Casual Planetarities

Choreographies, Resonance, and the Geologic Presence of People and Aquifers

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Abstract Planetary awareness has become synonymous with awareness of large-scale temporal, geographic, and geologic events. Given the scalar multiplicities and instabilities of life on earth, concepts such as planetarity, the Anthropocene, and even the global have provided analytic reprieve. They name that which is difficult to objectify: the geographic and historical vastness of geological presence. But those concepts grow from knowledge habits inherited from imperial and Cold War logics and can presume the existence of an all-encompassing observer who can grasp the unity of the planet as such. This article explores alternative assumptions. It asks how other practices of the earth deal with planetary scales of sense-making. It conceptualizes those practices as forms of *casual planetarity* that, instead of drawing on preexisting scales such as the planet or the Anthropocene, produce senses of closeness and/or distance between everyday life and the geological implications of human presence. It follows the work of geologists in Costa Rica who rely on a 3D physical model to bring about scalar oscillations that connect human experiences with the vastness of underground worlds. This association is made possible by focusing on the movement of water as a hydro-geo-social choreography of everyday life. The article shows how the resonant power of the 3D model geologists use to enact these choreographies opens pathways for people to come to terms with their geological presence without having to see the planet as a whole or presume the capacity for total observation.

Keywords climate change, models, scale, geology, underground, water

Definition. Casual (adjective):
1: subject to, resulting from, or occurring by chance
2: a: occurring without regularity: occasional
b: employed for irregular periods
c: met with on occasion and known only superficially
—*Merriam-Webster's Collegiate Dictionary*

Planetary awareness has become synonymous with an awareness of large temporal, geographic, and geologic scales. Building on images of the oneness of planet Earth from imperial and Cold War ambitions of global control, the idea of the planet is as

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much geological fact as it is a geopolitical product.[1] In the twenty-first century, planetarity is also an affective disposition that in its anxiety-ridden form signals potential annihilation due to nuclear fallout and/or climate change.[2] As a form of witnessing environmental harm, planetarity also accounts for centuries of extractive projects that dislocate organic and inorganic matter to secure the accumulation of capitalist value.[3] As crisis, planetary awareness diagnoses the need for new relations with nature. In this context, concepts such as entangled humanism, learning to live with extinction, and, of course, the concept of the Anthropocene name and bound phenomena that exceed human scales and turn the planet into a "structure of awareness."[4] These concepts, however, implicitly presume the existence of an observer who has attained something approaching a total perspective (in scalar terms), even if said perspective is predicated on a critical edge. They presume an observer who perceives Earth as a planetary unit.[5]

Parallel to those concepts and the all-encompassing observer they imply, there are attempts to name and resculpt the earth without drawing on unitary notions of the planet or presuming the existence of a stable, all-encompassing observer. These political projects do not aim to produce oneness, nor do they seek to diagnose blanket affective states. Instead, these projects are alternative practices of the earth that seek to make sense of human geological presence without drawing on the scalar vestiges of imperial and Cold War legacies.

I understand those alternative projects as forms of *casual planetarity*, practices of the earth for which awareness is not synonymous with global or imperial scales of observation. These casual planetarities articulate humans with their own geological presence but do not resort to premeasured scales of the earth, such as the Anthropocene or the global, to do so. Casual planetarities produce their own scales, where scale refers to the distance between geologic matter and social relations, as well as between the perspectives from which those relations can be observed.[6] This distance can be increased, widening the separation between one realm and the other, or can be decreased, bringing them into close epistemic contact. In either case, casual planetarities remain committed to environmental dynamics without focusing on total annihilation or extinction to justify their importance. Casual planetarities bring into people's everyday experiences new forms of sensing and making sense of their geologic presence.

Consider the following example: Don Pedro has worked as a plumber for a Costa Rican community aqueduct for three decades. His face shows the effects of hours and

1. Cosgrove, *Apollo's Eye*; Masco, "Bad Weather"; DeLoughrey, "Satellite Planetarity and the Ends of the Earth."

2. Masco, "Bad Weather."

3. Gómez-Barris, *Extractive Zone*.

4. Connolly, *Facing the Planetary*; Rose, van Dooren, and Chrulew, "Introduction: Telling Extinction Stories"; Spivak, *Death of a Discipline*; Elias and Moraru, "Introduction: The Planetary Condition," xii.

5. Some authors, such as Spivak and Elias and Moura, argue the planetary is an alternative to the global or Imperial whole in a much as it draws on concepts such as relationality and multiplicity to achieve its analytic and political purpose.

6. For a broader discussion of the relation between scale, care, and politics see Seaver, "Care and Scale."

hours spent under the sun. He explains his athletic complexion as the result of years of physical labor he has performed during his life. That labor includes drilling wells, laying pipes, fixing water lines, cleaning water pumps. Responsible for the infrastructure of his community's aqueduct, don Pedro has lived his professional life oscillating between the surface and the subsurface, paying attention to the movement of water from the underground into human worlds. He has extensive knowledge about subsurface infrastructures, soil types, well depths, the movement of sands, the effects of gravity. Yet when he saw the physical model that a geologist from a public agency had come to present at his community aqueduct, he was enthralled. The model restaged the movement of water from above the surface deep into an aquifer and back up into the surface. It did so through a system of hoses, syringes, and storytelling. After the geologist finished his demonstration, don Pedro took the floor to share his impressions: "So many years working with groundwater, with aquifers, and today is the first time I can see what happens in subterranean space. This gives me so much joy!"

From the perspective of those that apprehend Earth as a unit, don Pedro operates at an ineffectual scale for the environmental problems we face—at a community aqueduct, in a small town in Costa Rica. Yet I propose that don Pedro and the geologist–public servant he meets enact a praxis of the earth that while not relying on terms pregnant with the geographic or temporal scales of dominant planetary regimes (e.g., global, Anthropocene, earth) nevertheless creates a distinct form of planetary awareness that sits outside any strong environmentalist, Anthropocenic, or planetary program. As a shared praxis, *casual planetarity* is built out of occasional encounters and includes exchanges that are not organized around the precise measurement of a shared environmental condition. This form of casual planetarity emerges from histories and actions that do not seek narrative or epistemic completeness along ordinal scales (e.g., from small to large). Lauren Berlant describes casualness as a mode of engagement where people's "fantasies and practices . . . operate imprecisely, in interaction with complicated and contradictory environments of living."[7] As a form of planetarity, casualness results from interventions that are not tethered to the Anthropocene, the sixth extinction, or a shared planetary condition for ethical justification. Rather, casual planetarity is a side product of everyday technoscientific, but seemingly imprecise, forms of sensing subterranean worlds.[8] The point with this form of planetarity is less the annihilation of the oneness of the earth than the earthliness of everyday life.[9] The result is a praxis of the earth that is "far from a total force, absolute ground, or artifact of natural science" and more concerned with reducing the epistemic distance that separates the human and the geological in their quotidian expressions.[10]

7. Berlant, *Female Complaint*, 9.
8. See Ballestero, *Future History of Water*.
9. For another approach to planetary conditions in relation to weather see Zee, *Continent in Dust*.
10. Gabrys, "Becoming Planetary."

The casual planetarities that I chart in this essay begin with the human, move into the vastness of geologic space, and come back to a geologically imbricated human. The casual distinctiveness of this form of planetarity stems in large part from a focus on movement and scalar dynamics that, instead of privileging magnitude or size, focus on distance. In the case I examine, those oscillations between distance and proximity are cultivated through the charismatic 3D physical model that geologists use to invite audiences to think about the underground as more than a repository of commodities such as oil, minerals, and gas. Those oscillations bring everyday people closer to a form of geological sense-making that is far from spectacular and can simultaneously hold contradictory preoccupations such as keeping a job, caring for the environment, being concerned for water futures, increasing monthly water use, and many more.

To show the reach of casual planetarities as structures of awareness of human geologic presence, I first examine one of the concepts scholars have used to address the relation between geological processes and social life—the notion of a geosocial formation—and lay out its significance for the underground in Costa Rica. Second, I develop the notion of a hydro-geo-social choreography as a way to privilege water and movement under the surface. Third, I move to the practices through which geologists foster these casual planetarities and highlight the crucial role a physical model plays in laying out the choreographic relations at their center. I end with a short reflection on the significance of casual planetarities for our current environmental condition.

Putting the Accent on Water

If during the nineteenth and twentieth centuries the underground helped scholars think about denatured environments housing future technologies, about ways to seek refuge from surface disasters, or about the intractable depths of the earth, today subterranean spaces inspire other approaches.[11] Attention to the geologic substrate through ideas of deep time, for example, has inspired a rethinking of the "human and beyond human experience."[12] Scholars rely on subterranean space to consider "the material and deep intimacies and sensualities of human bodies" as they connect with underground formations.[13] Additionally, scholars have focused on the underground to argue for embracing the "inhumanity" of geological processes.[14] In this approach, the underground sits beyond phenomenological accessibility and requires analytics that go beyond human scales.

Nigel Clark and Kathryn Yusoff craft the notion of a geosocial formation as a "staging ground" where earth science and social science jointly shape the manifestations of

11. Williams, *Notes on the Underground*; Masco, "Life Underground"; Shortland, "Darkness Visible."

12. Hawkins, "Underground Imaginations," 4.

13. Hawkins, "Underground Imaginations," 5; see also Pérez, "Lines Underground"; and Cant, "'Tug of Danger with the Magnetism of Mystery.'"

14. Clark, *Inhuman Nature*.

spatiotemporal processes as part of collective life.[15] Paying attention to these spatiotemporal processes entails attending not only to the microhistories of social life but also to "[geological] forces capable of interrupting, undermining, or overwhelming the very conditions of doing politics or being social."[16] As these geosocial formations take shape, and as geological processes become more present in public discussions, some scholars are moving from an older hermeneutics of suspicion to an ethos of proximity that comes closer to geological modes of attention and intervention, engaging them as resources for critical work.[17] By reducing the distance between geological and cultural forms of sensemaking, as Manuel Tironi argues, we can sense the geopoetics through which geological worlds can be narrated by the social sciences and humanities without dissolving their alterity to the human.

The dominant formation where geophysical science has come closer to the social sciences and humanities, but also to capitalist logics, is an extractivist one that articulates geological knowledge with forms of value accumulation.[18] In the case of subterranean worlds, this has been glossed as extractivism, a system of resource exploitation that can take small, medium, or industrial scales and is organized around mining as a means for capitalist accumulation.[19] In this extractivist geosocial formation, conflicts are often translated into controversies over what knowledge—for example, technoscientific, Indigenous, intimate, state based—legitimately represents the subsurface. If irresolvable, those controversies become irreducible ontological differences that powerful actors brush aside.[20]

Critics and practitioners of the extractivist geosocial formation have paid considerable attention to mining and oil and gas extraction to explain or challenge the permanence of these industries.[21] Practically, mining and fossil fuel extraction has turned the underground into a deep-time vault that holds resources patiently waiting for either extraction or protection. In these geosocial formations, extraction is not only a material and economic practice; it is also a semiotic ground that has become implicit in global discussions about the underground. Today, the extractivist geosocial formation is taken for granted to such an extent that it has become the unmarked background against which we ask questions about what the subterranean world is in the first place.

15. Clark and Yusoff, "Geosocial Formations and the Anthropocene."

16. Clark and Yusoff, "Geosocial Formations and the Anthropocene," 15.

17. Tironi, "Lithic Abstractions."

18. Valladares and Boelens, "Extractivism and the Rights of Nature"; Bebbington, *Governing Extractive Industries*; Riofrancos, "Extractivismo Unearthed"; Marston and Kennemore, "Extraction, Revolution, Plurinationalism."

19. Jacka, "Anthropology of Mining"; Gómez-Barris, *Extractive Zone*; Fabricant and Gustafson, "Moving beyond the Extractivism Debate"; López and Vértiz, "Extractivism, Transnational Capital, and Subaltern Struggles."

20. De la Cadena, *Earth Beings*; Ureta and Contreras, "'. . . y nos vamos a ir toditos para abajo.'"

21. Bebbington, "Underground Political Ecologies"; Ferguson, "Seeing like an Oil Company"; Villalta, "La explotación de oro"; Gudynas, "Transitions to Post-extractivism."

Along with the carbon-based resources that the extractivist worldview privileges, subterranean spaces also hold vast quantities of water. As underground figures, aquifers are also commonly approached through extractivist parameters. From that standpoint, they are treated as containers for two kinds of liquidities, one financial and one material. Financially, aquifers are presumed to be akin to banks, structures that hold assets whose value has been determined through different financial techniques, including commodification and speculation on water futures and rights.[22] Materially, aquifers are reduced to tanks holding literal liquidity, quantities of water that can be extracted during a given unit of time—for example, liters per second, gallons per hour.[23] In the extractivist guise, aquifers are reduced to mere containers.

Elsewhere I have argued for the need to recapture the concept of an aquifer as an alternative to the disembodied and abstract notion of groundwater that extractivist formations prefer.[24] Aquifers are spatially located, saturated substrates with ambiguous beginnings and ends, always occupying a place where human histories and futures are at stake. Groundwater, on the other hand, is more easily abstracted into a standardized unit, like liters per second, that can travel across physical and capitalist networks.[25] This proclivity to abstraction makes groundwater easier to conceptually commodify and incorporate into the private property regimes that are essential for the extractivist geosocial formation to endure. As place-specific formations, aquifers create friction in that abstraction.

While I recognize how the extractivist mindset has shaped dominant geosocial formations through investments in scientific research, by creating friendly regulatory environments, and through sheer violence, I am interested in denaturalizing its presumed universality.[26] To do so, I borrow a powerful question that Clark and Yusoff pose: "With what specific geological processes or properties have different social actors joined forces in order to acquire their geologic agency?"[27] In Costa Rica, to the extent that most people explicitly join forces with geological processes, they have done so with aquifers rather than minerals or carbon-based resources. More than 90 percent of the country's drinking water comes from some form of subsurface source (aquifers and springs).[28] This coupling between subsurface space and water modifies the mineral- and oil-based geosocial dyad that extractivism privileges. In place of that dyad, this coupling advances what I think of as a hydro-geo-social triad. I add the *hydro-* prefix not because it is

22. Ballestero, "Flickering Frontiers."

23. Ballestero, "Touching with Light."

24. Ballestero, "No More Groundwater, More Aquifers!" For a different take on the conceptualization of groundwater see Powis, "Relational Materiality of Groundwater."

25. Walsh, "Beyond Rules and Norms."

26. For a rich analysis of the violence tied to this formation see Oguz, "Sedimenting Territory."

27. Clark and Yusoff, "Geosocial Formations and the Anthropocene," 5.

28. Orozco-Gutiérrez and Solís-Castro, "Inventario de la calidad y fuentes de Abastecimiento Operadas por el Institutio de Acueductos y Alcantarillados para el año 2015."

intentionally excluded from the original concept of a geosocial formation that Clark and Yusoff propose, but because of the need to put the accent on water as a geological factor itself. This accent is necessary because in the dominant extractivist mindset, with its emphasis on mining and oil and gas extraction, water is a side concern. It is an afterthought, or a technical obstacle to accessing more valuable resources. In contrast, by joining forces with water, in the form of aquifers, we find different actors and knowledges at play. Our attention is redirected to other geophysical forces. Crucially, when the accent is on water, movement becomes the necessary starting point.

3D Hydro-Geo-Social Choreographies

In Costa Rica, there is a group of geologists who work to disseminate notions of the underground as water and movement. They build on decades of community and environmental activism against open-pit mining, the pollution of aquifers by toxic chemicals used in plantations, and the allocation of water to luxury real estate developers in coastal areas.[29] Those mobilizations have taken the country's "spongy aquifers" beyond the closed circles of government officials and well-drilling companies, where they remained during most of the twentieth century.[30] Today, many recognize aquifers as critical resources for the future of the nation, as fragile formations under serious risk of pollution, and as the only option for adapting to climate change's water-stressed future.

As geologists and members of the public pull aquifers to the surface of collective attention, they push their imagination downward. They focus on peoples' daily experiences and on the geological worlds that simultaneously make possible and exceed their lives. Bringing both people's experiences and geological worlds into focus requires conceptualizing aquifers as hydro-geo-social choreographies that articulate the "technical, scientific, kinship, gender, emotional, legal, political, and financial aspects" necessary to bring geologic entities into social presence.[31] In these choreographies, aquifers are much more than containers of liquidities. They are force-filled spaces characterized by the ongoing push and pull of matter, history, and people's imagination. To make these hydro-geo-social choreographies apparent, geologists in Costa Rica enroll physical models like the one don Pedro reflected on.

I first saw one of these models at an organization I will call Subterranean Water (SW). SW is a public agency and one of the main institutions responsible for water protection, water quality, and hydrological processes in Costa Rica. While scientists at SW have a legal mandate to do scientific research on groundwater, most of their work entails making administrative decisions as they are part of the executive branch of government. In that capacity, they perform calculations and conduct field research that other

29. Díaz González, "De caminatas a los juzgados"; Villalobos Arévalo, "'El oro que contempolan los gusanos'"; Rodríguez and Prunier, "Extractivismo agrícola, frontera y fuerza de trabajo migrante"; Martínez Sánchez, "La piñera nos contaminó el agua"; Alpízar Rodríguez, *Poder y participación política en la gestión*; Navas and Cuvi, "Análisis de un conflicto socioambiental"; Cañada, "Water Conflicts in Guanacaste."

30. Ballestero, "Spongy Aquifers, Messy Publics."

31. Thompson, *Making Parents*, 8.

agencies use to approve or deny permits to drill water wells—a classic function intended to enact state sovereignty over the subsurface.[32] But another dimension of their work, albeit a proportionally smaller one, is what they call "socially oriented" work. This requires them to travel to different communities to disseminate knowledge about aquifers. This part of their work is quintessentially modernist: they reach out to the citizenry in a pedagogical mode and disseminate information about aquifers with the purpose of "educating" the public about water as a geological factor. That is, they work to turn people's gaze downward, below the surface. It is in this pedagogical mode that we find a casual form of planetarity that, as we will see, works through a series of scalar oscillations between closeness and distance that become graspable when we think in choreographic terms.

In early 2017, I had a conversation with Jorge, one of the SW geologists. Jorge has worked at SW for more than a decade and is part of the research and management team. While most of Jorge's work entails processing files, writing binding opinions, and reproducing legal arguments, he is also involved in the agency's socially oriented activities. He is not shy to say that he really enjoys this part of his job.

Aware of my interest in models, Jorge's supervisor had told him I was coming over to see *El Modelo*, "The Model." It struck me that he referred to the model in this form, as *the* model, as if it were the only model they worked with. Throughout many years of fieldwork among geologists in Costa Rica, I have encountered many mathematical models, different pieces of software for modeling aquifers, and regulatory models that SW follows when approving well-drilling permits. Yet here they referred to this as *the* model.

That afternoon, we entered an office where three unused desks were stored. The model sat in this somewhat sad bureaucratic context, enveloped by the coldness of fluorescent lighting. It rested on a desk that functioned as its temporary pedestal. The model consisted of a transparent plastic structure simulating a vertical slice of the underground and revealing a stratigraphic architecture—like a skinny terrarium with layers of pulverized rock of different textures, colors, and thicknesses. Several small transparent tubes penetrated the layers of rock to different depths. I later learned that each tube represented an extraction well, and the larger indentations on top represented rivers or lakes. The deeper section on the right side was the ocean.

In their planetary pedagogies, and despite lacking the draw that computational models have for understanding the planet, 3D physical models are irreplaceable. This kind of model proliferates in architecture and the visual arts. In those realms, a model renders the world knowable and actionable not necessarily because of the knowledge that goes into its creation, as is the case of mathematical models, but because of its mimetic properties. 3D models aim to convey "a sensuous sense of the real, mimetically at once with what it attempts to represent," and gain "something of the power and personality of that of which they are a model."[33]

32. Ballestero, "Underground as Infrastructure?"

33. Taussig, *Mimesis and Alterity*, 16.

Figure 1. The model sitting on its pedestal, 2017. Photograph by the author.

To be honest, upon seeing the model (fig. 1) I was a bit underwhelmed. Unsure about why that was, several reasons quickly flashed in my mind. Had talk about the informatization of life, the artificiality of intelligence, or the carbonization of blame desensitized me completely to the modesty of pulverized stone, hoses, and plastic? Jorge asked if I wanted to see the model "work." He had carefully prepared a series of implements: water in a squeezable bottle, dyes of different colors, a yellowish mini-hose, and a big syringe. As he manipulated these objects, he began telling me about how he uses the model. "It is all about how you pull people in," he said. "This model has an amazing capacity to do just that." And just like that, Jorge began rendering hydro-geo-social choreographies knowable and actionable. As he continued, he would take me through a series of scalar oscillations that connected the everyday with the dynamic materiality of the aquifer and the generalized vastness of underground worlds.

"I tell them a story," Jorge explained. "I narrate what is happening above the ground, to remind them of what they know. I then ask questions about what they see happening under the surface." He leaned a bit closer, fully shifting into storytelling mode. "I tell them, this is a water extraction pump, and it turns out there is a neighbor nearby. And his well is much deeper. So, this neighbor goes to turn his pump on because it is noon, and they are going to make lunch at his house. Like I said, you have to build a complete story so that it makes sense, and of course you adapt the story depending on the audience." As he manipulated the squeezable bottle he continued:

> I explain environmental issues as I continue manipulating the model. I mention that maybe there was deforestation here, or that this year there was less rain because of climate change. You have to make those connections so that it all makes sense. So the señor is here, he arrives to the place where the pump sits, and at the count of three he starts it. If there are kids in the audience, I ask them to count out loud: one, two, three. And I draw water out with this syringe. Because I have explained before that there has been pollution

> in this other place, they can see how as I pump water out here, water pulls the pollution plume deeper into the aquifer. And, let me tell you, this part where they see how water comes out like this, yellow, is shocking to them.

As I was going to learn, the model has a rich social life. Jorge and his colleagues pack and transport it across the country and display it in public events such as fairs and environmental education demonstrations. They do so as part of their daily jobs. Ideas such as the Anthropocene and planetary end of times are conspicuously absent here.

A few months before our meeting in his office, Jorge had traveled outside the capital city, San José, carrying posters, brochures, and the model to set up a booth at an environmental fair. The local municipality had convened NGOs as well as public agencies to showcase their work for local residents. After arriving, the organizers showed Jorge and his colleagues to their table. He noticed nearby colleagues from another public agency who had also brought the same kind of model to the fair. Jorge set up his materials on the table provided, filled a bottle with tap water, and set up the yellowish hose that drains water from the model into a bucket. Then he waited for the public to arrive.

Once people started arriving, Jorge began making his model work. Across the aisle, fellow public servants observed from their table. They were using the same model, but only as a static set of geological layers. No water was involved. Nor were they making their model work. To convey their sense of geological presence, the other model sat still—a world in stasis, moving at speeds inaccessible to the human sensorium. Jorge, in contrast, made his model work by running water movement experiments the entire afternoon. Each experiment consisted of pouring water into one end of the model, dropping some dye into a well to create a pollution plume, fitting a large syringe into one of the little tubes that represented a well, and extracting enough water to make the water level go down. Jorge repeated this procedure numerous times, composing casual stories of decreased rainfall, saline intrusion, gas spills, the incredible depth of the subsurface, the densities of fresh and ocean water, the porosity of different rock layers, and many more. Jorge's stories about above-the-surface behaviors, hydraulic mechanics, geological architectures, and histories of water extraction enlivened the hermeneutic power of the model.

As is often the case, that day SW had one of the busiest tables at the fair. Their audience easily tripled that of other agencies. As we discussed his success, Jorge kept emphasizing the magical powers of the model. "I cannot quite explain it," Jorge said, "but this model just draws people in. You see somebody passing by and as soon as they see what we are doing they come closer and ask questions. This [modest] model has magic powers to pull people toward us. I often stop to think about this—it mesmerizes me."

Models

Good scientific models render the world knowable in large part by sedimenting the knowledge and experiences that modelers translate into them.[34] While materially produced,

34. Myers, *Rendering Life Molecular*.

scientific models are usually described as things you hold in your head, not in your hands.[35] They are deemed valuable for how they enable forms of hermeneutic approximation to an object of study and how they facilitate the production of conceptual insights impossible to achieve through direct observation.[36] Furthermore, at a practical level, models organize everyday scientific activities and can also represent things agreed to be already in existence.[37]

Since the mid-twentieth century, the scientific models that circulate in public life have become increasingly quantified.[38] New and more powerful forms of computing have allowed scientists to combine observed data with numeric modeling to understand processes at temporal and spatial scales "that go far beyond what humans can phenomenologically experience."[39] These quantitative models have played a key role in bringing about planetary awareness in the era of climate change. They help communicate assumptions about how different physical realms relate to one another.[40] They also channel controversies about how those assumptions operate, and they help people move those controversies across populations in a variety of knowledge forms such as diagrams, graphs, and simulations.[41] As these quantitative models travel, users examine their validity by opening the mathematical propositions on which they are built in order to (re)interpret, correct, and/or (re)contextualize their claims.[42]

In contrast to quantitative models, physical models render the world knowable primarily through their iconicity and power to replicate the significance of the entities they are models of, and less because of the precision of the knowledge they embody or sediment. Physical models restage relations that cannot be easily conveyed in two dimensions. As sense-making artifacts, physical models sever ties with their creators early on; authorship is much more fragile than it is for mathematical models and their representation. When physical models travel, the richness of their social lives depends on how successfully their users "[link] scientific and technical expertise with hermeneutic expertise, taking into account what things mean, to whom, why, and to what end."[43] Through their circulation, physical models become a "key medium of traffic between the sciences and the wider culture."[44]

In Costa Rica, that hermeneutic work is carefully performed by Jorge as he crafts stories and invites his audiences to imagine their geological presence as a choreography

35. Hacking, *Representing and Intervening*.

36. Edwards, *Vast Machine*; Kroepsch, "Groundwater Modeling and Governance"; Frigg and Hartmann, "Models in Science."

37. Sismondo, "Models, Simulations, and Their Objects"; Fox Keller, "Models of and Models For."

38. Murphy, *Economization of Life*; Benson, "Re-situating Fieldwork," 70.

39. Chakrabarty, "Planetary Humanities," 230.

40. Smith and Smith, "Engineering and the Politics of Commensuration."

41. MacKenzie, *Engine, Not a Camera*; Edwards, *Vast Machine*; Nystrom, *Seeing Underground*; Kroepsch, "Groundwater Modeling and Governance."

42. Nelson, *Who Counts?*

43. Fortun et al., "Pushback," 5.

44. Hopwood and De Chadarevian, "Dimensions of Modelling," 6.

that increases and decreases the distance between water, everyday lives, and their knowledge about the subsurface world. As with other 3D physical models, this one presents the audience with a sculptural object designed to be seen from a variety of angles and with the power to restage movement.[45] By casually making the model "work" at an environmental fair or school event, Jorge draws on those capacities to bring into relief the scalar relations between geological processes and quotidian social experiences that may not be immediately apparent in people's everyday lives. Jorge and his model bring people closer to their own geological substrate through the casualness of the multiple demands on the everyday—turning on a water pump, preparing lunch, recognizing decreasing rainfall, recognizing surface toxic spills, discovering layers of rock.

3D Resonance

Jorge's model breaks with the quantitative tradition that is dominant in hydrology, hydrogeology, and science more broadly. Its significance stems from a capacity to physically bring people close to what is directly inaccessible to the senses—the vast magnitude and distance of underground worlds—while keeping everyday preoccupations in focus. Together, Jorge and the model "connect and even conflate what is geographically, geopolitically, temporally, or morally 'near' while simultaneously distinguishing that nearness from that which is 'far.'"[46] At his public appearances, Jorge brings people's imagination closer to the layers of rock and gravel undergirding, for example, the sanitation habits of a hypothetical señor living on the surface. Observers can almost see the little señor on top of the model, flushing his toilet or opening a faucet, his wastewater moving downward, percolating in intimate friction with soil, rock, and air. The scale of human activity, in comparison to the vast volume of underground space the model embodies, resonates with daily life.

At the same time, the model and Jorge's stories allow people to widen the scale of their sense-making and grasp that which, given its distance, is impossible to phenomenologically experience. Aligning his story with the staged movement of water throughout layers of crushed rock, Jorge grants his audience the power to see far into a vast underground that otherwise remains inaccessible. Through the model, his observers gain a kind of volumetric reach—seeing below the surface, following hydraulic mechanics—that makes graspable a choreography of humans, matter, and gravity pulling and pushing each other.

This kind of oscillation between proximity and distance moves from a sense of immediate presence circumscribed to everyday human tasks such as making lunch and flushing a toilet, toward a perspective where one's sense-making stretches into the distinct vastness of the underground world. This epistemic oscillation grants the observer a planetary awareness of that which remains ultimately intractable and indifferent. This epistemic work brings about a kind of scalar relation that does not depend

45. Hopwood and De Chadarevian, "Dimensions of Modelling."

46. Lempert and Summerson Carr, *Scale*, 3.

on the unity of planet Earth as a foundational structure of awareness. In this casual form of planetarity, while more can be seen, precision and measurement are beyond the point.

The choreographic oscillations between distance and proximity in Jorge's use of the 3D model generate a resonance not dissimilar from how planetary scientists sense and make sense of distant planets by studying the earth. For Lisa Messeri, resonance is a form of knowing that includes a sense of excitement and enthusiasm as one accesses something phenomenologically inaccessible, akin to don Pedro's joy after seeing the model.[47] Resonance places into iconic relation two objects: on the one hand, an immediate material object (such as the physical model) and, on the other, the object of investigation (such as the choreographic movement of an aquifer). Through that iconic relation they can take each other's place. The vastness of the underground and the movement of water remain impossible to experience without mediation; nevertheless, after experiencing the resonance between model and inaccessible aquifer via Jorge's stories, one develops a sense of proximity. One gains an awareness of something new, not because distinct components like water, rock, and people have been precisely identified and located but because the model keeps the dynamics between all of these casually connected and in movement, as they are in the world. Rock, water, and people become inseparable. This kind of planetarity can handle both the immediacy of the human and the expansiveness of the geological worlds beyond.

Conclusion

Growing up in Costa Rica and having worked on environmental issues and climate change–related projects since the 1990s, I have seldom heard my interlocutors use the term *Anthropocene* or refer to the planetary. The few times I have, it was within academic circles.[48] This is surprising if one considers Costa Rica's prominent role and political investments in the "dominant regime of planetarity" that understands climate change as a question of the viability of the oneness of the earth, a vision supported both by science and global political players including nation-states, multilateral organizations like the UN, and more recently multinational corporations. Considering how many people in Costa Rica are involved in environmental projects and transnational environmental circuits, this paucity is remarkable and poses an interesting challenge to theorizations of planetarity. Acknowledging that specificity, I offer the concept of casual planetarity and show how it is cultivated in supposedly small locations (rural Costa Rican towns), by supposedly ineffectual subjects (technocrats), in supposedly insignificant events (environmental fairs and demonstrations), all of it in a place that has been globally recognized as being at the helm of global environmental questions.

As seen from this specific case in Costa Rica, it seems that the dominant image of our planetary condition is tied to the extractivist geosocial formation and its sense of

47. Messeri, "Resonant Worlds," 132.

48. Díaz Arias, "Antropoceno y neoliberalismo."

the underground as a deep-time vault whose value stems from minerals and carbon-based resources. Many people, however, escape the epistemic grip of that geosocial formation. Some, like Jorge and don Pedro, join forces with water as a geological factor to revisit what the underground world is, how it works, and how humans figure in its material presence. What interests me is how we might approach the planetary if we build on these efforts rather than replicating extractivist geosocial parameters. The idea of casual planetarities offers a potential path.

The concept of casual planetarities highlights the practices through which people come to terms with their geologic presence without drawing on imperial or Cold War visions of the earth and their extractivist priorities. Casual planetarities do not align with salvational environmentalist projects or seek precise measurements of harm. They are structures of awareness that align themselves with geologic forces that are undervalued by extractivist projects. They center the human from within the contradictory forces and demands that shape their lives. Casual planetarities are the practical concern of geologists in Costa Rica, a group of professionals who travel around the country restaging hydro-geo-social choreographies and their mundane connections to everyday human life. At these events, people go on scalar oscillations that move their awareness from very human practices to distant and phenomenologically inaccessible geological processes. These are not oscillations that chart the relation between the planet as a unit and people's responsibility for its destruction. Rather, these oscillations produce scales at the level of sense-making, moving through what seems to be strictly human preoccupations and going far beyond these into geologic forms. Such oscillations increase or decrease the distance between one's daily life and the vast underground worlds through which water moves. These oscillations result from the resonance between a model that grounds sense-making and the aquifers it evokes.

In thinking about these 3D models, I embrace forms of geophysical abstraction and imagination as events with generative capacities. Instead of approaching them from a hermeneutics of suspicion, I take these events—constituted by models and stories—as fields of intervention set within the contradictory limits of everyday action, within the inescapable responsibilities people have in their daily jobs, and within the unruly movements, excesses, and scarcities of aquifers as material formations. The 3D physical model and the exuberant stories Jorge tells are invitations for Costa Rican publics to inhabit the planetary—not because of annihilation, not because the planet demands it, not because the end times are imminent. This is only a casual invitation to make sense of one's everyday geological presence.

Casual planetarities are not salvational. Rather, they engage the world as one encounters it, from within one's bounds and limitations, and in full awareness of the contradictory forces that shape one's existence. They are invitations to attend more intentionally to the hydro-geo-social choreographies we all take part in: something that is intimate and distant at once. Cultivating forms of casual planetarity might help us fashion different semiotic grounds for living. They might help with the incessant,

unaccounted-for, and unvalued work necessary to shift the extractivist mindset that continues to reduce subterranean worlds to their utility for twenty-first-century capitalism.

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