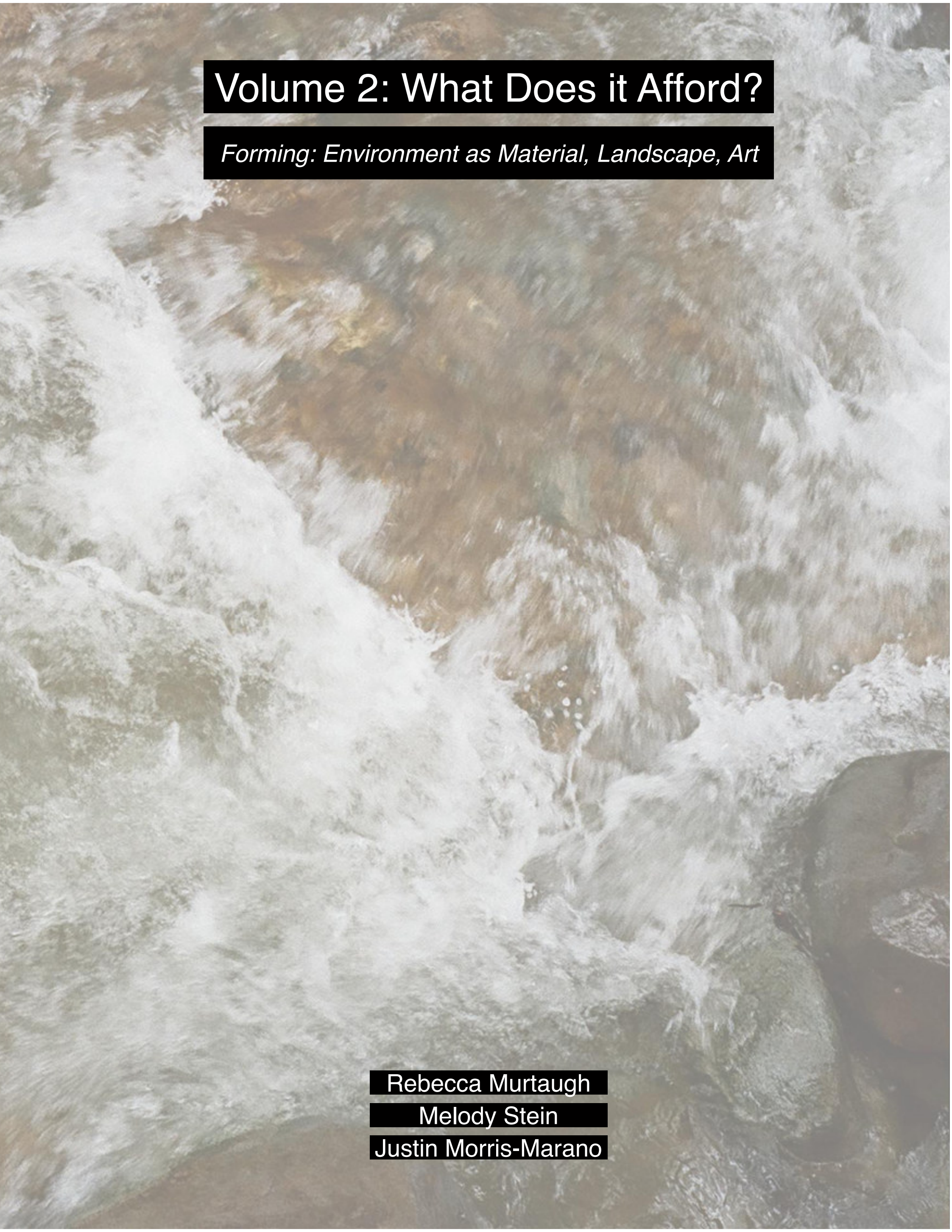
Volume 2: What Does it Afford?

Forming: Environment as Material, Landscape, Art



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This project has been generously supported by the Dietrich Inchworm Grant at Hamilton College.

Forming

Vol 2: What does it afford?
Rebecca Murtaugh

What is the process you are focusing on?
Creating ceramic sculptures from erosion topographies.

Artist Residency at Swale House with Urban Soil Insitute on Governors Island, October 2024
Photo: the author

I set out to make thin quick plaster gauze molds at sites of erosion aiming to translate and transform that topographical landscape into a ceramic sculpture with my locally harvested clay.

Returning to my studio, I then created rice paper molds from the plaster gauze molds. These become coddles that I build upon and fire along with the clay in the kiln to offer structural support. The rice paper burns away in the kiln.

Working with Cretaceous clays and terra cottas, these sculptures address a shifting ecology, a history of a site in time, which is often slow but sometimes a dramatic and swift transformation.

Rolled and Folded
terra cotta
15” x 10” x 6”
2024

My first exploration with this process was with the most plastic and forgiving harvested clay, which involved rolling very thin slabs between craft paper to offset the stickiness, it required quick working and demonstrated very little forgiveness.

These challenges led me to reconsider my approach and drove me to work with clay in the liquid form.

What Does it Afford?

What are the affordances of this process?
Leveraging the material intelligence of harvested clay.

My process of harvesting local clay includes a number of sites. In Central New York the terra cotta clays were formed about 13,000 to 20,000 years ago through the formation of glacial lakes with clay sediment deposited on the lake bottoms.

On Long Island, clays were formed during the Cretaceous period from two types of glacial deposits of till and outwash and are about 70 million years old. These deposits of till are the result of weathering that broke down rocks and minerals to smaller particles. The till was further ground and transported from glacial grinding and erosion that results in fine-grained particles of clay.

Above:
Salty Shell
ceramic
2024

Left:
Scraped & Rolled I
terra cotta
16” x 6.5” x 4.5”
2024

The Cretaceous clays vary in colors of white, grey, yellow, and pink and have a high kaolinite content, allowing them to be fired to higher temperatures that are standard for clays such as porcelain or stoneware.

Firing temperature also reveals a variety of results in regard to color and surface, with very rich and lush results.

Repaired
ceramic with lustre
13.5” x 12” x 4”
2024

Clay has an affinity for water, this was a consideration in shifting to work with harvested clays as a liquid.

I can now manipulate the material in new ways such as pouring it onto a plaster surface and scraping slabs of clay up that contort and impart a lively gestural form.

Contorted & Layered
ceramic
10” x 14” x 5”
2024

It also provided a dynamic texture and the ability for me to work more intuitively as each slab was unique in how it would respond to force and the speed of my tools.

This process of drying clay on a plaster slab has been part of processing my clay after digging, so reintroducing some of its origin to the making was of interest to me.

Furthering this endeavor, I made many of my harvested clays in what is referred to as a “casting slip”. A deflocculant was added to decrease the amount of water and increase the clay content. This allowed for me to explore dipping natural fibers such as cheesecloth and burlap into the slip and placing into my rice paper coddle. While in grad school I worked extensively with dipping paper into slip, so this was a return to a previous practice that I’ve wanted to pursue for some time.

Saturated Topography I
ceramic
10” x 14” x 5”
2025

How can you engage further?
How can the sculptures be activated?

Studio view of works
2025

My scientific research has increased my understanding of local geologies, soil science, and the role clay plays in water quality.

I will reflect on this new knowledge to consider the potential for ceramic pieces to work as water filters and further my exploration working with clay in the liquid form to achieve this goal.

Volume 2 References:

Foley, Nora. “Environmental Characteristics of Clays and Clay Mineral Deposits.” Usgs.gov, 2019, pubs.usgs.gov/info/clays/.

René, Miloš, “Mineralogy.” IntechOpen EBooks, IntechOpen, 4 Jan. 2022. Accessed 24 June 2025

Geological Survey. Bulletin - State of New York, Water Resources Commission. State of New York, Conservation Department, Water Resources Commission., 1965. Bulletin 64.

Photo Credit:
Jason Mandella for Rebecca Murtaugh’s photographs that are not attributed to author.

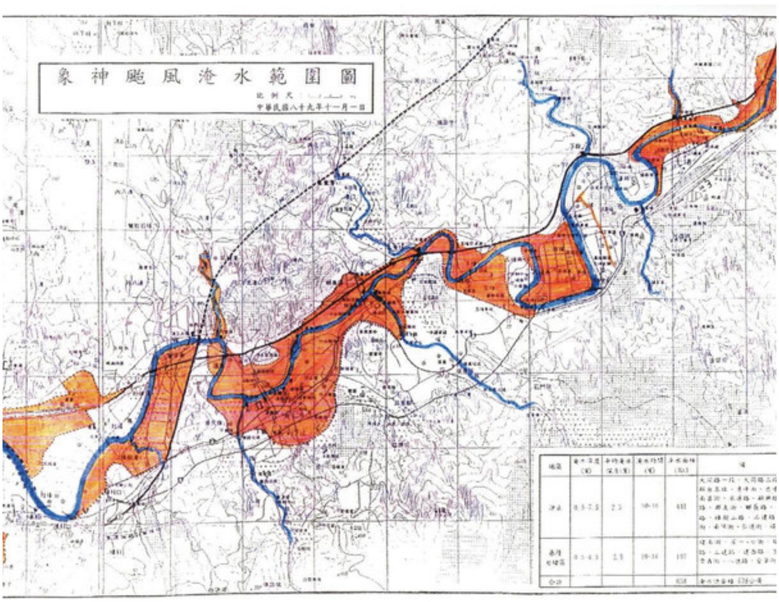
Forming

Vol 2: What does it afford?
Melody Stein

What is the process you're focusing on?
I dove deeper into how flooding operates by setting up a call with Dr. Erich Hester. Dr. Hester is a civil and environmental engineer who leads a lab at Virginia Tech and published the paper that I came across about floodplains filtering pharmaceuticals out of waterways.

We discussed his work studying wetlands as functional systems in around the world, including in Taiwan.

Below: Historic floodmap of the Keelung River in Taiwan.
Source: Taiwan Water Resources Agency



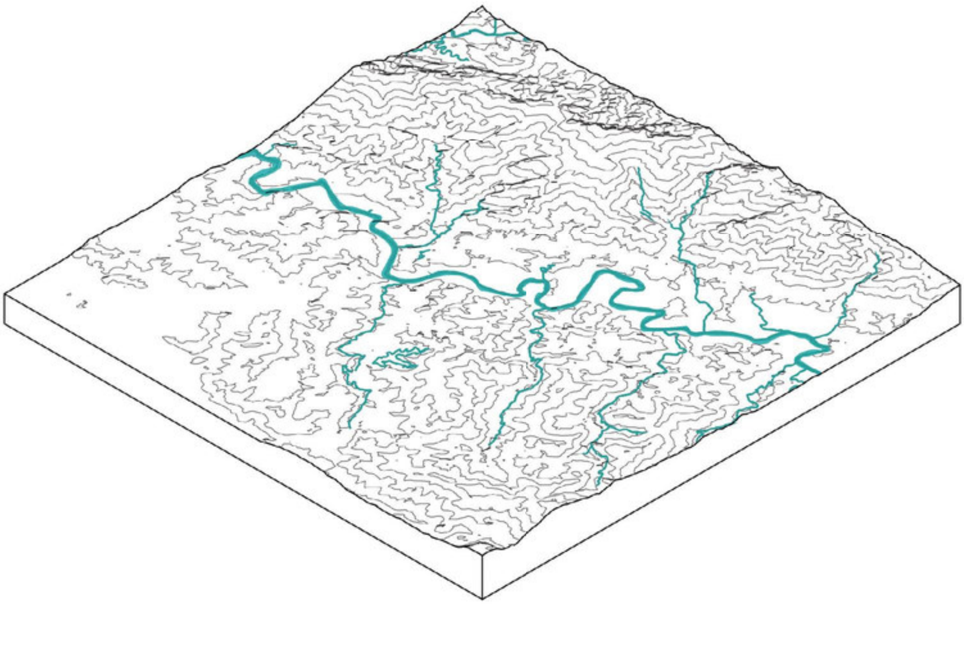
圖六-1　象神颱風基隆汐止淹水範圍圖

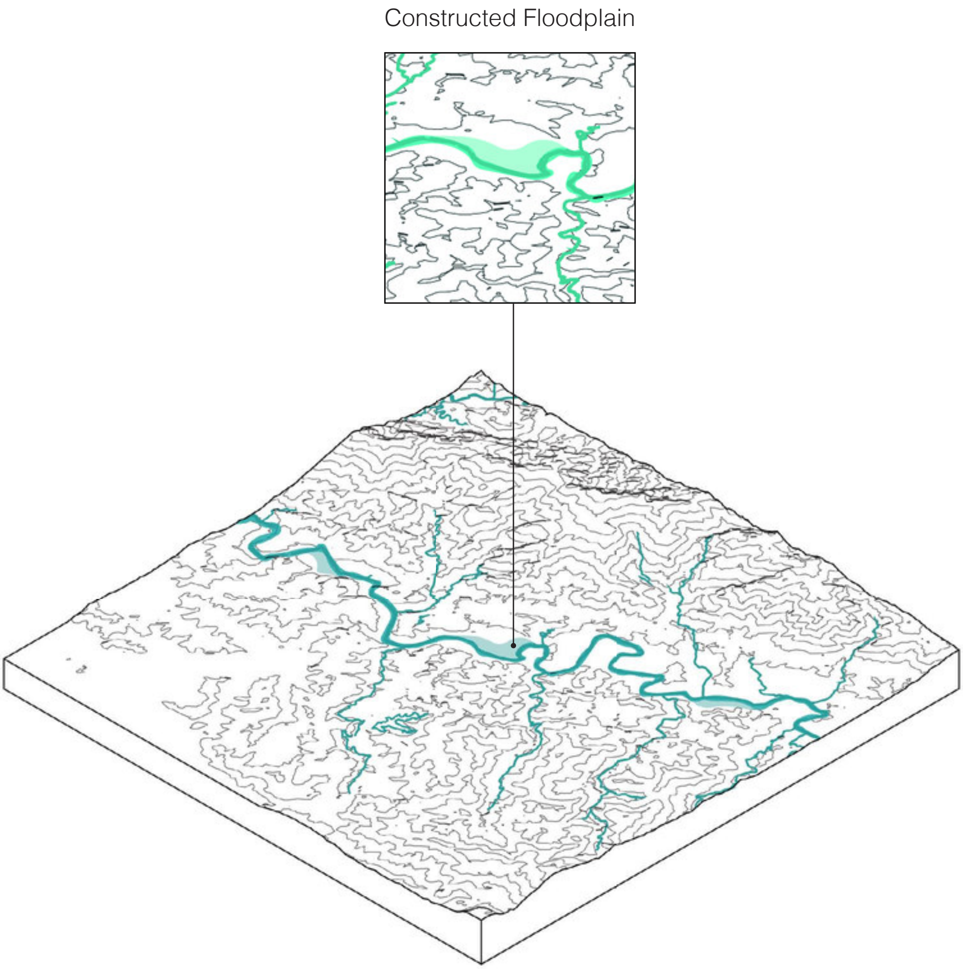
He started his work there in a similar way we did: he asked, "What's abundant here?" and recognized that the most abundant resource in a summer in Taiwan is the sun. He wondered, how could sunlight be leveraged? What systems or tools could harness it to address contamination? The answer came in the form of a floodplain. Floodplains work by collecting overflow water from adjacent rivers and then spreading it out in a shallow film over the landscape, allowing light to penetrate through the volume. Then, the water flows back into the river and continues on

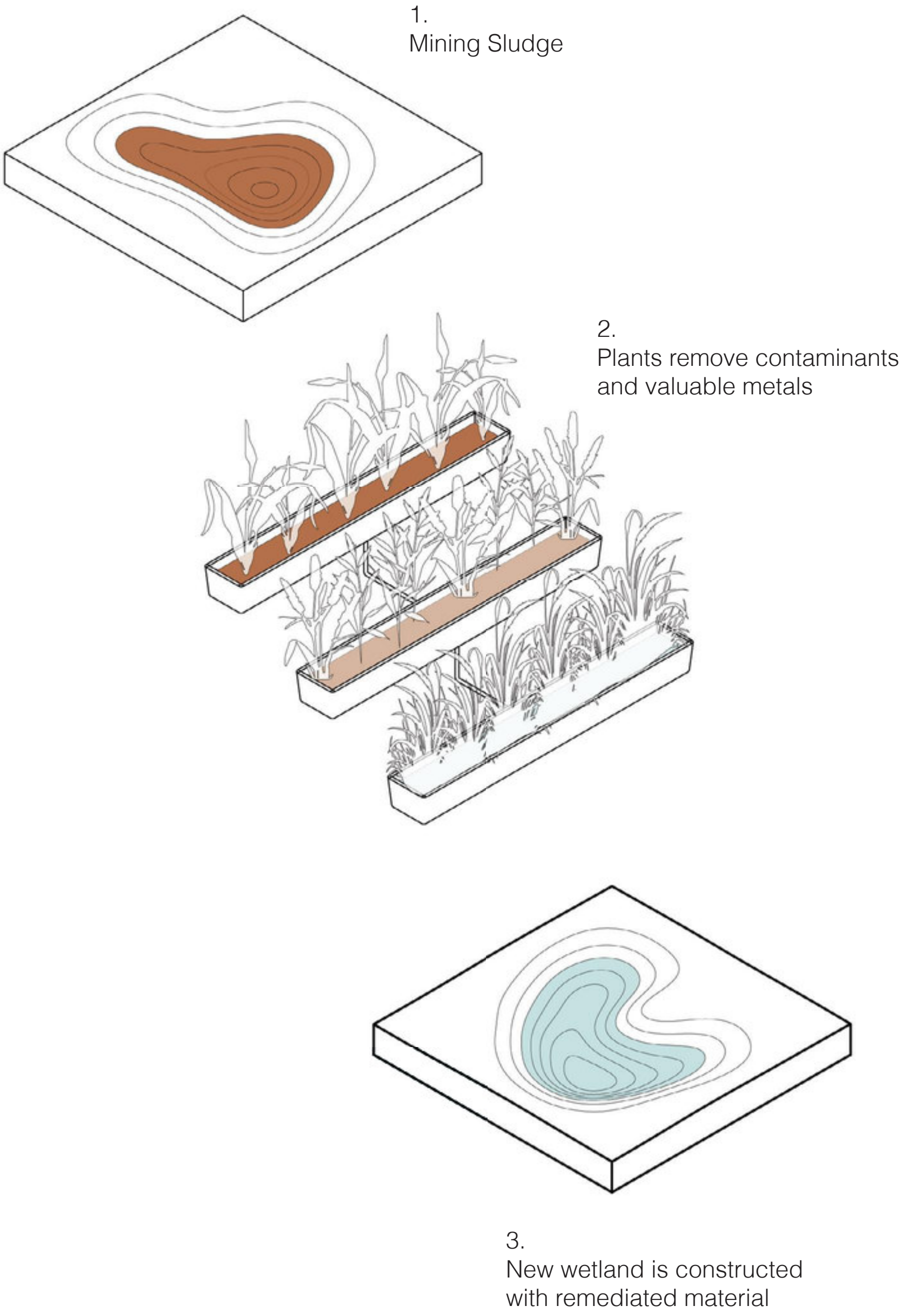
its way. The floodplain is a naturally occurring landscape system that works like a machine for filtering water. Landscape architects and civil engineers have developed effective methods for constructing functional wetlands.

Above: Flood control infrastructure, like the massive floodwall pictured above, separates the city from the river almost completely in contemporary Taipei. Source: Photo by author

But Dr. Hester recognizes the misconceptions and barriers that can cause research bottlenecks and sideline implementation. Scientific research relies on controlling for the unknown and delivering predictable results, but there are so many variables in a water system that being able to promise reliable results is difficult. “Rivers are downstream from the whole landscape,” he says.




Constructed Floodplain


1.
Mining Sludge
2.
Plants remove contaminants
and valuable metals
3.
New wetland is constructed
with remediated material

What are the affordances of this process?
My inquiry jumped from floodplains to their marshy cousin: wetlands. I spoke with Dr. Colleen Doherty at the University of North Carolina in Raleigh to learn more about her work with contamination and constructed wetland systems.

Doherty Lab studies the use of using plants to extract rare earth elements from acid mining drainage sludge through a process known as phytomining. She thinks about “synthetic” wetland systems as plant-powered machines for extracting valuable materials while remediating the contaminated waste of mining operations.

Synthetic wetlands differ from in-situ wetlands in that they in no way replicate the appearance of wetlands and instead only duplicate some of their functions. She described a system in which contaminated mining sludge and water could be pumped through a series of containers holding different species of plants that would clean it of various compounds before releasing the cleaned water back into the environment to construct a new, in-situ wetland ecosystem. When the mining sludge has been fully cleaned, the containerized plants are removed and processed to extract the valuable metals they have absorbed.

Our conversation reminded me of the biomimicry discourse that emerged first in industrial and architectural design and has since grown in popularity in the urban design space. Biomimicry is the theory that natural processes, strategies, and patterns can be emulated and leveraged to address human challenges. Biomimicry at the ecosystem level is complex and can quickly dissolve into replicating how something looks instead of what it does, something that Dr. Doherty’s work brilliantly sidesteps.

Previous page:
Conceptual diagram of synthetic wetland system.
Source: the author

How can you engage further?
Each of these interviews progressed my thinking about what functional land-based remediative systems could be and how they could relate to existing and emergent ecosystems.

What also stood out to me was the inherent interdisciplinary nature of both scientists' work. These multi-variable projects engage engineering, microbiology, chemistry, ecology, and more.

Below: Pokeweed (*Phytolacca americana)* at Doherty Lab grow in water containing 20% acid mine drainage.
Photo: Manuela Lourenço

Forming

Vol 2: What does it afford?
Justin Morris-Marano

What is the process you are focusing on?
Metal uptake in plants.

What are the affordances of this process?
An understanding of how plants uptake metals from soils led to the discovery that those metals could be subsequently extracted from the plant body through an emerging process called phytomining. This technology leverages a biological process as a mechanism for turning waste into resource.

How can you engage further?
I jumped on a call with Colleen Doherty at North Carolina State University to hear more about her research. Colleen spoke with incredible knowledge on the state of the field, its past misrepresentations, its aspirations for the future given renewed federal interest in recovering Rare Earth Elements (REE's) from soil, and her lab's interdisciplinary work. We pitched Colleen on a visit to her lab, where we could speak further on phytomining and learn more about her work. We recognized a lack of rigorous and compelling storytelling in the phytomining field, so we chose to start by photo documenting our visit with Coleen, and followed with an interview. This interview has been edited for length and consistency.

Justin: Why is phytomining so pertinent now?

Colleen: Right now, one of the major things we need are these rare earth elements. We want to have clean electricity, we want to have a green environment, we want electric vehicles and offshore wind turbines — but these elements are in short supply. There really is a monopoly on their mining, extraction, and purification from China. Being able to produce these elements domestically would provide domestic security. What we're targeting is the national need and urgency for these metals. And, their availability in the waste stream is an impetus to clean up that waste.

Above: ***Phytolacca americana*** growing in 20% acid mine drainage
Photo: Manuela Lourenço

Phytomining is never going to meet the demand for rare earth elements that we have now. It's just going to be a drop in the bucket, but it's going to be a very important drop in the bucket because it's going to target areas where we have waste.

What I'm most excited about with phytomining — and we're nowhere near this now — is to address the challenge of separating rare earth elements out. We know we can mine the waste, but getting materials separated from each other is difficult. Plants are doing some of this naturally. Can we go from using plants to take up the metal and then using bacterial or chemical methods to get the metal out, to getting plants to actually go ahead and make the next step of the product? They can take up the metal, but can they make it into a specific nano particle that can be used in commercial applications? One of my long-term goals is to understand enough about the biology of rare earth elements to then say, let's ask the plants to put it in a specific location or make it into a specific chemical formula that would then be usable in commercial downstream applications.

Below: *Lemna spp.*
Right: *Phytolacca americana* fruiting
Photo: Manuela Lourenço

Justin: I'm curious, what do people usually get wrong about phytomining?

Colleen: So, I have a lot of things. Phytoremediation kind of has a negative connotation for some people because people try to remediate and then nothing happens. Part of that is because plants are slow. They take a long time; you can't expect things to happen overnight with plants. Plants are excellent at phytoremediation, but they take time and so we have to think about that as part of what we're doing.

Above: ***Phytolacca americana*** growing in contaminated medium
Photo: Manuela Lourenço

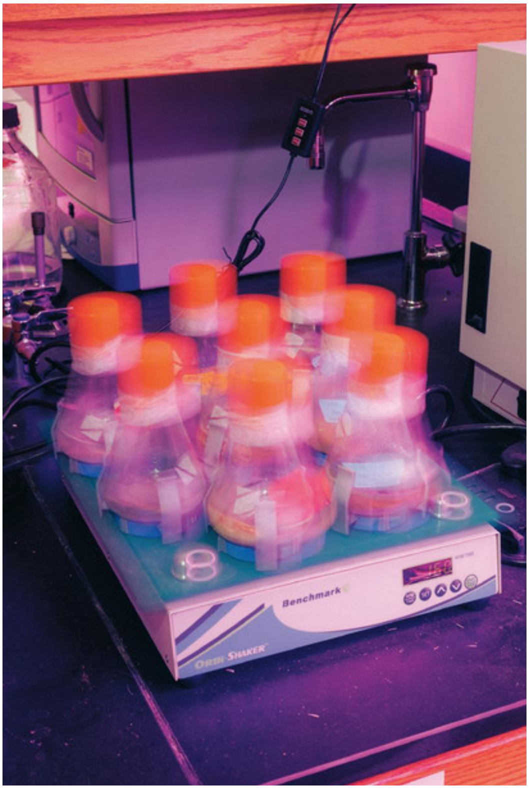
Melody: Can you explain how you deploy genetic analysis and editing alongside plant breeding to identify and select for desirable characteristics?

Colleen: Our original idea was to say let's improve the plants. Let's make them more efficient. It turns out they're already super efficient, but they're just not consistent. A lot of my expertise is in RNA sequencing analysis — so looking at the transcription, and asking what is the plant trying to respond to. How is this plant responding to its environment? How is it responding to acid mine drainage? How is it responding to the presence of these metals? If we see that a particular plant is really great at uptake, then that's a trait we want to breed for.

We would do gene editing on these plants, but not necessarily for putting out into the field. Let's say that plants with gene A turned on are really good at taking up metals. That's a correlation. It would be necessary to show causation before we spend a lot of time breeding for that particular correlation between gene A and high uptake. So what we would do is engineer a plant that turns gene A on really high to see if it is actually causing better uptake, and if it is, we would hone in on breeding for that target.

Below: Shaker, unknown
Photo: Manuela Lourenço

Following images in order of appearance:
Doherty Lab Greenhouse,
Dr. Colleen Doherty,
Unknown
Photo: Manuela Lourenço

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