshness. As with the earliest iterations of mechanical climate control—used to improve production processes so that ink wouldn't run and threads wouldn't snap—the working body is cooled only incidentally.


↑ Social media post by the Teamsters Union dramatizing the thermal inequalities of global shipping.

Seen from this perspective, the division of labor is fundamentally, if often imperceptibly, about the distribution of thermal exposure, made all the more extreme by rising temperatures both inside and out. The homogeneously air-conditioned inside weather that the architectural historian Daniel Barber describes as the "global interior" only extends to certain kinds of indoor spaces.[3] The distribution of thermal exposure is also about the division of *laborers* across these unevenly conditioned spaces: in other words, it is about the kinds of people that are forced into certain kinds of high-exposure jobs.[4]

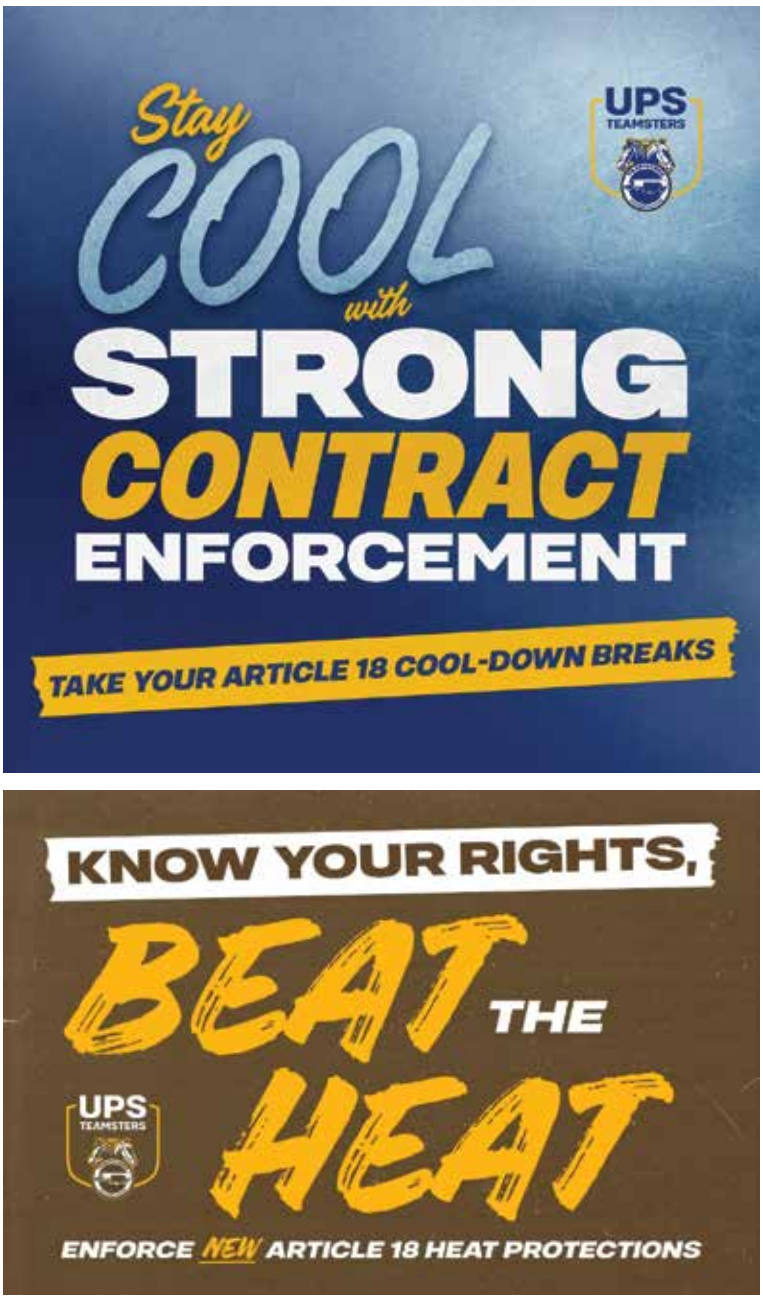
In 2023, just over a year after Esteban Chavez Jr.'s death, members of the Teamsters Union ratified a contract with UPS, after threatening to strike during what was described as "Hot Labor Summer"—not coincidentally, the hottest summer in recorded human history up to that point. The contract stipulated that delivery vans purchased in the new year would include air conditioning in the driver's area, although not in the cargo hold, as well as various other heat-related protections. (This was but the latest concession that UPS had made to the heat. Back in 2006, the company had introduced "Cool Solutions," a suite of interventions to prevent heat-related illness among their workers that largely amounted to making sure that water, ice, and electrolytes were

1 Karina Brunn, Olivia Toledo, Chelsea Tran, Ashwin Vasudevan, and Bharat Jayram Venkat, "Carceral Heat Exposure as Harmful Design: An Integrative Model for Understanding the Health Impacts of Heat on Incarcerated People in the United States," *Social Science & Medicine*, 367 (2025): 117679, https://doi.org/10.1016/j.socscimed.2025.117679.

2 Zoé Hamstead, "Critical Heat Studies: Deconstructing Heat Studies for Climate Justice," *Planning Theory & Practice* 24, no. 2 (2023): 153–72, https://doi.org/10.1080/14649357.2023.2201604.

3 Daniel Barber, "The Shaded Modernism of the Global Interior: Climate and Risk in the Architecture of MMM Roberto, Rio de Janeiro, 1936–1955," in *Weather, Climate, and the Geographic Imagination: Placing Atmospheric Knowledge*, ed. Martin Mahony and Samuel Randalls (University of Pittsburgh Press, 2020), 232-273.

4 Bharat Jayram Venkat, "Can the Subaltern Sweat?," in *The Routledge Handbook of Subalterns Across History*, ed. Saurabh Dube and Ishita Banerjee (Routledge, 2025), 211-220.




↑ Teamsters' Union graphics reminding UPS workers of new language in Article 18 of their contract offering enhanced protections from the heat.

widely available, and that managers reminded their crews about the most obvious symptoms of heat-related illness.)

Just a day after the ratification of the new contract, Christopher Begley, fifty-seven years old, began to feel ill while completing his delivery route for UPS in northern Texas. As he delivered the final packages of his twenty-seven-year career, outside temperatures soared above 100°F/38°C. Begley was given a few days off to recover, during which time he was hospitalized and died.

When we focus on these delivery trucks, Los Angeles seems less the exception than the rule, and cities like Dallas and Indianapolis start to look more like Los Angeles than we might expect. When the center is the warehouse hub rather than a nostalgic downtown, and when you follow boxes and the people who deliver them, urban political boundaries start to fade in favor of supply chains and distribution nodes. But this is more than just an exercise in comparative urbanism. The uneasy geometry of these networks enables the distribution of heat in unequal ways, and further scrambles the porous distinctions between inside and outside. In fact, commercial logistics networks seem to multiply insides. There is an interior microclimate within the box carrying heat-sensitive medications, and within the truck that carries these boxes along with its human driver. There is also, of course, the interior of the warehouse, where packages arrive off of long-haul trucks, trains, and ships, before being redistributed along local delivery routes.

Jamison Eleuterio, a former UPS warehouse worker in Dallas (now unemployed due to a hernia he developed on the job), described to me his first week of heaving packages at the loading docks. Like John, he also worked the twilight shift. "I ended up throwing up from just the amount of heat and all the work I was doing. I was pretty miserable."

Jamison added that he had "only" experienced acute heat-related symptoms—vomiting or pain in his chest—a few times while working at UPS. More often it was a baseline hum, a "lack of focus, where you're just so hot and drenched. Your body—your body gets noticeably more tired working in the heat. Sometimes your skin feels like it's getting pinched by the heat…. You do get considerably more, I guess, fuzzy in the head, because of how hot it is."

Heat stress is about more than the heat you absorb from the warehouse. It's also about work—the metabolic heat that your body generates to keep you alive, to make your muscles contract, to stack boxes and fill trailers. It should come as no surprise that one of the origins of the field that came to be known as occupational environmental physiology was another hot microclimate, the apartheid-era South African mines studied by physiologist Cyril Wyndham. Wyndham conducted research on Bantu, Nyasa, and other African peoples

working in these mines in order to determine physiological limits to working in heat, as well as strategies for achieving optimal acclimation among different ethnic groups. His version of thermal physiology, which became globally prominent in the mid-twentieth century, was premised on ideas of racialized physiological differences.

Across the twentieth century, researchers of thermal physiology have been aware of the fact that heat is less often an event, and more often an ongoing process. Working in a warehouse, what's far more common than heat exhaustion or heat stroke is a gradually accumulated thermal burden. Yet, physiologists have struggled to characterize the effects of these accumulated lower-level heat exposures—what Jamison experienced as tiredness, tightness, and fuzziness. Institutional ideas about safe or acceptable thresholds for heat exposure have usually been tied to an event-based conception of illness, rather than a cumulative, deteriorative understanding of heat and bodily harm. In California, the recently established indoor heat standard requires employers to provide certain remedies only when a specific temperature threshold is met: 82°F/28°C.[5] But if you're slowly simmering at 81°F/27°C, there's no recourse.[6]

"For obvious reasons, they don't want us to slow down if we don't have to," explained Stephen, a forty-two-year-old army vet and former UPS employee in Indianapolis (before he too suffered a shoulder injury). "But obviously, when it gets that hot, you know, some people just can't keep up that pace." As I heard from numerous warehouse workers, managers at UPS cajole and threaten workers to keep them working quickly, to fulfill quotas and keep boxes moving—but they also have to remain within safety quotas, measured in injuries and illnesses and days off. And the managers experience pressure to meet these quotas from their own supervisors; as Stephen put it, "crap runs downhill."

5 California Code of Regulations, Title 8, Section 3396, "Heat Illness Prevention in Indoor Places of Employment." The standard went into effect on July 23, 2024.

6 This idea is slowly changing in certain parts of the agricultural sector. See Alex Nading, "The Heat of Work: Dissipation, Solidarity, and Kidney Disease in Nicaragua," in *How Nature Works: Rethinking Labor on a Troubled Planet*, ed. Sarah Besky and Alex Blanchette (University of New Mexico Press, 2019), 97-113.

## "Buildings are soaked in heat; bodies are soaked in sweat."

Stephen also worked the twilight shift, loading trailers. I began to realize that *twilight* was not simply an index of a particular time period, bookended by sunset and the darkness of night. Twilight is instead a concatenation of space, time, and labor, congealed by heat, both metabolic and environmental. Twilight offers a way of synchronizing experiences of labor in what are otherwise very different places.

"Sometimes I was just sweating so much, and I think this is true for all of us working: It felt like we jumped into a pool with all of our clothes on. We were that soaked," Stephen said. "As the day goes on, you know, the sun is just soaked on everything. The heat just kind of gets in the building. Once everything gets hot, there's just not nowhere else for the heat to escape. So it just soaks in."

Buildings are soaked in heat; bodies are soaked in sweat. In writing about low-wage warehouse workers, the geographer Juan de Lara notes that "their trace—their sweat and labor—is often undetectable in the things we buy."[7] Such outlays of life and labor, central to the logistics networks that undergird much of contemporary life, are systematically effaced by an aesthetics of convenience, and by a fetish of the commodity. Some people soak in sweat, in indoor climates conditioned only by the demand for profitability, so that others don't have to. ⊙

7 Juan de Lara, *Inland Shift: Race, Space, and Capital in Southern California* (University of California Press, 2018), 90.

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p.59: Image via X.
p.60: Teamsters for a Democratic Union.

A C T

P L A

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A N S

*Everybody in India is convinced that Kolkata is dying. Kolkata is declining. Kolkata is decaying, right? So that was part of the allure of Kolkata, of locating the story in Kolkata, because Ahmedabad has got a Heat Action Plan. Mumbai has a Climate Action Plan. Delhi's got a Climate Action Plan. Kolkata has got nothing. This is nowhere close to Kolkata's priorities. Their concerns are about perennial rains in Bengal, which lead to flooding in Kolkata. But nobody's talking about extreme heat in Kolkata. And I think that's because it's a very humid city, so people tend to assume that it's never going to be as crazily hot as, say, Delhi.*

*But the temperatures have been consistently rising. And in fact, when I was there last summer for the story, I noticed the West Bengal government has started sending out these SMS's whenever it gets too hot—whenever it crosses 40°C [104°F], you get an SMS saying, "Don't go out" in Bangla. That's all you get, unless you're a government employee. If you're a government employee, you might get a day off.*

*In Kolkata, you don't have technocrats hovering around writing op-eds regularly, doing podcasts talking about the importance of addressing climate change. The politics of the city is still very different compared to what we see in other cities.*
—Anant Gupta

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*The Architecture of Vector Control*
by Elizabeth L. McCormick, Ann H. Kelly,
& Ibrahim Msuya

# Can bricks be made to breathe?

**Houses in the towns and urban centers of Tanzania's Kilombero Valley share several characteristics.**

↑ A house in Dar es Salaam.

While some are built from wattle and daub and others brick and plaster, most conform to the "Swahili style," a rectangular and modular layout with several rooms branching off a central corridor. Many of these houses are also characterized by their unfinished state—missing portions of walls or roofs leave sections exposed where crops like beans, cassava, and sweet potatoes are grown.[1] The windows, or rather window-like forms, are the most striking—suggestive rectangles covered up with bricks, clay, *kangas* (clothing fabrics), or burlap bags, awaiting the necessary funds to procure a frame, metal mesh, or glass.

While they provide homes for Kilombero Valley families, these unfinished houses pose public health problems. Sealed-up windows create dark, hot, potentially toxic interiors where contaminants and particulates can accumulate, particularly when cooking indoors. Gaps in the eaves between the walls and ceilings can provide some natural light and ventilation, but such openings introduce other risks, most notably malaria-transmitting mosquitoes—disease vectors that thrive in the valley's vast alluvial floodplain. Mosquitoes are drawn inside by the heady perfume of carbon dioxide and human sweat. The result is a persistently perilous domestic existence, what anthropologist Mike Degani describes as a house that "entombs the living."[2]

1 Claire Mercer, *The Suburban Frontier: Middle-Class Construction in Dar es Salaam* (University of California Press, 2024).

2 Michael Degani, "Air in Unexpected Places: Metabolism, Design, and the Making of an 'African' Aircrete," *Cambridge Journal of Anthropology* 38, no. 2 (2020): 125–45, https://doi.org/10.3167/cja.2020.380209

← Window infill materials in and around Ifakara and Dar es Salaam.

The connection between health and housing has emerged as a key area for mosquito-borne disease research and intervention. The large-scale rollout of insecticide-treated nets and indoor residual spraying of insecticides has resulted in lowering the risk of malaria. In recent years, however, the World Health Organization has reported that progress has stalled. Increasing insecticide resistance is a major driver of malaria's resurgence. But labor is also an issue. Frontline tools like nets and spraying require consistent use, continual reapplication, and comprehensive coverage, which is difficult to sustain.

In light of these challenges, malariologists, health policymakers, and designers are working to "build the vector out" of domestic environments. The result is a series of innovations including low-cost screened doors and windows, insecticide-treated barriers for eaves, solar chimneys, and ceiling fans. While scalable and promising, these enhancements of domestic space do run up against the problem of local uptake. Techno-fixes require adjustments to the material structure of the house, as well as ongoing maintenance and investment.

**"What if the very notion of interiority were reconsidered? Could the home itself be reimagined as a more porous, more adaptive system—one that not only blocks disease vectors, but actively reshapes flows of air, light, and human activity?"**

These interventions largely operate within a familiar paradigm, one that presumes the home is a fixed interior to be fortified against external threats. But what if the very notion of interiority were reconsidered? Could the home itself be reimagined as a more porous, more adaptive system—one that not only blocks disease vectors, but actively reshapes flows of air, light, and human activity? While the twentieth century saw the interior sealed off and mechanized in pursuit of comfort and control, the twenty-first century demands a more dynamic approach, one that acknowledges the leaky, contingent nature of domestic space. In this context, the brick, the world's most accessible building material, offers not just a structural solution but a conceptual shift. The brick is a tool for rethinking the very relationship between architecture and health.

↑ Builders (in Swahili, mafundi) measuring a typical brick in Ifakara.

In architecture, walls tend to be imagined as barriers, serving to separate and insulate. That effect of partition, however, could be reimagined as a means of *filtration*, allowing for buildings *to breathe*. "The presence of air," architect Nerea Calvillo writes, "differentiates a building from structure or a pile of materials…. Inhabitation is having air to breathe. The air is moving architecture."[3] Subtle changes to the brick's geometry and material properties can encourage airflow and convective heat transfer, cooling interiors and even disrupting the flight patterns of disease-carrying insects—all without recourse to mechanical force or insecticidal sprays.

3 Nerea Calvillo, *Aeropolis: Queering Air in Toxicpolluted Worlds* (Columbia University Press, 2023), 23.

Sarika Merchant

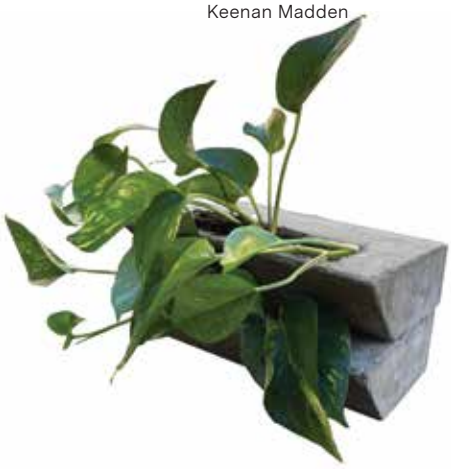
Elijah Rutkowski

Abena Atiemo

Keenan Madden

Sarah Auger

Michael Serrano

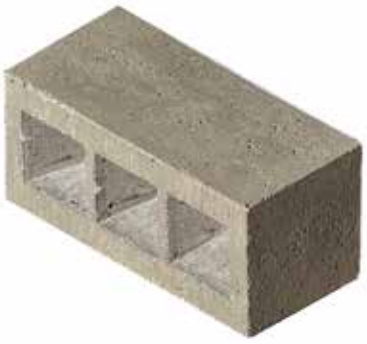


Kaili Weaver

Eric Jackson

Hector Rubio

John Schilz



Nathan Smith

Josh Shields

Nejla Harris

Vamsi Krishna Kamatham

Alicia Saunders

Amir Heydarpour

Nirvana Kimiyaie

Aidan Martinez

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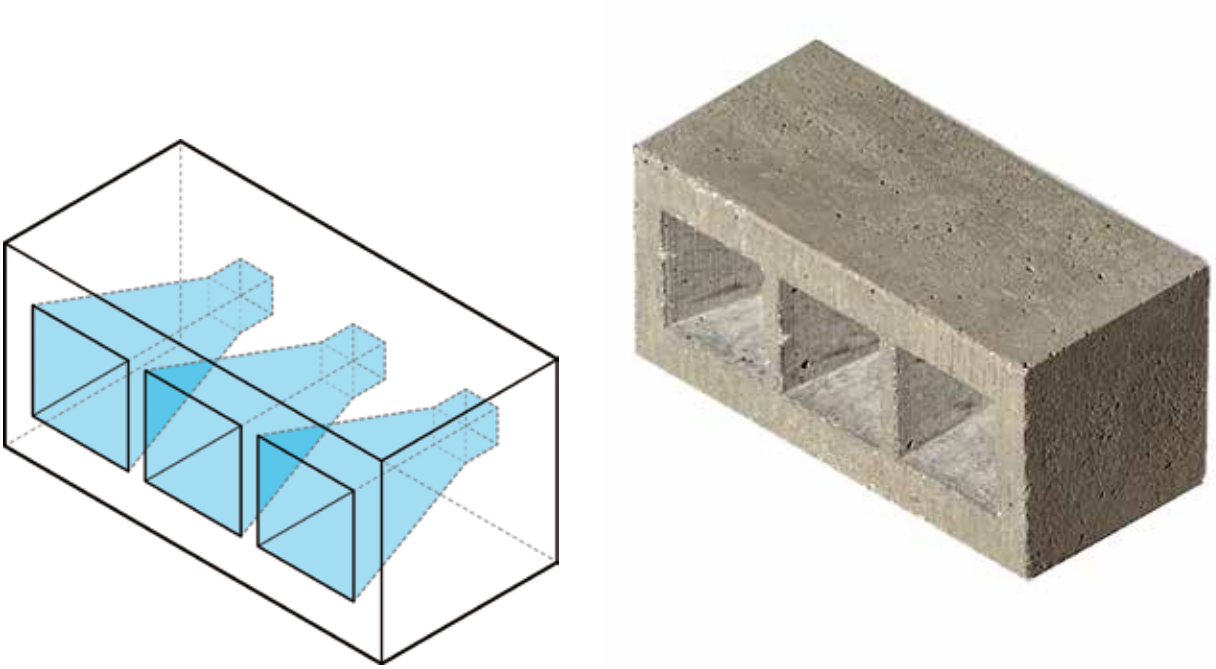
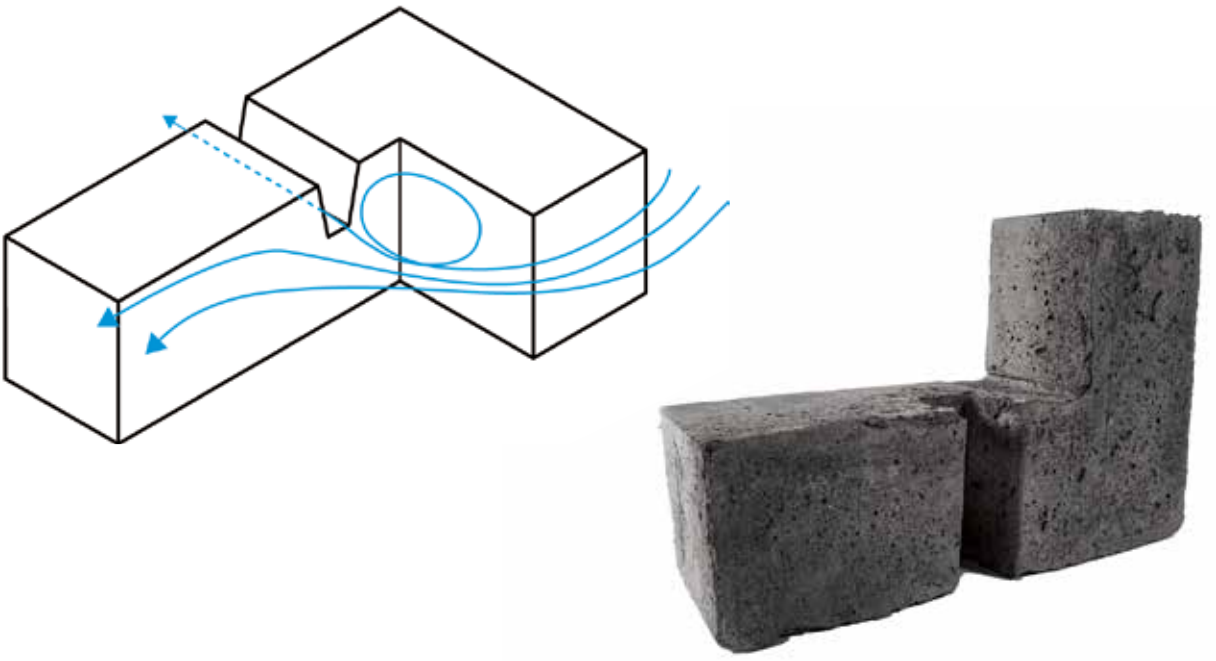


"Vortex Block" by Michael Serrano, UNC Charlotte.



"Venturi Block" by Nathan Smith, UNC Charlotte.

## "The brick is a tool for rethinking the very relationship between architecture and health."

↑ A brickmaker in Ifakara using a mold to make a brick.

Students of Architecture at the University of North Carolina Charlotte were tasked with creating novel prototypes, demonstrating how bricks can actively engage with air to serve multiple functions beyond their traditional role in construction. Prototypes were co-developed with Tanznaia's Ifakara Health Institute and the University of Dar es Salaam. Though the work is preliminary, the students have produced some promising ideas, and a first set of prototypes will be tested and adapted with local masons.

The "Vortex Block," designed by Michael Serrano, employs the principle of vortex shedding (a natural phenomenon that occurs when air flows around a surface) to create alternating swirling eddies. By designing the brick to encourage small convective pockets, air movement is amplified—cooling the surrounding space while disrupting mosquito flight patterns.

Nathan Smith's "Venturi Block" uses the principles of the Venturi effect, by which air speeds up as it moves through a narrow channel. The block's horizontal hollow core accelerates airflow, reducing indoor temperatures and $CO_2$ concentrations without mechanical intervention, while also interfering with mosquito navigation.

Vamsi Krishna Kamatham's "Porotherm Block" experiments with the brick's porosity and thermal mass to enhance both airflow and privacy. Designed to promote natural ventilation while maintaining visual enclosure, it encourages buoyancy-driven flow, where differences in temperature and density create air movement. A recessed base allows the structure to passively regulate temperature and airflow.

These three designs, along with several others in development, showcase how thermally resilient, safe, quality housing might be achieved through a fundamental rethinking of the materials with which we build. Rather than the "designed air" of air-conditioned buildings or insecticide-suffused interiors, "designing with air" directly engages air movement and fluid dynamics.[4] Architectural elements that were once fixed, uniform, and passive can be made more vital, regulating interior temperatures, circulating air, and expelling toxicants and pathogens. As walls become more like skin, interiors become more responsive, a kind of "immune system" that enables secure exchanges between the inhabitants and the outside world.[5]

Bricks are just as modular, mobile, and scalable as bed nets and insecticide, but they are also refreshingly mundane—the literal *building blocks of home*. The clay and sand in bricks can be dug from the ground with handheld tools. As a global health technology, bricks could be transformative. They could not only make houses more livable in the context of endemic mosquito-borne disease; they could also shift disease control from an external, abstracted agenda to something grounded in the everyday realities and aspirations of those for whom disease vector interventions matter the most.

Home-building is how we inhabit the Earth. Rethinking the design of bricks as breathing, moving surfaces fosters a deeper connection between architecture and well-being, creating a space where global health and local living conditions might coexist, adapt, and thrive. ⊙

4 Calvillo, *Aeropolis*.

5 Roberto Esposito, *Immunitas: The Protection and Negation of Life*, translated by Zakiya Hanafi (Polity, 2011; originally published in 2002).

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PHOTO CREDITS

p.66-73,77: Photos by the authors.
p.74-76: Photos and drawings by students of UNC Charlotte's ARCH 7102.

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*Under the Surface*
by Andrea Ballestero

# How do you make sense of an inaccessible interior?

**They are neither caves nor mines, but aquifers are also not simply volumes of water.**

They are saturated substrates—dampened rock, sand, and pores. The United States Geological Survey defines an aquifer as an underground formation saturated to the degree that it can yield water for wells or springs.[1] Their inaccessibility to direct observation makes it challenging to sense or make sense of aquifers. Located within the lithosphere, the dermis of the Earth, aquifers exist in an expansive interior that is immense for humans but paper-thin for the planet.

In the twenty-first century, aquifers refuse to remain out of sight. They have become sites of geopolitical struggle, objects of attention for national security projects, and irresistible riddles for planetary science. We know that globally, there is a hundred times more fresh water under the surface than in all rivers, lakes, and swamps combined. Across Central America, projections suggest that by the end of the century, rainfall will significantly decrease, while temperatures will increase by 4°C/7°F. Aquifers will become the only stable source of water for human and industrial needs.[2]

In this context, Costa Rica is going beneath its surface. A country accustomed to looking up to make sense of the rain that falls from the sky, now looks downward to understand the interior of the Earth. This reorientation relies on time, distance, and texture as technoscientific resources. The journeys of scientists, community members, and humanitarians to access the Earth's interior exemplify the embodied, epistemic, and computational resources needed to make aquifers sensible.

1 "Principal Aquifers," United States Geological Survey, accessed March 21, 2025, https://www.usgs.gov/mission-areas/water-resources/principal-aquifers.

2 Hugo G. Hidalgo et al., "Hydrological Climate Change Projections for Central America," *Journal of Hydrology* 495 (2013): 94–112, https:/ doi.org/10.1016/j.jhydrol.2013.05.004.

↑ Researchers conducting infiltration tests. Costa Rica, 2010.

## TIME

We chat. One of us sits on an empty bucket. The rest stand and watch as water moves downward. Infiltration tests are enchanting procedures. They help determine the likelihood that rain will infiltrate a subsurface and eventually recharge an aquifer. After digging a hole twenty centimeters deep, a premeasured amount of water is poured in from a bucket. One of the team of government researchers starts a chronometer to time how long it takes for the water to infiltrate the soil. Sometimes water presses quickly into the ground, meaning that the soil is sandy. Other times it moves more slowly, indicating that the soil has a high clay component or is already saturated from rain, rivers, or the aquifer itself.

Time moves slowly. As we wait, we chat. The topic is political turmoil in the country. After all, we are there because of intense protests opposing the land grabs that resulted from tourism expansion in Costa Rica's Pacific region, the driest part of the country. In response to the water conflicts that ensued, courts instructed the government to update its scientific knowledge about this aquifer, which supplies water to all residents and businesses in the area. The results of our infiltration tests will feed the models and calculations necessary to understand the aquifer's condition. These water molecules pushing into the Earth are indices of a new era of climate politics in Costa Rica.

The subsurface is both a distant reference and an immediate concern. Transnational economic forces have turned the region into a desired destination for expats and tourists, which demands more and more water. Scientific evidence of water moving slowly inside the Earth justifies the construction and expansion of new resorts and accommodations.

Our choreographed test—digging a hole, pouring water in, measuring time—mimics the movement of water inward, toward the center of the Earth. After eighteen minutes, there is no more water in the hole. The exact duration is written down. We pick up our tools, get in our cars, and drive from these cattle grasslands to the next site, a riverbank. We expect a sedimentary plain with pebbles, stones, and boulders. Digging our hole will require more effort. Time will be slow. Once again, we will return to our futile conversation about politics.

↑ Measuring water table depth in a *piezómetro*. Costa Rica, 2024.

## DISTANCE

The Green Aquifer Association on Costa Rica's Caribbean coast collects data from a system of monitoring wells. Once a month, Don Carlos travels by bike on a circuit of about fifteen kilometers, carrying a bag with the necessary instruments to collect data at thirteen wells. He stops at each *piezómetro* (monitoring well), measures the water level, writes down the data, and later delivers them to a colleague in the office who will transfer the numbers to an Excel sheet and produce a mathematical vision of the aquifer's health.

On this day, however, Don Carlos is doing the rounds in a pickup truck. The reason is that I and the Association's newly hired administrative assistant—an undergraduate student doing an internship—want to learn about aquifer monitoring. To reach the piezómetros, Don Carlos drives us through narrow back roads hidden under overgrown grasses. We cross riverbeds that have lost their bridges to flooding. We walk on muddy trails that cattle have turned into slippery pathways.

A piezómetro is used exclusively for monitoring aquifers. It consists of a mechanically drilled borehole lined with a metal casing, inside of which another pipe, usually made of PVC, is fitted. The inner pipe functions as a narrow, vertical tunnel to lower instruments, which detect water levels, measure water conductivity and temperature, and collect water samples for chemical analysis.

Visiting each piezómetro to collect data is repetitive, as scientific monitoring tasks tend to be. This job requires patience, and an openness to routine. Monitoring tasks bring little immediate gratification. Their value rests on sustained repetition. Don Carlos seems well suited for the job. He is observant, analytical, and curious about things that are not fully apparent—the kind of things you learn from long-term monitoring.

The most important tool Don Carlos uses for this task is a water level meter, a battery-operated instrument with a long measuring cable wound around a wheel. An electrode at the tip of the cable emits a high-pitched sound upon contact with water. Once we reach a piezómetro, Don Carlos unlocks the padlock on the well's lid. He positions the cable, unrolls it, and lowers the electrode down the shaft until it beeps. *Beeeeeeep*. He makes a few careful adjustments, lowering the cable a few times to find the exact point where water meets air. At that precise location, Don Carlos tightens his grip, and he checks the number on the tape to relay it to the assistant taking notes. The evidence is recorded on a form: our descent into the Earth reached a depth of 5.36 meters—at once an incredible and insignificant distance.

## TEXTURE

The promise Don Saud made to his audience at the University of Costa Rica was that the method he was presenting required much less fieldwork than usual, meaning fewer infiltration tests, fewer bike rides to monitor wells. You could get inside the surface of the Earth without needing to puncture its dermis. With this new technology, the sensing work would be performed by algorithms. Texture is the defining criterion. Satellites would record data about the texture of the Earth to infer the aqueous world underneath—decades of scientific, military, and extractive remote sensing technology redirected to aquifer protection in the era of climate change.

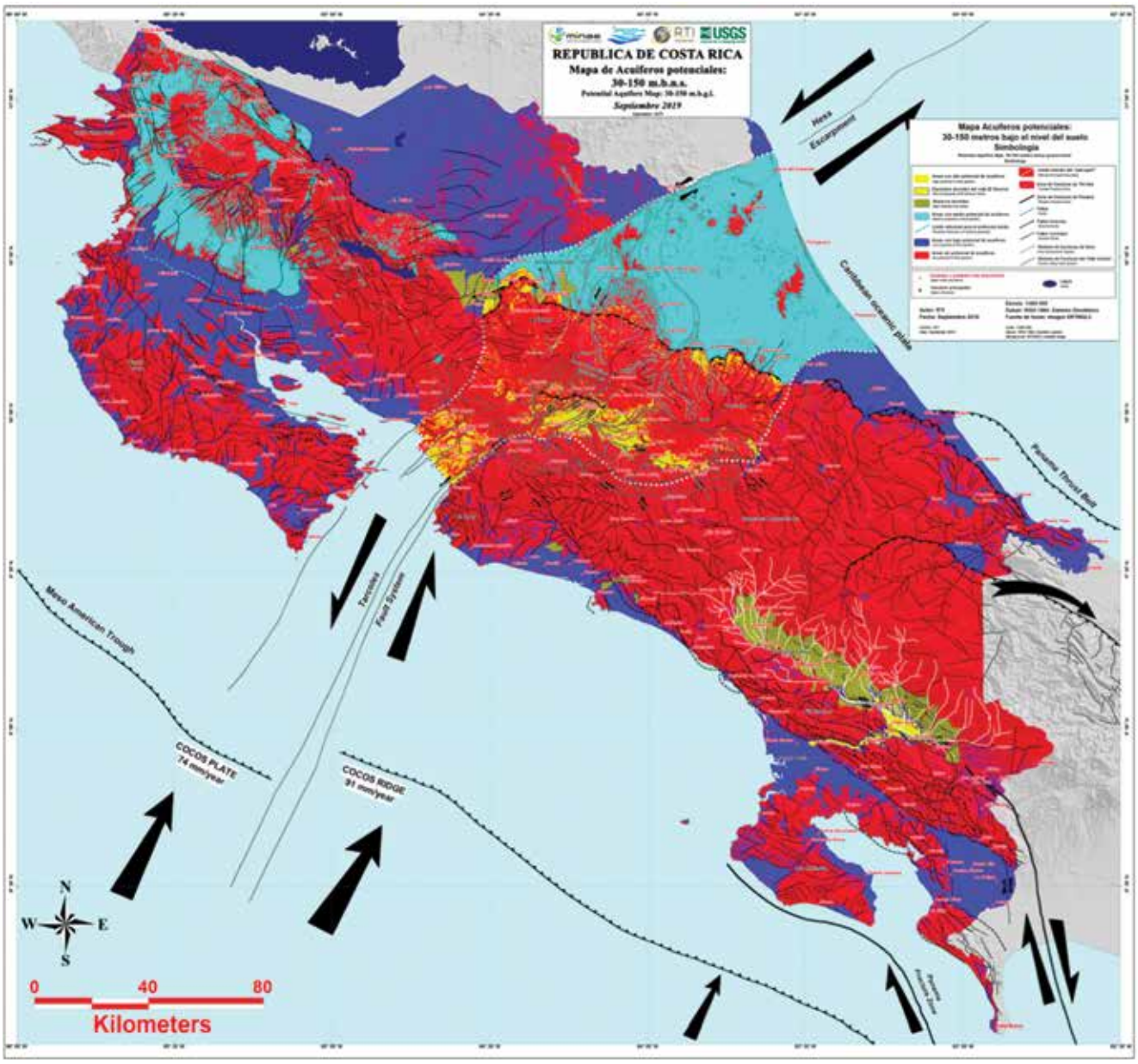
Don Saud represented the US government in an agreement with the Costa Rican Environment Ministry. The collaboration included a contract whereby the Costa Rican state would pay the United States Geological Survey and a private company, Radar Technologies International, $1.5 million to map the country's aquifers using WATEX™—the method he was presenting. This journey a few hundred meters into the Earth started by first going to outer space and back, riding an algorithm that sorts surface textures.

WATEX was an unexpected side product of the frenetic search for minerals, oil, and gas that was characteristic of the late twentieth century. While looking for evidence of mineral deposits in Libya, Alain Gachet, the creator of WATEX, noticed that instead of minerals, his algorithm identified moisture under the surface. The first time this happened, it picked up a broken water line under the Libyan desert. This realization turned into an epiphany for Gachet. Instead of looking for minerals, oil, and gas, he could be a water explorer. Soon thereafter, he left the industry to become a humanitarian advisor. During the Darfur conflict, a test bed for humanitarian intervention, Gachet's method allowed aid agencies to drill wells that hit water with ninety-five percent accuracy, an extraordinary success rate.

**"Many interiors are inaccessible—from aquifers to souls. Reaching into them depends on forms of care, scientific practice, and political organization that negotiate this inaccessibility."**

Don Saud was brought to Costa Rica by the country's ambassador to the United States. While in Washington D.C., the ambassador had heard Don Saud narrate the Darfur story. Many emails, phone calls, and meetings later, Don Saud, Gachet, and WATEX produced an interior out of algorithmic calculations. The project's outcome was a series of maps visualizing the probability of aquifer presence at various depths (25, 50, and 150 meters).

This pseudo-magical conversion of surface texture into subsurface probabilities into colored maps redirects ambassadors, geologists, and policymakers downward. It allows them to make sense of the world beneath the Earth by using scientific knowledge to organize collective life spatially—to promote investment here or poverty assistance programs there, to offer new tax incentives for tourism here or more agriculture there, to deny a permit for mining here or approve one for new luxury construction there. The interior matters outside. The possibilities of petrocapitalism, military technology, and climate data reveal a future that sits below the surface.




↑ Aquifer potential map produced by agreement between USGS and Costa Rica's Environment Minister. 2019.

## DOWN TO THE FUTURE

Aquifers are much more than water. In Costa Rica, they are the knowledge for the state to respond to water conflicts. They are the burden of data collection that rests on the shoulders of local residents on bikes. They are the algorithms that link oil and mineral exploration with humanitarian concerns.

As the pressures of climate change make water conflicts and the outsourcing of scientific practice central features of Costa Rica's political climate, time, distance, and texture guide our journeys inward. Aquifers disabuse us of the dream of unrestricted access, and they activate the imagination. They demand we learn to relate to that which is out of sight and only partially knowable. Many interiors are inaccessible—from aquifers to souls. Reaching into them depends on forms of care, scientific practice, and political organization that negotiate this inaccessibility. Learning to care for and live with an inaccessible interior is a practical and ethical challenge in the era of climate change. ⊙

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PHOTO CREDITS

p.78: Kenrick Mills courtesy of Unsplash.
p.80,81: Photos by Andrea Ballestero.
p.83: Costa Rica's Environment Ministry and the USGS.

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*Apertures all the Way Down*
by Emily Lee & Emma Pask

# What's concealed in a frame?

↑ *Postcard* single-channel video (still) 1:40.

## An aperture is an opening—of an eye, a camera, a telescope—a boundary between inside and out.

It's the device that determines how much light gets into an optical system and illuminates an otherwise dark interior. The aperture is also a frame. It's not only about how much light the aperture lets in, but how much light it keeps out. In this act of mediation, the aperture itself typically disappears from view.

We choose to focus on the aperture itself as much as the image it produces by putting stills from a video artwork in dialogue with an essay exploring Texas's caves. Between the two, the aperture is a device that helps us consider

the politics of framing. The mouths of the caves are apertures that frame relations among scientists, landowners, and the public. Apertures thus mediate not only light and dark, but also inside and out, private and public, knowledge and risk. Apertures are contested sites, both epistemic and material.

The images opposite are stills from *Postcard*, a video piece depicting a narrow view of the sunset. As the sunlight fades into darkness, it becomes clear that the frame around the view is not just a static border. Rather, it is a physical surface onto which another video has been projected—a video that slowly comes into view as the sun sets. *Postcard* reveals our propensity to overlook what the aperture obscures.

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You don't know that there is a vast cave underneath your feet until the bats emerge at sunset. They spill out of a small hole—a nearly unnoticeable tear in the landscape. As the light fades, one, five, ten bats swirl into a cloudless sky. In seconds, more bats pour up out of the cave, fast and hungry, at such a rate that they seem liquid, like a single body rather than a swarm of individuals.

↗ Looking out of a karst cave, April 2022.

↑ *Postcard* single-channel video (still) 14:40.

As these bats emerge en masse, you start to get a sense of the cave's interior—ever expanding, its contents continuously spilling out. The experience evokes a combination of wonder at the spectacle and anxiety at the dawning awareness that the ground is not solid after all. It is hollow: full of bats, but also of potential knowledge.

When you think of the underground in Texas, it is hard not to conjure images of oil fields tapped by countless derricks. But caves are just as prevalent here. As the population of Texas balloons and its subterranean water resources dwindle, its caves have become valuable resources for scientists who want to better understand this landscape in order to conserve it.

The specific caves of interest here are karst caves, which are formed through the dissolution of limestone. Karsts often act as aquifers, sustaining life on otherwise inhospitable semi-arid land. By definition, karsts are caves

↗ Bats outside a karst cave, August 2022.

that have an opening—an aperture—to the surface, allowing things to move in and out of their interiors.

These caves are like laboratories: they hold certain conditions constant, like internal temperature and humidity. Karst caves remain relatively insulated, their microclimates controlled, their interiors uncannily out of time. They therefore allow scientists to identify and observe the statistical patterns that emerge from non-fixed variables, like the movement of water.

But they are not completely isolated. Even slight internal changes index external disturbances. This makes karst caves useful in studying wider climatic changes over time. Similarly to archeological digs, paleoecologists can find within them relics of historical ecosystems. Data from these spaces is used to visualize the otherwise invisible phenomena of the karst cave's interior, effectively turning the karst inside out.

↑ *Postcard* single-channel video (still) 28:16.

Karsts are messy apertures, with animals, people, air, and water constantly spilling in and out. Translating them into models that help scientists study climate change requires obscuring a lot of messy circumstances—the site-specific processes by which data is collected, as well as the on-the-ground debates over land use that climate science occasions.

Environmental scientists hope that these models will shape global climate science on the one hand and local environmental management on the other. There is very little environmental regulation in Texas, and over ninety-five percent of the land in the state is private property. Many landowners fear that research wielded by the state will undermine property rights.

Across Texas, the karst is thus contested between private landowners and science. Unlike almost anywhere else in the world, in Texas, the subterranean is legally under the aboveground landowners' domain. Texas law holds that landowners' property rights extend "from heaven to hell," that is, volumetrically above and below the surface of the land. This is why the entire oil industry in Texas is dependent on private land ownership: it is the landowner who controls the mineral rights and the potential value there, and no one else. This means that, despite being easy to walk into, karsts are notoriously difficult to access in the first place.

↗ A hidden karst cave, December 2022.

Scientists in Texas share secret maps of the state's caves with one another because finding out where their openings are is nearly impossible. The relationships they build with landowners are always tenuous. One misstep can sour that relationship for everyone, which makes it impossible for outsiders to access that land in perpetuity, and ends the production of scientific knowledge there.

It is only after finding the karst caves, signing liability waivers, and assuaging landowner anxieties about data privacy, that scientists can finally enter these spaces. Then, wearing protective gear, kneepads, and headlamps, scientists carry all their technical equipment underground to record air quality, swab living organisms, and track changes in the stalagmites and stalactites.


↑ Filming *Postcard* at Hornsby Bend.

Some landowners, prompted by indications from scientists that there is something special about their subterranean estates, charge researchers and the public fees to enter them, or to watch bats exit them. Other landowners respond differently. Sometimes they deny scientists access, citing fears of federal intervention on their property if, for example, endangered species were found there.

It's also not unusual to see landowners fill their karst caves with rocks, dirt, or even household garbage and hazardous materials. They call them "Texas trash holes." The practice ensures that nothing can move in or out of them. It risks polluting soil and water systems and animal habitats with dangerous toxic material. It also makes these spaces no longer, by definition, karst caves.

The movement of scientists, like bats, in and out of these caves creates an unstable terrain of desire and fear around the openings to Texas's underground. The caves become an ethnographic aperture for watching scientists and landowners negotiate the terms of knowledge production. Sometimes, the very act of pursuing scientific research makes these places less knowable. In

↘ From within a karst cave, April 2022.

Texas, decisions are made not necessarily in a legislative session, or on the national stage, but on private land.

Like the microclimate of the karst, even as the external climate changes, some things hold steady across environmental management projects in Texas, like the settler colonial property regime and a desire to escape oversight. Looking at these karsts through the frame of property relations can help us see more widespread patterns of land use.

Our apertures are changing. Unstable scientific funding, strained property rights, and runaway climate change all mediate the landscape's visibility and accessibility. Often, the attempt to access these spaces exacerbates their opacity. What we see instead is the role of property in the practice of science.

Environmental knowledge in Texas, and across the settler southwest, is a game of apertures—of finding openings and framings across law and land. Karst caves illustrate how defining the land's interior is a matter of apertures all the way down, of framing models, relationships, and public perception by what goes in and what stays out. ⊙

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PHOTO CREDITS

p.84,87,89,91,93: Photos by Emma Pask
p.86,88,90,92: Photos by Emily Lee

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*Middling Worlds*
by Javier Lezaun

# Can we imagine a climate future inside a giant plastic bag?

**In virtually any field of scientific inquiry, producing knowledge requires the fabrication of interiors.**

One such interior is a *mesocosm*—an experimental device used to observe natural interactions in a bounded and partially enclosed environment. The term was coined by Eugene Odum, the pioneer of ecosystems ecology, who used it to describe the "middle-sized worlds" where researchers try to bridge the distance between the reductionism of the laboratory and the entangled understanding that emerges from observations in the field.[1]

In a recent oceanographic study on the island of Gran Canaria, researchers from the GEOMAR Helmholtz Centre for Ocean Research in Kiel, Germany, deployed a series of mesocosms in Taliarte harbor, on the island's east coast, to determine how plankton communities respond to the addition of alkaline minerals to seawater.

Each system consists of a translucent, four-meter-long thermoplastic polyurethane bag, mounted on a hexagonal floating frame. It is filled with water collected outside the harbor, and contains the range of microscopic life one would typically find in this section of the North Atlantic. To each bag, researchers add a solution of sodium carbonate and sodium bicarbonate to produce a series of gradual increments in the level of total alkalinity, from the natural baseline (no intervention) to twice as much alkalinity as in the surrounding waters.

The setup is that of a classic perturbation experiment, in which certain environmental parameters are selectively altered to observe changes in an ecological community. Every two days, researchers extract samples from each of these "giant test tubes," as they sometimes describe them, to assess particulate and dissolved organic matter, phytoplankton and zooplankton communities, chlorophyll concentration and photosynthesis levels, and to measure changes in alkalinity and in the concentration of dissolved inorganic carbon.

On the surface, the research design could not be simpler: adding more salt to saltwater. Yet this ocean alkalinization study represents a landmark experiment in "climate repair."

Ocean alkalinization describes a set of strategies to rapidly increase the alkalinity of the upper ocean in order to accelerate the uptake of atmospheric CO2. The ocean holds fifty times more carbon than the atmosphere, and it is estimated to have absorbed about a third of all the CO2 emitted by the burning of fossil fuels since the beginning of the Industrial Revolution. One of the mechanisms of this absorption is the presence of alkaline substances. Runoff from the natural weathering of carbonate- and silicate-based rocks carries alkaline molecules into the ocean, and these molecules react with the CO2 dissolved in seawater to form stable bicarbonate and carbonate ions. This creates an imbalance between the pressure exerted by CO2 in the air and by CO2 dissolved in surface waters, and the result of this imbalance is that more atmospheric CO2 enters the ocean.

1 Eugene P. Odum, "The Mesocosm," *BioScience* 34, no. 9 (1984): 558–62, https://doi.org/10.2307/1309598.

This process unfolds constantly, slowly drawing carbon from the atmosphere over geological timescales; ocean alkalinization seeks to speed it up to human-relevant timescales by directly dumping alkaline minerals into the sea.

That is at least the idea—and, at this point, it is not much more than an idea. The appeal of ocean alkalinization as a climate solution rests on a series of theoretical calculations, a modest effort to model the Earth system under different intervention scenarios, and the advocacy of a few scientific groups and start-ups. They may appear unassuming, but the mesocosms calmly floating along the pier in Taliarte harbor were the first ever attempt to investigate, in natural or at least semi-natural conditions, how the rapid addition of alkalinity to seawater might affect marine biological communities and food webs. Despite the modesty of this experiment, it could augur a radical intervention in geoengineering.

↓ Sampling the mesocosms.

## CARBON RUNAWAYS

One thing that becomes apparent when one spends time around mesocosms and the research community that looks after them is that these experimental devices are not self-evidently interiors—or, to put it another way, that their interiority demands constant work.

The fabrication of interiority begins with the assembly of the system, which requires several days of intense work by students and postdoctoral researchers, a small and joyous international community of budding marine biologists. They construct the floating frames, lower the polyurethane bags into the water, and attach plastic roofs to prevent the introduction of bird droppings and airborne dirt. A member of the research team marvels at how quickly all this effort will be forgotten once the scientific study begins, a phenomenon he describes as "mesocosmic amnesia."[2]

2 Michael Sswat, "A Good Omen and Mesocosmic Amnesia," *OceanNETs Blog*, May 9, 2022.

↑ Mesocosm systems moored along the pier in Taliarte, Gran Canaria, September 2021.

↓ Scientific bric-a-brac on the Taliarte pier.

Yet this memory is never quite lost, if only because preserving the interiority of each mesocosm is an ongoing endeavor. Cleaning is the activity that brings this effort into focus. As soon as the experiment starts, algae, particulate matter and marine detritus begin to accumulate on the exterior and interior walls, creating a biofilm that threatens the comparability of observations. If organic material is allowed to grow on the interior walls, then the mesocosm will fail to mimic interactions in the open ocean; growth on the exterior walls creates irregular shading effects that influence the ecological dynamics inside each enclosure in unpredictable ways.

Every other day, standing on the floating frames and bending carefully over the open mesocosms, a researcher gently wipes the inside of each polyurethane bag with a pool brush attached to a long pole, reaching all the way to the sediment trap at the bottom. The brushes themselves must be carefully cleaned before moving from one mesocosm to the next, to prevent them from cross-contaminating the different containers.

Cleaning the exterior walls is an even more dramatic affair. Once a week, scuba divers perform a careful scrubbing routine around the underwater sections of the mesocosms. The operation requires a careful calibration of force—brushing a surface that offers little resistance to the hand while staying stationary underwater is an arduous exercise—and can only be carried out by members of the research team who are certified to work as scientific divers.

These maintenance operations provided the first indication that something unexpected was unfolding inside one of the mesocosms. Toward the end of the six-week study, divers began to observe the formation of an unusual white calcareous film inside the system that contained the highest addition of alkalinity. An analysis of water samples suggested that the carbonate chemistry in this bag had shifted due to runaway calcium carbonate precipitation. It was (and remains) unclear what exactly triggered this process, but the researchers surmised that plankton or inorganic matter had served as condensation nuclei for the emergence of solid calcium carbonate. The regular cleaning of the interior walls, by scraping off carbonates, may have created additional nuclei, thereby hastening the reaction.

This was just one of several examples of minerals "just not doing what we expected them to do," as one member of the research team put it, but it was by far the most momentous. It meant that, in at least one of the mesocosms, the addition of alkaline substances had led to a net loss in total alkalinity, as precipitation of calcium carbonate would consume bicarbonate and carbonate ions. If this had been an actual intervention in the ocean—as opposed to a contained experiment in a giant floating plastic bag—it would likely have led to an increase in the leakage of CO2 from the ocean into the atmosphere. A much-vaunted climate solution would have only compounded our climate problem.

## INTERIOR (DIS)COMFORTS

Arguably, runaway precipitation is the sort of surprising finding that a good field study should be expected to generate, a recalibration of our way of thinking about the world born of an experimental encounter with the matter at hand. Yet it is difficult to draw a sharp line between the kind of surprise that enriches our understanding, and the equally unexpected but much less welcome *anomaly* that forces us to jettison hitherto useful certainties.

**"A member of the research team marvels at how quickly all this effort will be forgotten once the scientific study begins, a phenomenon he describes as 'mesocosmic amnesia.'"**

Among the certainties to be questioned here, one may be the solace provided by a conceptual form of interiority, that of the global carbon cycle. This idea presupposes a world divided into discrete "reservoirs" or "pools" of carbon, and a linear transportation of the element from one to the other to the next. Thinking through and within the global carbon cycle is a precondition for modeling the Earth system, and for anticipating how different human interventions might impact climate change. It is a core assumption of the models making the case for ocean alkalinization. The concept of the global carbon cycle suggests an elegant (in metaphysical terms, perfect) form of movement, which sequences time into the interlocking segments of a full circle. It is only by inhabiting this spatio-temporal geometry that we can imagine accelerating geological time into human-relevant scales.

A phenomenon like runaway carbonate precipitation, by contrast, foregrounds reaction and change, thresholds and tipping points, unpredictable dissolution kinetics, and shifts in material states that acquire their own momentum and irreversibly disrupt a previous equilibrium. The cyclical movement of a chemical element becomes less relevant than its ongoing, escalating transformation. When a human intervention expected to remove carbon *out* of the atmosphere leads to even greater emissions *into* the atmosphere, we are reminded that carbon is not a discrete actor tracing a geometrical figure across planetary domains, but an element constantly entering into diverse configurations of living or lifeless matter.

The mesocosm provides its own interior comforts, of course. Even in a short-lived experiment like this one, it is easy to get used to the idea that each enclosure provides a perfect encapsulation of the relevant world—in this case, a miniaturized version of the nutrient-poor marine food webs and biogeochemistry of the eastern North Atlantic Ocean biome. Yet there is something about the physical characteristics of this particular interior, and about the research life that gathers around it, that counters the tendency to see these worlds as self-contained.

The routine handling of the experimental apparatus—the laboriousness of its assembly and maintenance, the challenge of preserving a sense of enclosure while maneuvering equipment into and around it—seems to keep researchers grounded in a fairly modest understanding of the affordances of their midsized universes. There is just enough contingency and openness to the surrounding world to short-circuit the temptation to extrapolate just a bit too far, to jump too quickly to a definitive conclusion. "Mesocosmic amnesia" never quite sets in, and researchers find themselves constantly referring their findings back to particulars of their equipment, or to specific moments and circumstances in their investigations.

In sum, mesocosms are remarkable climate interiors. Unlike mathematical models or metaphysical representations of the Earth as a closed or autopoietic system, they produce a form of epistemic interiority that is never entirely self-contained or fully self-assured. In that respect, they are a great vantage point—an aperture, as Emma Pask and Emily Lee describe in this issue—into problems that are neither outside nor inside human experience, and that might require middling interventions rather than definitive solutions. ◉

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PHOTO CREDITS

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p.97,98: Photos by Javier Lezaun.

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*The primary interior that most people think about is the home, obviously. In relation to heat, it's always air conditioning. More and more time spent in air-conditioned homes, more and more parts of the home that are air-conditioned. I grew up in a house where only one room had an air conditioner. When it got very hot, everybody went to that one room. But now it's quite commonplace for all rooms to have air conditioners. Even living rooms have air conditioners. Central air conditioning is still not a big thing in India because it's not very affordable. It's crazy where people think they can install an air conditioner. Kitchens also have air conditioners now in some homes.*

*As with most things, the affluent are ensuring that they can insulate themselves from everything else that the world around them has to deal with. And that is a big part of interiority in India, right? It's inseparable from India being the hyper-segregated place that it is. Interiority will always mean the privileged cocooning themselves, the privileged occupying the core, and the peripheral being left for the marginalized people. It's how caste is imagined. It's how most of India's inequalities are rationalized—as just layers that are separated by distance. And the core is always kept for the most affluent Indians, the most prosperous Indians. I guess interiority excludes those who, by nature of their work or the nature of their circumstances, don't have access to it and have to spend days outside.*

*Of course, since we're talking about Kolkata: in Tagore's book,* Ghare Baire (Home and the World)*, at home and outside also comes to mind. It deals with gender primarily. Women and their lives being imagined to be more interior, interiorized, more domesticated, and the journey out to the world.*

*What was compelling about Sana was that she was mostly at home, by any definition, by any economic standard. She's an at-home mother, raising three kids. But she's barely at home. That kind of got me fascinated with her, that she was so extroverted, that she struck up this friendship with me. Most of our time together was time outside the house. She was showing me the neighborhood. She was showing me the primary health center where they hang out, which also serves as a cooling center. To me, it's interesting how ideas of interiority and outside kind of intersect with India's many inequities, whether it's caste, whether it's gender.* —Anant Gupta

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*Escape to the Country*
by Sarah Besky and Yojak Tamang

# How has agrarian crisis transformed the interiors of the Himalayan foothills?


↑ Welcome to Sillery Gaon, named after the celery that used to grow here. Located in a remote part of Kalimpong district, the village grew out of what was once a small settlement of workers for the West Bengal Forest Department. Sillery Gaon has grown exponentially in recent years. Fields have been cemented over to build houses and to park cars. But these houses are not for the villagers. Instead, they've been built to meet a rapidly increasing demand for "homestay tourism"—in which villagers sell an agrarian experience to tourists who sleep and eat in their homes.

↓ Tourism is pretty new in Kalimpong, at least in villages like Sillery. Twenty years ago, the rice paddies would have been awash in green during the monsoon. People even called Kalimpong the region's "breadbasket," noting a contrast between its food-producing fields and the monocultured tea plantations in neighboring Darjeeling. Today, the steps of once productive rice terraces have become overrun with weeds, and the invasive peacocks that eat anything the farmers plant. These national birds, however, cannot be harmed or even chased, lest retribution fall on you at the hands of the Forest Department or a Hindu nationalist neighbor.

↓ To stimulate "rural development," put failing Himalayan farmland to work, and stem out-migration from the hills, the government of West Bengal aggressively promotes homestay tourism. Bengali visitors from cities in the plains can stay in the "traditional" mountain homes of Nepali-speaking families to escape the heat below. Kalimpong now has, by an order of magnitude, the most homestays in the state. In Sillery Gaon, there are an estimated 250 homestay rooms in a village of roughly 40 families.

↑ Sillery Gaon boasts spectacular views of Mt. Kanchenjunga (the world's third-highest mountain) and the surrounding Himalayan range. It is located up a rough road. Homestay tourism here was made possible through state development initiatives. Foremost among these is the Mahatma Gandhi National Rural Employment Guarantee Act. The work program, which promises one hundred days of annual employment to each rural household, employs hundreds of people in the hills each year on infrastructural projects. Over the past two decades, men in the hills have been choosing this guaranteed wage labor over the seasonal payouts of farming. These initiatives have led to the construction of hundreds of miles of new roads, connecting villages once only accessible by foot to main highways.

↑ Thanks to the new roads, it is now possible for Bengali urbanites to leave Kolkata, escape the stifling pollution, and take refuge in the cleaner, cooler air of the mountains. And tourists can drive straight into villages that until recently were unconnected. Without this connectivity, there would be no homestay market.

↓ Kalimpong's value as a place of retreat comes from what people call its "openness": the vistas, the agrarian landscape, the low population density.

↓ Affordability is a quality that many tourists insist upon, and it is incumbent upon homestay operators to provide food and other comforts at the prices that visitors expect. In Sillery Gaon, a stay during the high season costs around Rs. 1,000 (about $12) per head per night for a room and three meals.


↑ Even as homestays may have helped some families remain in Kalimpong and in their homes, the work of remaining provokes ambivalence. One older homestay operator in Sillery Gaon summarizes the economic situation in which she and her neighbors find themselves: “Earlier we used to graze the cows and goats, and farm. But now there are no fields. Homestays are the only way that we can make money.”

↑↗→ Residents have taken out loans and made deals with Bengali tour operators to finance the rapid construction of additional rooms and other enhancements. Retrofitting home interiors for budget tourism has given more urbanites access to climate retreat, even as it has deepened debt for villagers.

↑ Despite the debts, homestay tourism is a means of avoiding the out-migration that has become a hallmark of family life across the region. As one woman explains while taking a break from turning over rooms in the middle of the day: "Earlier, people here used to go to cut the trees in the forest for two or three months. In those days, there were no mobile phones and no communication between those working in the forest and their families back in the village. Opening a homestay," she says—making the home into a space where strangers were welcome, "has allowed everyone to stay together."

↓ Kalimpong's villages are often described as "sleepy." Sleepy villages have no history. They have no economy. They do things as they always have. But with homestays, villages aren't really that sleepy. "The Bengalis don't come here to sleep," one homestay operator who also runs a small canteen out of her kitchen explains. Even though many tourists explain that they come for the peace and quiet, when they get here, they are often quite loud, with bonfires, music, singing, dancing, and drinking late into the night. Then they demand their "bed tea" at dawn.

↓ “Food is especially important,” one homestay operator tells us. “We’ve learned that you must give food according to their palate. So, you must give them Bengali cuisine.” To feed tourists familiar food often requires traveling to distant markets to procure fish—a staple of Bengali cooking that is exponentially more expensive in the hills than in the plains.

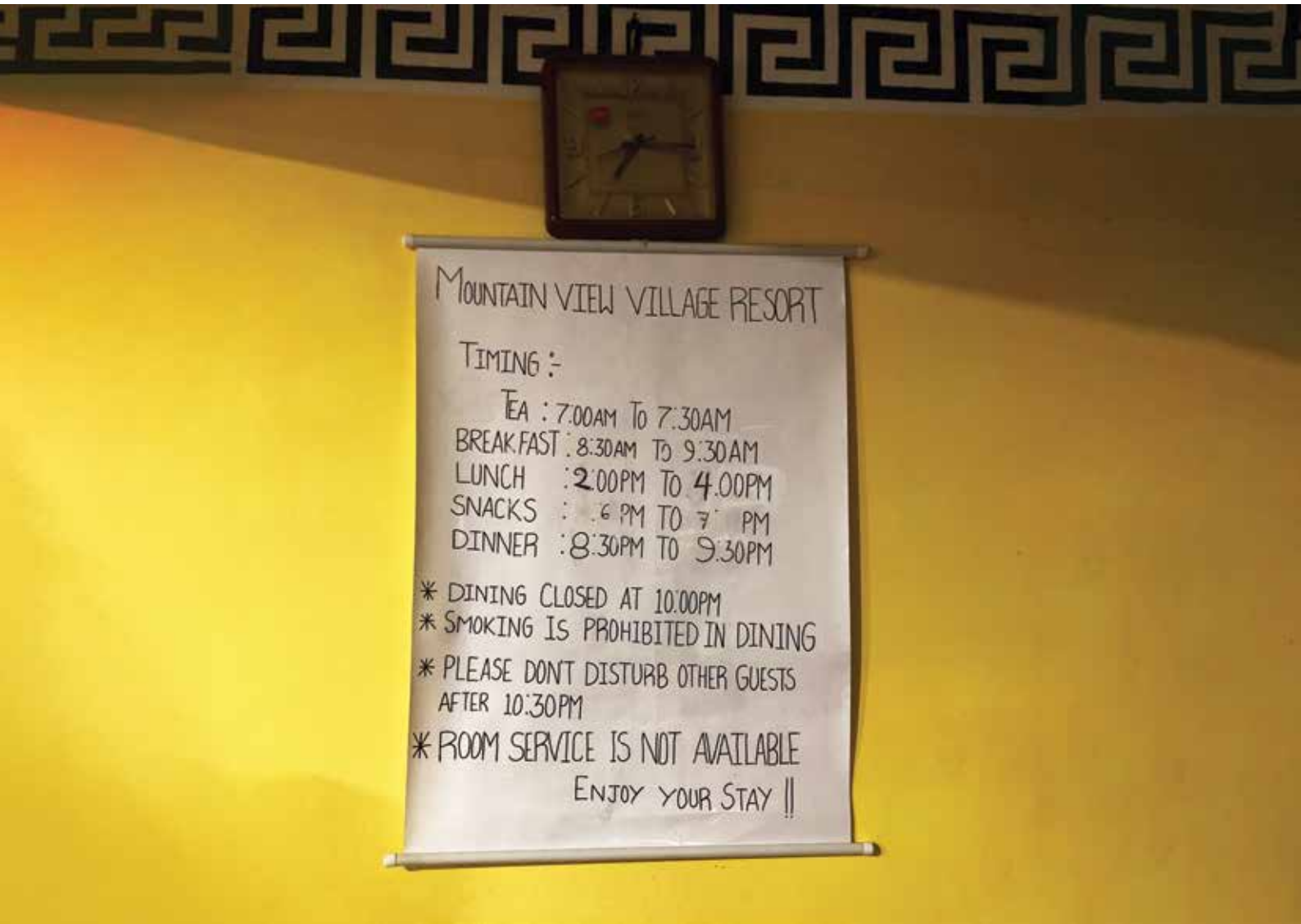


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PHOTO CREDITS

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↑ A contradiction is built into this economic model. As tourists continue to come, looking for the next "open" space, the enclosed space of the interior becomes an intensified site of labor. Paradoxically, agrarian life in the face of climate crisis has moved inward, from the field into the house. ⊙

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*Disappearing Balconies*
by Llerena G. Searle

# What does the enclosure of balconies say about climate, class, and caste?

**On a warm February day, my research assistant Srushti Karale and I visited an apartment under renovation in the Mumbai neighborhood of Andheri West.**

The apartment takes up one entire floor of a five-story stucco building from the 1980s. Amid the sawdust and noise, we could make out signs of luxury: Italian marble floors, French paneling, built-in cupboards, and a custom powder-room sink. As we scrambled among hanging wires and tried not to get in the workers' way, we noticed something missing: the balconies. The contractor explained that his men had extended the walls to enclose the balconies, replacing them with strips of windows.

As we left, Srushti pithily summarized these renovations: the house had been "interiorized." "I think the only outdoor space was for the A/C units!" she remarked. Five air conditioning condensers were perched on the eaves outside. Their refrigerant lines ran into the house to mini-split units in each room through ducts concealed above a false ceiling, creating the effect of central air conditioning at less cost.

The rise of the interiorized home is striking in a country where verandas, courtyards, rooftops, stoops, curtained doorways, and balconies have all historically enabled residents to regulate temperature. Even for those who have electricity, such liminal spaces have allowed the use of natural sources of energy—wind and sun—for household tasks, from drying laundry to growing herbs and vegetables. Even multi-story buildings like this one were originally apportioned with individual balconies for each apartment, so that their residents had access to air and light.

Functionally, enclosing the balconies provides the family in Andheri West with more space. Indeed, we estimated that the owners had added five hundred square feet of living space—bigger than an entire apartment elsewhere in Mumbai. Home interiorization has accelerated as climate change and pollution make Mumbai's air more dangerous, as traffic noise increases, and as pigeon populations grow. But the desire for an interiorized space is as much about class and caste relations as it is about comfort or health. Put another way, climate, comfort, and status are intertwined in urban India. The interiorized home blends a climate-induced desire for insulation from heat and dust with an enduring effort to keep caste and class division intact and safely out of view.

In South Asia, the inside, Dipesh Chakrabarty writes, is "produced by symbolic enclosure for the purposes of protection," while the outside is "where one comes across and deals with strangers."[1] An outside is any space marked by social mixing, like a street or bazaar. Inside/outside boundaries change with time of day and activity. Outside spaces can be made more inside-like through dress, cleaning, or religious symbols—or through social exclusion along class and caste lines. Today, traveling by air-conditioned car rather than public transport, frequenting malls and clubs with security guards, or attending events with ticketed entry are all strategies for remaining inside—in socially purified spaces—even outside the home.[2]

1 Dipesh Chakrabarty, "Open Space/Public Place: Garbage, Modernity, and India," *South Asia* 14, no. 1 (1991): 15–31, https://doi.org/10.1080/00856409108723146.

2 Kathinka Frøystad, "Anonymous Encounters: Class Categorization and Social Distancing in Public Spaces," in *The Meaning of the Local: Politics of Place in Urban India*, ed. Geert de Neve and Henrike Donner (Routledge 2006), 159–81.

Socially, then, balconies are thresholds. They allow for what architect Bernardo Zacka calls "reserved sociability."[3] A balcony allows one to see the comings and goings on the street below, while distancing oneself from social mixing. Of course, balconies also allow for neighborhood surveillance. But in interiorized homes, instead of regulating social relations through the liminal space of the balcony, residents turn to their A/C units.

Early twentieth-century migrants to Bombay (as the city was then known) lived in *chawls*, multi-story buildings with a single room for each family. Verandas, used for laundry and other household tasks, stretched the length of the building; they were above the street, but they were shared and thus outside spaces. By contrast, in the early 1930s, builders began constructing apartments for middle-class families with private balconies and bathrooms. Separate entrances allowed low-caste servants to enter the apartments to clean the toilets without crossing into living areas. Even as these new upper-caste, middle-class domestic spaces were partially enclosed, the envelope of enclosure was fluid. Servants slept in stairwells, vendors traversed the low boundary walls at the edge of each compound, and families mixed through open doors and shared domestic tasks.[4] Mumbai's newest apartments lack the permeability of Bombay's 1930's-era buildings. Today, subtle marketing and sales techniques restrict many apartment complexes to upper-class, upper-caste, Hindu residents.

3 Bernardo Zacka, "What's in a Balcony? The In-Between as Public Good," in *Political Theory and Architecture*, ed. Duncan Bell and Bernardo Zacka (Bloomsbury, 2020), 81–102.

4 Nikhil Rao, *House, But No Garden: Apartment Living in Bombay's Suburbs, 1898–1964* (University of Minnesota Press, 2013), 160–68.

**"The interiorized home blends a climate-induced desire for insulation from heat and dust with an enduring effort to keep caste and class division intact and safely out of view."**

→ A range of balcony enclosures in a Mumbai apartment building.

→ Sliding windows replace balconies in a residential tower in northern Mumbai.

**"The 'bubble' is not just a climatic interior. It is an enclosed social sphere."**

IndiaBulls Blu is a high-end housing complex in Lower Parel completed in 2019. Lower Parel was once the hub of textile manufacturing in the city. The textile mills and the chawls that surrounded them have been redeveloped into fifty-story towers, encased in meticulous grids of blue glass squares. From her living room on the twentieth floor, Payal, a woman in her early 50s who moved into the development in 2021 with her husband, explained that a few of these blue squares were operable windows. She cranked one out six inches to demonstrate, but she made it clear that she didn't think it was safe to open the windows. Pointing to apartments in the adjacent tower with windows pushed wide open, she worried that a strong wind could tear the windows off and crash them down below. In these new enclosed tower blocks, what was once valued as a cooling ocean breeze has become a dangerous force.

Because Payal's apartment is interiorized, electric appliances are indispensable for climate control and household tasks. Instead of drying clothes on an open balcony, Payal uses a discreetly positioned "utility room" with an electric dryer stacked over the washing machine. "It's the first time in Bombay that I haven't had a drying balcony," Payal said as she showed it to me, so "everything goes in the dryer."

Without liminal spaces, social purification strategies have become elaborate and regimented, including high boundary walls and complex entry procedures. The Mathurs, for example, live in a recently completed housing complex in Goregaon with large sliding windows over a waist-high grille—like a balcony flattened to two dimensions. These windows let air and light into the apartment, but they don't allow for spatial transgression. Unlike the balconies on older buildings, which connected residents to the street, this non-balcony, high on the fifteenth floor, encourages a view off into the distance. It transforms the apartment's surroundings into a two-dimensional panorama.

Mrs. Mathur told me that "from a health and wellness perspective" it was preferable to live in what she called a "fully contained society." Instead of *being* outside, the Mathurs were content with a view of it: "This kind of view, you will just not get anywhere," she told me. I remarked that the apartment's cheery white and blue interior reminded me of the Greek islands. Mr. Mathur explained:

> We don't feel we are in Mumbai. Our desire for traveling or for going for holidays has actually gone down a bit, because we literally feel like we are in a holiday home. If you walk around the campus, you'll see two swimming pools, squash courts, tennis courts. So it's literally like being in a Four Seasons, or being in the Westin, or just a nice resort property every day.

↑ Pool and gardens at the Lodha Trump Towers in Worli, Mumbai.

Mr. Mathur is not alone in comparing his home to the Four Seasons. Hotels have become key reference points for India's cosmopolitan elite. Before economic liberalization in the early 1990s, some imported goods were only available at five-star hotels. After liberalization, travel abroad has become commonplace for Indian elites, and familiarity with resort locations is a key marker of cultural capital. Interior designers who work in new tower blocks told me that residents commonly show them pictures of hotel rooms as inspirations for interior renovations.

As Payal and I walked around IndiaBulls Blu on a rubberized running/walking track, we passed indoor and outdoor tennis courts, a cricket practice pitch, basketball courts, a fenced dog park, a party hall, and the club (with a salon, café, and pools). These places provide leisure experiences without the need to interact with social Others. Payal explained that these amenities helped convince her and her husband to move here from Bandra (a posh neighborhood north of Mumbai's city center). At IndiaBulls Blu, Payal explained, "it's not just the home, but the whole place is an extension of the home." In this gated community, "we don't struggle with the outside world. You stay in your bubble." The "bubble" is not just a climatic interior. It is an enclosed social sphere.

Just as such bubbles obscure migrant labor in Qatar (see Chang and Pandian, this issue), the residential bubbles of contemporary Mumbai obscure the work of social reproduction. To see a housing complex as an enclosed leisure space, one must ignore the workers who come daily to maintain it: the numerous uniform-clad employees who cut the lawns, water the plants, and staff the elevators, café, and salon. Paid domestic workers—and the social tensions their presence may create for middle-class and elite Indians—are not new in South Asia. In these new residences, however, their erasure is striking. The Mathurs both work from home, so they have renovated their apartment with two study-work spaces. By interiorizing their own work, they enhance its immaterial status, and distinguish themselves further from the workers who maintain their resort-like compound manually.

The value of these elite homes comes in part from the way they insulate residents from rising heat, relentless air pollution, and the dangers of unpredictable weather. Yet interiorization is not just a straightforward response to climate change—especially as these homes contribute to climate change through electricity use and heat generation. Interiorization is also a means for elites to re-establish class and caste barriers, and to systematically obscure the continued presence of social Others in their midst. Rather than simply reproducing climate change denial, the interiorized space is one of climate disavowal, a space where caste and class—and the labor that maintains these divisions—are replaced by a stunning two-dimensional view of the horizon. ⊙

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PHOTO CREDITS

p.120-125: Photos by Llerena G. Searle.

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*Behind The Purdah*

Photos and text by the Ankur Writers Collective

Introduction and translation from the Hindi
by Amita Baviskar

# What's it like to be a working-class woman in a hot city?

## Across every threshold hangs a curtain.

It's made from sturdy cotton fabric, brightly colored and patterned. The cloth is bunched together and looped over the open door when it's in the way, but for most of the day, it stays suspended, a soft yet definitive divide between home and the world outside. In this neighborhood of narrow alleys and windowless single-room dwellings where the breeze never reaches, people don't shut their doors during the day. If they did, they would suffocate. The curtain gives them a breath of air.

A *purdah*, the Hindustani word for curtain, is not just a material device for moderating heat. It is also a technology for maintaining female modesty. Behind the purdah, women live and labor, with the *dupatta*—another piece of veiling cloth—draped around their heads. They bend toward the stove, stirring dal and flipping rotis, the dupatta soaking up the sweat at the backs of their necks. The stove sits near the door so that the heat from its flame and the fumes from tempered spices can escape through the curtain. No one cooks outside. Because purity and pollution remain governing concerns in Hindu households, the sacred space of the hearth must be indoors, insulated from outsiders. So must women be inside, behind the purdah.

Delhi is a hot city. Situated on the plains of northern India, its temperature soars to 45°C/113°F in summer. It hovers there from early May to late June, when the monsoon winds bring cooling rains. This is the rhythm of the seasons, and those who live here have learned to sway to its beat. Well-to-do Delhiites shelter in air-conditioned rooms, sipping cold juice or lassi, showering often and long. They travel in air-conditioned cars, sunglasses perched on their noses, antiperspirants sprayed on their underarms.

For people in working-class *bastis* (neighborhoods), where roofs made from thin sheets of tin and concrete catch and concentrate the sun's rays, cool interiors and cold water are luxuries. Rackety ceiling fans that circulate hot air or tiny exhaust fans are about all they can afford, and a power cut can bring even these to a standstill. Water must be collected from communal taps. Yet despite their meager means, the people here manage to craft a kind of thermal comfort.

These vignettes have been penned by young women and girls from the Ankur Writers Collective. They have taken these pictures. In between their school hours and domestic chores, they observe, reflect, and write about their world. There is a matter-of-factness in their tone. There is also irony and humor. Some dream of different ways of being. Some scheme to make the most of what they have. Some grumble about the awfulness, while others exult in triumphing over the trials of everyday living.


Super Shine

## SHORTS
*by Yashoda*

Chanchal lives with her bedridden husband and three children in a cramped room above her in-laws. Every available inch of space is taken up with the paraphernalia of daily life: mattresses and clothes, kitchen jars and utensils, a gas cylinder, a small wooden sofa, a giant drum to store water, a tiny cupboard with the children's books. The place smells musty; the odor of rotting garbage wafts in from outside.

On Sunday, July 21, 2024, the hottest day in the history of the Earth, Delhi's temperature crossed 48°C/118°F. In Chanchal's house, it felt even hotter. Men and boys were out of the basti and on the street, trying to cool themselves by the breeze of passing cars. Elderly women sat out in the narrow lanes. But for women and girls like Chanchal and her daughters, there was no space on the street or in the lane. They had to remain in their claustrophobic room.

That afternoon, Chanchal's sweat refused to dry. Her *salwar-kameez* (loose fitting pants and tunic) stuck to her body, no matter how she folded up the sleeves or lifted the bottoms to her knees. Her daughters kept washing their faces, but they couldn't tell the sweat from the water. Then Neha said, "Mummy, *chachu* (father's younger brother) downstairs discarded lots of old clothes. There were some shorts there, too. Can't we take those?"

Chanchal said, "But those are all boys' clothes. If you wear them, what will your *dadi* (paternal grandmother) say?"

Neha replied, "Dadi will only say something if we wear them downstairs on the street." Chanchal sorted through the old clothes and gave Neha and Tassi a pair of shorts each. The sisters looked at each other and smiled. Feeling cooler, they fell asleep, eyes closing easily after their restless night.

The rest of the story describes what happens when Neha wakes up in the evening and rushes out to buy milk, forgetting that she is still wearing shorts. In a basti where many women wear the full-body burqa when stepping out of their home, the shorts are a scandal. What did the old women's dress police say? We will leave you in suspense.

## OLD TIMES

*by Zeba*

Chandravati likes to talk. Once she starts talking, it's hard to get her to stop. When I asked her about heat, she poured out a flood of memories. How it was in her village, where houses were set apart. Not squeezed next to one another on narrow alleys like here. Sure, they had no running water or power, but it felt open and breezy. There was a neem tree in their courtyard, and they would spread their *charpais* (string-cots) below it. Or they would sleep on the roof. It was airy there, but when the wind died, they would cool themselves with homemade *beejna* (fans) of woven grass. What fun it was to go with friends to collect the grass for making the fans! Then to jump into the canal to cool off! When a woman got married, they would send several *beejna* with her so that she could fan herself and remember her home.

When Chandravati got married at fifteen and came to Sundarnagri forty years ago, there were only a few shacks dotted about the land. They would climb on top of their tin roof and sleep outdoors. Now all the houses are stuck tight together. There's no room to breathe. You stand in the lane and look up, but you can't see the sky. In the village, they could put a charpai or two out in the lane to sleep on. Here, there is no space. But still, when there is a power cut and all is dark and still, Chandravati opens her door and lies down with her head on the threshold. She fans herself with her *beejna* until she falls asleep. Sometimes she sprinkles water on its frayed, braided-grass surface. As the moist droplets fall on her face, she thinks of her village home, its cool open spaces now fading into the recesses of her mind.

## FRIDGE

*by Ruchi*

Bimla works as a maid in a mansion. Her tasks there are the same as the ones she does at home, but she has to set out at five in the morning and travel by bus through thick traffic. When she arrives, she must work hard and long. When she comes home in the evening, she hides her weariness behind a smile as she greets her husband Ramesh, a photographer whose business has dwindled since mobile phones became common.

Bimla's employer at the mansion trusts and likes her, so when she bought a new fridge, she gave the old one to Bimla. For two days, the fridge sat outside, gathering dust. There was no place for it in their 162-square-foot home. Then they somehow managed to maneuver it in, wiped it clean, and plugged it into the power board. A muted roar erupted from the old compressor. A yellow light glowed when they opened the fridge door. They put in a bowl of water and a plastic bag of chilis and tomatoes.

The fridge cooled things inside, but it threw heat out. Within a week, their room was suffocatingly warm. The bed on which Bimla and her daughter Surabhi slept was right next to the fridge. Now their sleep fled. Ramesh slept on the floor, covering himself with a damp scarf that would cool him as its moisture evaporated. In the middle of the night, Bimla, exasperated, and Surabhi left their bed and joined Ramesh on the floor. She began to switch off the fridge at night, but stopped when she heard that this was not good for the fridge. What can you do? You learn to live with heat.

## HOSPITALITY
*by Rani*

When Lajjavati's *jhuggi* (small shack) was demolished, she was given a plot of land in Savda, on the outskirts of Delhi. Slowly, people settled there and built proper houses. But Lajjavati and her mentally disabled son still live in a tiny shack made from bamboo mats with a mud floor. The officials had not installed her electricity meter, so she had only a kerosene lamp to light her dark. But then Gupta-ji next door extended a wire, so she has a lightbulb to see by. No electricity, no electric fan. She fashioned a piece of cardboard into a fan, and it is always in her hand. To keep away mosquitoes, she shuts her door and burns dung-cakes made from the manure of wandering cows. After working in the vegetable fields all day, she lies down on the floor, fanning herself to sleep.

One day, acquaintances from her old neighborhood came to visit. They had not met for years. The demolition had scattered families to different places. Lajjavati went to Gupta-ji and said, "I have guests, but there's no space inside to seat them. Please lend me your chairs." Gupta-ji gave her his plastic chairs, and she arranged them outside her shack so that her guests could sit. Then arose the problem of feeding them. There were not enough provisions to fill everyone's stomach, and smoke from her wood-burning mud stove would bother them.

Lajjavati had a brainwave. She called her son and told him to show their guests around Savda. Now she could cook in peace. She rushed to the shop and bought some provisions on credit. She plucked some tender sponge gourds from the creeper outside her shack and made a *sabzi* (vegetable dish). She made rotis. When the guests returned, she spread a mat on the floor for them to sit and lovingly served them the sabzi with hot rotis. They savored each bite.

After they left, Lajjavati returned the chairs to Gupta-ji. She sat down against the wall next to the stove, soaked in sweat. It was a challenge, she thought. But it is nice to have guests.

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The young women who make up the **ANKUR WRITERS COLLECTIVE** live in Delhi's working-class neighborhoods. They meet several times a week to read aloud their stories, which usually respond to a mutually decided prompt. They draw on their own experiences and on interviews, observation, and imagination. Comments, critique, and suggestions from members of the Collective help them revise and polish their drafts. The Collective is set up and supported by Ankur Society for Alternatives in Education, a Delhi-based NGO that has been engaged in building the intellectual life of working-class neighborhoods for more than four decades. Currently, the Collective includes more than five hundred writers across seven localities. Their work has been published in literary journals and collected volumes. An anthology of translations titled *Trickster City* was published by Penguin India in 2010.

STO

# RIES

*The stories that I get drawn to now are where there is some sense of people mobilizing in the face of institutions, obviously, in the face of power, obviously—but also in the face of the general notions of well-meaning people, even potential allies of ordinary people, like academics, journalists. Sometimes the understanding that we bring to those situations actually works against people. There's something that people are trying to say to us. There's something that, for the lack of a better word, the most oppressed are articulating, which we miss because we are looking for something else. Those are the stories that draw me, I think. And it wouldn't be bad if I managed to say something significant about this in the course of my life.*

*This approach to storytelling kind of came from the Kolkata story, where a group of people were convinced that the deaths in the neighborhood were because of heat, even though science, hospitals, governments, everybody would convince them otherwise. And they did it. They went into a mall. They didn't damage anything. They didn't hurt anyone. There were people coming out of late-night movie shows that night when they went into the mall, I think a couple of cafés were still open, because in India, people still drink coffee very late in the night. So that's what they saw in the mall. And later, of course, they were accused of trying to steal gifts for Eid, which was approaching, which really affected people deeply in the neighborhood. I think that's what's going to stay with me.*

—Anant Gupta

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