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Microcosmic Design: Glass Envelopes and Otherworldly Entanglements

Natasha Baranow

With each striding step or brush of the hand, we unknowingly traverse entire worlds too small to notice. All around us, assemblages of tiny beings coalesce, taking shape as rocks of planetary complexity or puddles as murky as primordial seas. Despite, or perhaps thanks to, their unassuming contiguity with daily life, miniature spaces recede to the periphery of happenings more often noticed at the "meso scales of human perception." [1] These innumerable space-times, or microcosmos, occur at the limits of human sense-ability and at scales in which the body can never fit but the imagination is readily projected.

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1 Robert Frodeman, "Nanotechnology: The Visible and the Invisible," *Science as Culture* 15, no. 4 (2006), 383–89, here 385.

The terrarium — a miniature, sealed garden — is one site through which individuals actively seek out and cultivate such small realms. fig.1 The following article engages with this horticultural pastime by closely examining the practices of contemporary terrarium design and discussing the challenges of propagating a dynamic autonomy within miniature hermetic structures. Drawing from interviews with professional terrarium builders, analyses of internet forum discussions, and my own terrarium care experiences, this study traces the ways that little worlds actualize, endure, and dissipate within glass orbs. Moreover, it finds that encounters with such spaces are dictated by small-scale "response-abilities" and "sense-abilities" that can manifest through the affective experiences of anxiety, longing, or wonder.

fig.1 Flask terrarium from above. Photograph: Natasha Baranow, 2020, Vermont

Ultimately, I propose that terrarium construction and maintenance can be understood as a process of *microcosmic design*: a blend of miniature infrastructuring, iterative experimentation, and prolonged forms of care that sustain otherwise tenuous forms of existence. Rather than reducing the terrarium to the "bits of matter" that constitute our familiar three-dimensional environment, [2] we will see how these worlds arise performatively from conditions sustained by dynamic infrastructures and more-than-human labor. That is, human beings do not create small worlds but have learned to carefully design and cultivate the circumstances from which these space-times may or may not emerge. And the terrarium, as both observational tool and world-unto-itself, becomes an experimental device for encountering novel configurations of the small-scale and the spectral, affording moments in which to slow down, sense, and speculate.

2 Alfred North Whitehead, *Modes of Thought* (New York: Macmillan, 1938), 179.

Potted Histories

Terrarium technologies were initially developed during the Victorian era and quickly incorporated into the biocolonial efforts of British imperialism before going on to stimulate the rise of contemporary horticultural industries. [3] But though the terrarium has shaped the global distribution of plants, irrevocably altering the earth's biosphere, its origins are modest at best—emerging out of an encounter between a man and a glass bottle. fig. 2 Indeed, the invention of the terrarium is generally attributed to a doctor and gentleman horticulturalist, Nathaniel Bagshaw Ward, who discovered and publicized the device in the nineteenth century. [4]

In 1829, during attempts to cultivate fragile plants within the smog of East London, Ward stumbled upon a curious phenomenon. Having placed a moth's chrysalis within a glass bottle to observe its metamorphosis, he noticed that the very plants he had struggled to keep alive in his back garden had willingly taken root within the sealed ecosystem. [5] Ferns and mosses unexpectedly thrived, shielded by the walls of the glass vessel and surrounded by a "moist atmosphere free from soot or other extraneous particles." [6] Ward quickly disseminated his findings and began to construct variations of this glass jar, filling every windowsill and the roof of his home with glazed cases of every dimension. [7] After several years of experimentation and collaboration with prominent botanists, the Wardian case was placed on ships bound for the colonies in the 1830s. [8] Whereas previous attempts to transplant seeds and seedlings between continents had proved unsuccessful, with specimens arriving shriveled and lifeless, Ward's sealed glass boxes provided a solution for sustaining delicate vegetation across oceans. fig. 3

With the aid of these cases, vast networks of people, plants, and practices began to shift. By the mid-nineteenth century, the British Empire and other European powers had uprooted and transported tea, coffee, bananas, and rubber from their origins across the global tropics. An invisible catalyst for the age of the plantation, [9] terrariums facilitated the establishment of sprawling monocultures and extensive collections of specimens at botanic gardens. [10]

3 As devices meant to enhance plant resilience, glass cases have been entwined within the geometries of power and geographies of the state since their inception. For general histories, see Jim Endersby, *Imperial Nature: Joseph Hooker and the Practices of Victorian Science* (Chicago: University of Chicago Press, 2008); Stuart McCook, "'Squares of Tropic Summer:' The Wardian Case, Victorian Horticulture, and the Logistics of Global Plant Transfers, 1770–1910," in Patrick Manning and Daniel Rood, eds., *Global Scientific Practice in an Age of Revolutions, 1750–1850* (Pittsburgh: University of Pittsburgh Press, 2016), 199–215; and Sten Pultz Moslund, "Postcolonial Aesthetics and the Politics of the Sensible," in *Literature's Sensuous Geographies* (New York: Palgrave Macmillan, 2015), 45–57. Also see Donal P. McCracken, *Gardens of Empire: Botanical Institutions of the Victorian British Empire* (London: Leicester University Press, 1997).

4 The terrarium was first documented by Scottish scientist A.A. Maconochie in 1825, but the early examples were named after Ward. David Elliston Allen, *The Victorian Fern Craze: A History of Pteridomania* (London: Hutchinson, 1969), 9.

5 See Margaret Flanders Darby, "Unnatural History: Ward's Glass Cases," *Victorian Literature and Culture* 35, no. 2 (2007), 635–47.

6 Nathaniel Bagshaw Ward, *On the Growth of Plants in Closely Glazed Cases*, 2nd ed. (London: Samuel Bentley and Co., 1852), 37.

7 See David R. Hershey, "Doctor Ward's Accidental Terrarium," *American Biology Teacher* 58, no. 5 (1996), 276–81.

8 Jen Maylack, "How a Glass Terrarium Changed the World," *The Atlantic*, November 12, 2017.

9 Or the "Plantationocene." See Donna Haraway, "Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin," *Environmental Humanities* 6, no. 1 (2015), 159–65.

10 Katja Neves, *Postnormal Conservation: Botanic Gardens and the Reordering of Biodiversity Governance* (New York: SUNY Press, 2019).

By compressing space and time, the small worlds of the terrarium brought about change on planetary scales while distilling plants, and indeed entire archipelagos, [11] into a terrain that is miniature, manageable, and knowable. At the same time, the transport and opening of the terrarium, like Pandora's box, [12] amplified worldly complexities through novel encounters, spawning innumerable uncertain futures. Other plants and organisms accompanied these voyages: stowaways that accelerated the extensive propagation of lively networks deemed weed, pest, or disease. [13] Beyond their role as tools of colonial enterprise, terrariums also became desirable ornaments on Victorian windowsills and thus objects of conspicuous consumption. [14] Encompassing pockets of clean air within the heavy fog of industrial London, Wardian cases were not only a symbol of wealth and imperialist nationalism but a visible reminder to Victorians of the atmospheric "contact and contagion" resulting from urban manufacturing practices. [15]

Despite the historical and political significance of this technology, scholars have not often examined the contemporary implications of bounded plant life, such as within the shopping mall, greenhouse, or terrarium. Exceptions include the work of Rob Bartram and Sarah Shobrook deconstructing Biosphere II—the largest sealed ecological system in the world—as a simulacrum of nature perfected, or an "eco-utopia." [16] More recently, Natasha Myers examined plants under the glass canopy of Singapore's Cloud Forest Conservatories in the Gardens by the Bay, a building she describes as "infrastructure for end-of-time botanical tourism." [17] Through her ethnographic work, she outlines how garden boundaries, whether composed of glass, wood, or ceramics, enact and sustain their own kinds of biopolitics and visions of the future. Although gardens are often crafted as "space[s] of seclusion set apart from the world," [18] she argues that they can also become sites in which to confront a world marred by extractive capitalism and design different arrangements of life. Debbora Battaglia pulls us into the aeroponic portals of some of these futures—a geodesic greenhouse in the center of a Disneyworld theme park and a zucchini planter on the

11 And family units. See, for example, Anna Tsing, "Unruly Edges: Mushrooms as Companion Species: For Donna Haraway," *Environmental Humanities* 1, no. 1 (2012), 141–54.

12 See Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999).

13 See Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe*, 900–1900, 2nd ed. (Cambridge, UK: Cambridge University Press, 2004); and Luke Keogh, "The Wardian Case: How a Simple Box Moved the Plant Kingdom," *Arnoldia* 74, no. 4 (2017), 1–12.

14 See Lindsay Wells, "Close Encounters of the Wardian Kind: Terrariums and Pollution in the Victorian Parlor," *Victorian Studies* 60, no. 2 (2018), 158–70.

15 Jesse Oak Taylor, *The Sky of Our Manufacture: The London Fog in British Fiction from Dickens to Woolf* (Charlottesville: University of Virginia Press, 2016), 24.

16 Rob Bartram and Sarah Shobrook, "Endless/End-Less Natures: Environmental Futures at the Fin de Millennium," *Annals of the Association of American Geographers* 90, no. 2 (2000), 370–80, here 373.

fig. 2 Flask terrarium. Photograph: Natasha Baranow, 2022, Vermont

17 Natasha Myers, "From Edenic Apocalypse to Gardens against Eden, Plants and People in and after the Anthropocene," in Kregg Hetherington, ed., *Infrastructure, Environment, and Life in the Anthropocene* (Durham, NC: Duke University Press, 2019), 115–48, here 118.

18 Erin Despard and Monika Kim Gagnon, "Gardens," *Public* 41 (2010), quoted in Myers, "From Edenic Apocalypse."

International Space Station — to emphasize plants' "storied matter" and the "interbeing ethics" that remain suspended in the hedgerows of plant-people relations. [19] And as a counter to NASA's orderly ozone gardens, in which lichen are grown for the sole purpose of measuring air quality, Jennifer Gabrys offers the speculative bioindicator garden — characterized not by taxonomic order but by lichen-as-microcosm — to renegotiate the lines between species, community, and world. [20] In the artistic sphere, glass sculptures by artists such as Hans Haacke, Olafur Eliasson, and Tomás Saraceno serve as technologies to accentuate circumambient elements so

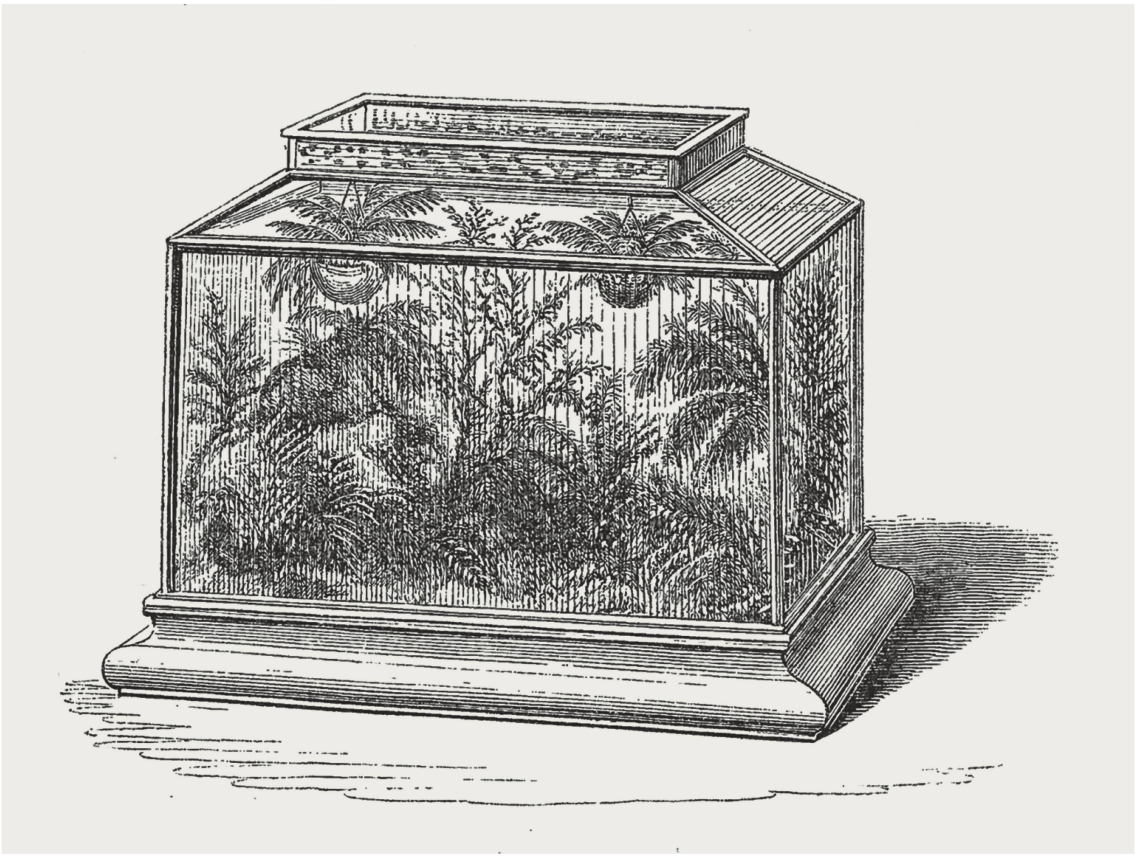

fig. 3 Wardian case. Shirley Hibberd, *Rustic Adornments for Homes of Taste*, rev. ed. (London: Groombridge and Sons, 1895)

often overlooked: water, light, and air. Underlying these practices, both scholarly and artistic, is not only a desire to distinguish how worlds precipitate as shapes and forces but also an attempt to apprehend what lies beyond our ability to perceive.

Bounded worlds, as these individuals demonstrate, need not be taken at face value. Instead, they are sites imbued with an onto-political charge, sustained by the life within and around them. Terrariums are one garden-like enclosure in which these worldmaking encounters perhaps occur, stimulating what María Puig de la Bellacasa identifies as a feminist *alterbiopolitics* or, more simply, a politics of care. [21] Through her speculative investigations, Puig de la Bellacasa extends the typically anthropocentric idea of care to the more-than-human alliances of soil food-webs in permaculture practices. Drawing on this work in her own studies of contemporary English farming practices, Anna Krzywoszynska

19 Debbora Battaglia, "Aeroponic Gardens and Their Magic: Plants/Persons/Ethics in Suspension," *History and Anthropology* 28, no. 3 (2017), 263–92, here 278.

20 Jennifer Gabrys, "Sensing Lichens: From Ecological Microcosms to Environmental Subjects," *Third Text* 32, no. 2–3 (2018), 350–67.

21 María Puig de la Bellacasa, *Matters of Care: Speculative Ethics in More than Human Worlds* (Minneapolis: University of Minnesota Press, 2017).

approaches soils as a relational materiality whereby human beings and living biota coassemble soils through ongoing networks of care. [22] Here, *care* refers to an ethical orientation toward ensuring the well-being of other entities, as well as a recognition of the interdependence of all biological life. Within the sealed environment of the terrarium, linkages of care shift from a broader world to the smaller scale: relationships are severed and rewoven, and existence is reimagined. Following these lines of thought, I do not approach terrariums as inert, ornamental objects on a windowsill, wholly controlled by godlike caretakers. Instead, I conceptualize these small ecosystems as "other worlds that occasionally graze" our own [23] —space-times that in their day-to-day unfoldings mostly withdraw from human beings.

22 Anna Krzywoszynska, "Caring for Soil Life in the Anthropocene: The Role of Attentiveness in More-than-Human Ethics," *Transactions of the Institute of British Geographers* 44, no. 4 (2019), 661–75; and Anna Krzywoszynska, "Nonhuman Labor and the Making of Resources," *Environmental Humanities* 12, no. 1 (2020), 227–49.

23 Kathryn Yusoff, "Insensible Worlds: Postrelational Ethics, Indeterminacy and the (K)nots of Relating," *Environment and Planning D: Society and Space* 31, no. 2 (2013), 208–26, here 216.

Isolation

The research for this project emerged out of unfamiliar and experimentally generative conditions. In March 2020, as a large percentage of the global population sheltered within their homes due to a pandemic, bodily coincidence within space and time was no longer feasible. In semi- or complete isolation, people experienced profound uncertainty against a media background of viral infections, job losses, police brutality, and political insecurity. At the same time, households also began to turn inward and tend to small worlds: erecting a balcony garden, updating a blog, or painting a nursery. My own project was thus tethered, theoretically and methodologically, to these kinds of everyday enclosure.

Nonrepresentational methodologies, developed to attend to the intangible or insensible aspects of ordinary life, [24] are part of the suite of approaches through which I apprehended microcosmic realities, caretakers, and inhabitants. Using sensory-focused ethnographic techniques, [25] I attempted to defamiliarize, to amplify, to "draw difference out," and to make the miniature palpable when physically visiting research sites was out of the question. [26] Specific methods were chosen for how they attend to the perceptible and imperceptible, while also preserving tensions and inconsistencies in the research process that surfaced along the way. [27]

Data collection and analysis were primarily conducted from my home in Vermont, a small, rural state in the northeastern United States. Over the course of several weeks during the summer of 2020, I employed a varied set of socially distanced qualitative methods to begin to immerse myself within the worlds of hobby terrariums. These techniques included remote interviews with people involved in the construction and maintenance of miniature worlds, including professional terrarium builders, artists, and dedicated hobbyists. Remote conversations with these individuals were

24 See Nigel Thrift, *Non-representational Theory: Space, Politics, Affect* (New York: Routledge, 2007); and Phillip Vannini, ed., *Non-representational Methodologies: Re-envisioning Research* (New York: Routledge, 2015).

25 See Sarah Pink, *Doing Sensory Ethnography* (London: SAGE, 2009); and Paul Stoller, *Sensuous Scholarship* (Philadelphia: University of Pennsylvania Press, 1997).

26 See Derek McCormack, "Devices for Doing Atmospheric Things," in Vannini, *Non-Representational Methodologies*, 89–111, here 94.

27 See Stephanie Springgay and Sarah E. Truman, "On the Need for Methods beyond Proceduralism: Speculative Middles, (In)Tensions, and Response-Ability in Research," *Qualitative Inquiry* 24, no. 3 (2018), 203–14.

supplemented with virtual ethnography conducted in multiple online social media forums dedicated to hobby terrariums.

I also undertook autoethnography, taking notes as I learned to build and care for several enclosures of my own. Starting with a mason jar and mosses from the backyard, I quickly began to test combinations of vessels, plants, stones, and other objects. By early July 2020, I found myself caring for six terrariums of various dimensions, the smallest being the size of a thimble and the largest the size of a basketball. Over the course of the project, I spent time reflecting on and recording in-depth notes about the design, build, and maintenance phases of each terrarium: from selecting a nameless plant at the gardening store to pouring charcoal through a plastic funnel. These physical activities, written notes, and transforming structures became places of ongoing experimentation in vulnerability, indeterminacy, and ethics: of making live and letting die.

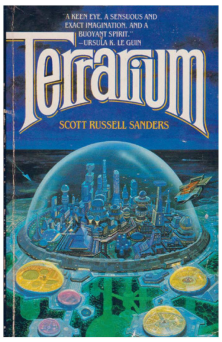

fig. 4 Front cover of *Terrarium*, Scott Russell Sanders Tor 1985

Under the Dome

Like a spaceship, the terrarium requires carefully designed, prebuilt support systems that maintain the necessary surrounds for existence. **fig. 4** Design processes often begin with schematic abstraction: a sketch or list intended to capture some ethereal residue of the *not here* or *not yet*. Prior to crafting my first terrarium, I found myself drafting crude diagrams and lists of components, over and over again, in anticipation of the build process. Effortlessly blending and layering various materials, more seasoned terrarium builders participate in an iterative set of practices, whereby small quantities of matter are arranged to generate a microcosm meant to endure for weeks, months, or years. In this way, terrarium construction can be understood as a means of gathering and withholding heterogeneous elements to generate circumstances "felt in forms of life as the possibility of a world." **28**

Abstraction and design are tied to the ways that environments and worlds are generated through sets of protective infrastructures. Infrastructure, though a contested concept, **29** can be roughly understood as the extensive assemblages of materials, technologies, imaginaries, and practices that enable "the possibility of exchange over space." **30** As Arturo Escobar writes, producing "auspicious conditions for collective life projects demands the creation of supportive environments through appropriate 'infrastructuring,'" through which design and materiality are inextricably entwined. **31** In his own work, Escobar refers to infrastructures of the mostly human variety. But these designed life-projects can also be understood within the context of more-than-human material structures, such as living breakwaters made

28 Derek McCormack, "The Circumstances of Post-phenomenological Life Worlds," *Transactions of the Institute of British Geographers* 42, no. 1 (2017), 2–13, here 7.

29 See Hetherington, *Infrastructure, Environment, and Life in the Anthropocene*.

30 Brian Larkin, "The Politics and Poetics of Infrastructure," *Annual Review of Anthropology* 42, no. 1 (2013), 327–43, here 327. See also Casper Bruun Jensen, "Experimenting with Political Materials: Environmental Infrastructures and Ontological Transformations," *Distinktion: Journal of Social Theory* 16, no. 1 (2015), 17–30.

31 Arturo Escobar, *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds* (Durham, NC: Duke University Press, 2018), 162.

of oysters and techno-gardens. [32] Though materially distinct from one another, what links these design practices is a process of abstraction: a form of substantive engagement informed by environments and actualized in physical form through drafting, scenario building, and prototyping, or what might be called "technomaterial world-diagrams." [33]

Like a greenhouse, the closed terrarium is sustained first and foremost by a transparent outer capsule. These hollow structures—ordered online or pulled out of the kitchen cabinet—range from high-tech containers, such as the programmed aquarium tank, to more modest vessels, such as the jam jar. Fishbowls, glass jugs, clear-lidded plastic bins, or the traditional cloche can also be used, though one should be wary of any small openings or sharp angles that could overly impede accessibility to the space during construction or maintenance. For plants that prefer high levels of humidity and warmth, a cork or lid blocks the primary entrance point, serving to limit the encroachment of external, climatic forces. [34] **fig. 5 a, b**

Growing plants also require illumination. Too little sun and the plants inside will wither; glass or plastic enclosures must be amply translucent. Too much sun, however, and the structure will overheat. While differing architecturally from one another, then, the primary mechanism of these technologies remains the same: to trap precise levels of light, heat, and moisture, thereby generating a habitable milieu for the organisms within. In this way, glass structures become outer protective infrastructures for their inhabitants, just as layers of the earth's atmosphere enfold and sustain varied ecologies. The glass shell, or "enveloping membrane," [35] serves to insulate the entities within, while permitting a degree of acceptable exposure to essential outer-worldly conditions.

After selecting a vessel and site, one can begin to incorporate the structural materials that will constitute the nutrient base for vegetation and microfauna. A layer of larger stones is first spread across the bottom, acting as a catchment reservoir for excess water. Fine mesh is placed on top of this bumpy surface to inhibit contamination from soil and plant roots. At this point, activated charcoal is distributed as a fine layer, meant to filter downward-seeping water by chemically binding to any impurities and the byproducts of decay. Finally, a high-quality potting soil, often made up of fluffy materials, such as coconut coir, and a small amount of distilled water are sprinkled within. These strata later meld with plants' roots to distribute and refine elemental currents of water and air, thus becoming the "pipes, cables, and roads" [36] —or inner infrastructures—of the terrarium.

32 See Stefanie Wakefield and Bruce Braun, "Oystertecture: Infrastructure, Profanation, and the Sacred Figure of the Human," in Hetherington, *Infrastructure, Environment, and Life in the Anthropocene*, 193–215; Battaglia, "Aeroponic Gardens and Their Magic"; and Natasha Myers, "From the Anthropocene to the Planthroposcene: Designing Gardens for Plant/People Involution," *History and Anthropology* 28, no. 3 (2017), 297–301.

33 Alberto Corsín Jiménez, "Introduction: The Prototype: More than Many and Less than One," *Journal of Cultural Economy* 7, no. 4 (2014), 381–98, here 387.

34 Open-faced terrariums are better suited to plants found in arid ecosystems, such as cacti and succulents.

35 Derek McCormack, *Atmospheric Things: On the Allure of Elemental Envelopment* (Durham, NC: Duke University Press, 2018), 29.

36 Thrift, *Non-representational Theory*, 163.

But for this system to work, less is usually more. By design, many terrarium builders avoid "clutter," partaking in a selective reduction and choosing only essential substances to fabricate these small ecologies. Constructing the exterior and interior of terrarium structures is as much about separating as it is about combining. Vessels should be liquid-tight to prevent inward or outward leakage. Substrata are held meticulously apart to avoid accidental alchemies as they strip contaminants from water and air. Some terrarium enthusiasts advocate the sterilization of inner components—baking soil in the oven and wiping surfaces with diluted bleach—to destroy any fugitive seeds or microbes. And upon sealing the cork, frigid air and "pests" are blocked from entry. Like composting and other gardening activities, [37] then, terrarium-building is about cultivating certain forms of togetherness while eschewing most others. Excessive entities and processes from surrounding worlds—frost, beavers, smog, powdery mildew, climate change, gnats, anxiety—are temporarily kept out. Still, despite builders' best efforts, some of these things begin to creep inward nevertheless.

fig. 5 a, b Wardian case. Edward William Cooke, engraving, in Nathaniel Bagshaw Ward, *On the Growth of Plants in Closely Glazed Cases*, 2nd ed. (London: John Van Voorst, 1852), 21

Consequently, the terrarium's glass envelope is characterized by a set of exclusionary tactics through which particular objects are intentionally or unintentionally left out. Escobar calls this a type of "operational closure," whereby a designed system is defined by the various relations that demarcate and maintain its independence from other beings. [38] Though this might seem bleak, the separation is not a negative feature; without this boundary, the terrarium would simply disintegrate into the surrounding environment. Immersion within this "togetherness" of the atmospheric envelope thus becomes an essential condition for the living entities that constitute the small world.

Upon fine-tuning levels of light and moisture, water vapor should ascend and condense on the glass, engendering a foggy microclimate and descending as a soft rain. Glass walls both facilitate this circulatory system and become the "elemental tool" with which builders begin to apprehend it. [39] Scrolling through images of terrariums on online forums makes apparent how fog and light often enshroud these spaces, making them awkward to view and photograph. With my own structures, I would often find my vision obscured by a patch of water droplets and fleecy "organo-slime" clinging to the glass. Drifting in continual flux, organic and inorganic substances co-perform what might be considered weather-worlds, [40] withdrawing from the viewer or gripping the contours of the vessel's inner surface as glimmering dew. And at every incoming moment, circumstances may shift, and connections between events and entities are retied: a cork is tugged out, an untimely dusk falls, a structure tumbles

37 See Sebastian Abrahamsson and Filippo Bertoni, "Compost Politics: Experimenting with Togetherness in Vermicomposting," *Environmental Humanities* 4, no. 1 (2014), 125–48; and Franklin Ginn, "Sticky Lives: Slugs, Detachment and More-than-Human Ethics in the Garden," *Transactions of the Institute of British Geographers* 39, no. 4 (2014), 532–44.

38 Escobar, *Designs for the Pluriverse*, 171.

39 Craig Martin, "Fog-Bound: Aerial Space and the Elemental Entanglements of Body-with-World," *Environment and Planning D: Society and Space* 29, no. 3 (2011), 454–68, here 465.

40 See Tim Ingold, "Footprints through the Weather-World: Walking, Breathing, Knowing," *Journal of the Royal Anthropological Institute* 16, no. 1 (2010), S121–S139; and Tim Ingold, *Being Alive: Essays on Movement, Knowledge and Description* (London: Routledge, 2011).

to the ground and shatters. Small atmospheres contract and swell, contingent on the changing conditions in which they are located and the extrusion of other worlds. In this way, infrastructural or geometric matters of shape and scale are augmented by "topological concerns." [41] Matter itself is revised as a series of multidimensional queries regarding the ongoing reconfiguration of worldly boundaries.

41 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham, NC: Duke University Press, 2007), 244.

Though terrarium spaces may be small and initially somewhat simple to construct, their involute ecologies are not easily sustained over time. Many things can go wrong for the first-time builder: from stagnation or desiccation to mysterious blight and overgrown flora. Attempting to dodge some of these hurdles, amateurs like myself gather in online message boards to trade strategies and receive advice from more senior authorities. Many posts from forum-goers contain pictures of ailing vegetation and a plea for help: Why are my plants brown and crispy? Can you identify these little round bugs? In one internet forum, one builder encourages a fellow "newbie" by responding, "It's not as easy as it looks. I made several closed bottle moss terrariums at the start of the stay-at-home order, and three of the six are still healthy. The others quickly wilted away." [42] Nonetheless, these types of assurances do not do much to quell the panic that ensues when infrastructures themselves decline, particularly when unfamiliar or unknown bodies—insects, fungi, and bored cats—seemingly breach the glass envelope, finding their way into the enclosure. More often than not, these entities were there to begin with, waiting for the right moment to crop up.

42 Anonymous forum poster, June 26, 2020. Anonymity is maintained in all interviews in compliance with Central University Research Ethics Committee (Oxford) guidelines.

On small scales, then, worldly precarity is amplified. Over the course of a few days or weeks, terrarium builders can watch a vibrant ecosphere suddenly collapse. Initial unravelings are not always obvious. Once these infrastructures are established and left to burgeon, the symptoms of ecological deterioration can be difficult to perceive. Even when one feels the pressure to intervene, uncertainty can hold the builder back: altering the enclosure in a meaningful way comes with its own risks. As one online hobbyist astutely suggests, "It is far more difficult to negotiate micro changes in a small environment than it is in larger ones." [43] Sometimes processes of becoming flow in unwelcome directions, not always manifesting as discrete worlds but as tenuous spaces highly dependent on human care. Even for professionals, terrarium construction can be hit or miss:

43 Anonymous forum poster, August 1, 2020.

"Not all of them make it. What I try to do is—when I make them—I'll keep them for two to three months [prior to sale]. So, I think about them as 'being in the cooker.' And I watch them, I see how they're doing. And I just check on them. I open the

lid for a second, I poke around and smell … I'm trying to be very mindful that if somebody buys something, they're getting something that's gonna last." [44]

Sharply attuned to the fragility of these ecosystems, professional builders develop their own careful routines intended to ward off bioecological snags. And, as implied by the builder above, the practices of circumspection that characterize the human-terrarium interface are underscored by a sense of responsibility, resulting in vigilant scrutiny. As feminist scholars have explored, forms of attentiveness are often tied to notions of care and everyday labor, whereby care is defined as "everything that we do to maintain, continue and repair" worlds. [45] Mending terrarium worlds can thus be understood within this framework of care, whereby sensory inputs, particularly sight, touch, and smell, guide specific responses from human caretakers.

Though maintenance tasks might vary significantly from person to person, they all rely on forms of bodily attentiveness: a process of "checking in." A slimy leaf might be extracted to discourage larger-scale decomposition. Distilled water might be spritzed on dry soils. An enclosure might be repositioned several times, rotated across each window of the house before finding its anchor point. Familiar glitches—wrinkled plants, mysterious molds, or bizarre aromas—become moments at which infrastructural repairs take place, sparking the opportunity for systemic changes, as "even ordinary failure opens up the potential for new organizations of life." [46] Failure, though perhaps not wholeheartedly embraced, is what builders anticipate, forcing them to attune to signs of malfunction and respond proactively to mitigate nascent concerns. As Escobar and Terry Winograd and Fernando Flores have written, these types of "breakdowns" can provide avenues for imaginative solutions. [47] At the same time, however, infrastructural breakdowns present the possibility of inadvertently fortifying a faulty system.

But human beings are not the only workers maintaining the terrarium. Just as in any other soil-based ecosystem, the terrarium environment is performed and sustained by ongoing forms of invisible, microbiotic labor. [48] Not only do these elusive organisms work to cycle atmospheric media on a miniature scale; they also actively reconfigure the surrounding material sphere. Bioactive *clean-up crews*—an affectionate term I often encountered online—enmesh themselves within organic waste, making otherwise inaccessible minerals available to others via metabolic processes. In my own terrariums, I would habitually observe fleeting patches of fungus: fuzz on detrital leaves or wispy mushrooms on driftwood. For days at a time, I tracked the

44 "Sarah" (pseudonym), a US-based professional terrarium builder, phone interview by author, June 31, 2020.

45 Puig de la Bellacasa, *Matters of Care*, 3. See also Joan Tronto and Berenice Fisher, "Toward a Feminist Theory of Caring," in Emily K. Abel and Margaret K. Nelson, eds., *Circles of Care: Work and Identity in Women's Lives* (Albany: SUNY Press, 1990), 36–54.

46 Lauren Berlant, "The Commons: Infrastructures for Troubling Times*," *Environment and Planning D: Society and Space* 34, no. 3 (2016), 393–419, here 393.

47 For more on this, see Escobar, *Designs for the Pluriverse*; and Terry Winograd and Fernando Flores, *Understanding Computers and Cognition: A New Foundation for Design* (Norwood, NJ: Ablex, 1986).

48 See Krzywoszynska, "Nonhuman Labor and the Making of Resources."

movements of ghostly springtails, tiny insect-like hexapods that would leave wobbly trails in the dew on their way to nibble a patch of mold. These beings, serving as "indicators" of ecological health, [49] negotiate the line between decomposition and recomposition, ensuring that rot results in renewal and vice versa. In this way, decay processes give way to world-building, whereby the unfolding of particular substances constitutes the novel re-formation of matter. [50] Moment by moment, the terrarium space is actively altered through myriad happenings, becoming a slightly different bodily arrangement than it was before.

Ancient relationships between molecule, microorganism, and macroorganism have arisen over millennia, emerging from entities' responsiveness and obligation toward others' variegated needs. Acts of care and labor are thus extended beyond the human and can be understood as animate beings' long-term commitments toward one another. But unlike agricultural soils or the petri dish, terrarium biomes are not shaped day-to-day within the context of human-microbe symbiosis; for the most part, they are left alone by their bipedal caretakers. Nor do terrarium worlds emerge solely from the synergies of lively microbiota. Inorganic beings also participate in and exceed these biological networks, affording essential nourishment. Vibrating particles, "a society of separate molecules in violent agitation," [51] join the "ranks" of "tiny laborers" [52] that partake in the rhythms of worldly inhalation and exhalation; both transformed and transforming in turn. In this way, small worlds exude not only the reticulation of nonlife and life but "the irrelevance of their separation." [53] Chemical ecologies of lively and nonlively beings cohere as loosely connected, interbeing choreographies of breath, entanglement, and care.

In this sense, prolonged care practices require an enduring trust in unknowable entities and an awareness that worldly happenings are sometimes beyond any individual's control. Like many maintenance processes, terrarium care compels difficult choices regarding whether to "uncork" and intervene in a system meant to thrive on its own. Elena, a terrarium expert based in London, writes about her urban-dwelling customers: "Everyone is super anxious about killing them, and we usually say that *over-care* [results in] usual deaths." [54] Anxiety—stemming from the Latin *angō*, meaning "to draw together" and "to choke"—is an apt descriptor within this context. Terrarium design, after all, is a process of drawing together, of assembling. Read another way, it can also be a process of asphyxiation of living beings, literally and figuratively. When knots of obligation become too tight, practices of upkeep can fall by the wayside or shift focus toward other modes of existence. Ironically, they can also pressure builders into overly hurried

49 Gabrys, "Sensing Lichens."

50 See Tim Edensor, "Waste Matter: The Debris of Industrial Ruins and the Disordering of the Material World," *Journal of Material Culture* 10, no. 3 (2005), 311–32; and Caitlin DeSilvey, *Curated Decay: Heritage beyond Saving* (Minneapolis: University of Minnesota Press, 2017).

51 Alfred North Whitehead, *Process and Reality: An Essay in Cosmology*, ed. David Ray Griffin and Donald W. Sherburne (New York: Free Press, 1978), 78.

52 Laura U. Marks, *Touch: Sensuous Theory and Multisensory Media* (Minneapolis: University of Minnesota Press, 2002), xxii.

53 Elizabeth A. Povinelli, *Geontologies: A Requiem to Late Liberalism* (Durham, NC: Duke University Press, 2016), 42.

54 "Elena" (pseudonym), a UK-based professional terrarium builder, email interview by author, June 24, 2020; emphasis added.

or unhelpful interventions. In this context, to conceptualize care in purely idealized or optimistic terms is naive. As Puig de la Bellacasa reminds us, engagements with care are often onto-politically ambivalent, riddled with these kinds of tensions: tied to feelings of affection just as often as feelings of apathy or disgust. [55]

When faced with the beginnings and ends of small worlds, practices of "letting go" become a necessary component of their care. As one builder told me, "It can be disheartening to see something you've put time and faith into die, but accepting that it's just part of the process is important." [56] On the one hand, then, "letting go" is a form of acceptance of the ways that worlds manifest and persist of their own discretion. On the other hand, it can be a form of "turning away," a mode of disentanglement from an intolerable relation [57] and thus a form of care toward oneself. In attending to the more-than-sensible, perhaps this means accommodating not only an ontology of relations but also one of detachment or absence. [58] In these ways, care underlies the insensible and unpredictable configurations of (in)organic labor that mediate small realms, becoming both an ethical matter and a matter that complicates ethics.

55 Puig de la Bellacasa, "Soil Times," *Matters of Care*, 169–216, here 147.

56 "Brian" (pseudonym), a UK-based professional terrarium builder, email interview by author, July 2, 2020.

57 Povinelli, *Geontologies*, 18.

58 See Ginn, "Sticky Lives"; and John Wylie, "Landscape, Absence and the Geographies of Love," *Transactions of the Institute of British Geographers* 34, no. 3 (2009), 275–89.

Small Worlds

Microcosmic space-times, in their very smallness, can be strange to encounter. One cannot walk, swim, or fly to get "there." Often, one must crouch low and squint one's eyes. Mostly, one must stop and concentrate. Like other miniature objects, terrariums require the viewer to get *close* to apprehend them. [59] At the same time, however, close contact against the glass only emphasizes the gulf between one's body and the world within. Thomas Doyle—an artist who constructs miniature environments struck by mysterious calamities—describes this same phenomenon with his encapsulated works: "because everybody wants to touch them and there's always nose prints and fingerprints all over the glass ... I find that when I see miniature work, it does something to me where there's a sense of longing, an aching." [60] Encounters with glass envelopes are accompanied by an abrupt yearning to bridge the distance that remains between body and world, a feeling accentuated by a sensuous allure: "Small objects become tactile universes that have a visceral pull." [61]

In staring at the terrarium, then, one is tempted to access the space imaginatively, tumbling down rabbit holes of reverie. Perhaps this is what compels some individuals to construct tiny scenes within their terrarium enclosures, arranging scaled-down versions of everyday objects—such as cars, sheep, and graves—to serve as bridges or anchor points between worlds. [fig. 6] In this

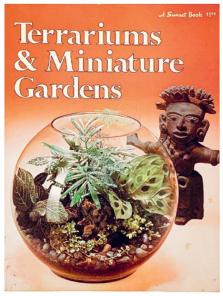

fig. 6 Front cover of *Terrariums & Miniature Gardens*, Kathryn Arthurs, 1973

59 See Suzanne *Ramljak, "Intimate Matters," in M. Anna Fariello and Paula Owen, eds., *Objects and Meaning: New Perspectives on Art and Craft* (New York: Scarecrow Press, 2005), 186–97.

60 Thomas Doyle, phone interview by author, July 3, 2020.

61 Marks, *Touch*, 11.

sense, miniatures offer a way of making sense of something mysterious or unknown, by having "a wonder." Builders with a penchant for the supernatural might assemble sequences of fairies, dinosaurs, gnomes, aliens, or toadstools, drawing upon familiar themes from science fiction and fantasy. Unlike other miniature hobbies, such as military simulation and model railroading, [62] terrarium scenographies are much less reliant on precise mensuration, however. They are not typically intended to replicate preexisting realities. Instead they often deviate toward a "thrown-togetherness," in Doreen Massey's sense of the term, [63] playing with materials, time, and scale in ways that are imaginative and sometimes playfully absurd. In our inability to fully experience them, small worlds blur the line between real and unreal.

Yet to wonder also means to ponder or doubt. And as abstractions, terrariums allow us to contemplate a troubling status quo while prompting us to speculate about the future. Multiple builders with whom I communicated referenced environmental issues—such as climate change—as something brought to the fore during the construction and caretaking process. As these builders explained, interactions with small worlds can prompt a broader worldly consciousness by rendering large-scale phenomena more intimate and apprehensible—more *real*. Yet climate change is not the only worldly event dissected and reconfigured by terrarium hobbyists. Some individuals have crafted cogent commentaries on COVID-19 or modern militarism within their enclosures—broadcasting political missives by integrating their practice with social media. These types of scenes have included, for instance, masked figurines encased within several spheres of protective glass or a corroding toy warplane overtaken by verdancy.

Through this kind of politico-aesthetic practice, small worlds help us "stay with the trouble" of contemporary issues, whereby care is used as a set of grammars to problematize the breakdown of worldly infrastructures, sociopolitical or otherwise. [64] But more than this, as artist Patrick Jacobs tells me, working with small worlds "provides relief from the constraints of what we consider normal." [65] Terrariums thus hold the potential to prototype alternate scenographies or visions of the future, articulating matters of concern through a small but powerful spatiotemporal syntax. [fig.7] Microcosmic design becomes a process through which to draw out "empirically felt variations" [66] across worlds and attend to matters of common interest to envisage new configurations of reality. In this way, worlds under glass become real unreals, or "tales that perhaps might be told about particular actualities." [67]

In their fragility, however, terrariums can appear unconvincing in their ability to endure, sometimes obliging builders to

fig.7 A terrarium as a retro-futuristic vision of a habitable bubble on an inhospitable planet. Knobby cacti fill the space within, enigmatic as to whether they themselves are the interstellar travelers. Andy O'Brien, *Outworld Dome*, 1983, glass terrarium with plants. Private collection, London

62 See Petra Tjitske Kalshoven, "The World Unwraps from Tiny Bags: Measuring Landscapes in Miniature," *Ethnos* 78, no. 3 (2013), 352–79.

63 Doreen Massey, *For Space* (London: SAGE, 2005), 140–43.

64 See Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016); and Manuel Tironi and Israel Rodríguez-Giralt, "Healing, Knowing, Enduring: Care and Politics in Damaged Worlds," *Sociological Review* 65, no. 2 (2017), 89–109.

65 Patrick Jacobs, email interview by author, July 9, 2020.

66 Isabelle Stengers, "A Constructivist Reading of *Process and Reality*," *Theory, Culture and Society* 25, no. 4 (July 2008), 91–110, here 96.

67 Whitehead, *Process and Reality*, 256.

intervene experimentally within parameters of near-total uncertainty. Instances of terrarium balance or stability are only ever fleeting: "permanence can be snatched only out of flux." [68] Mindful of their unruly trajectories, maintaining these ecologies teaches us to "give up dreams of perfection or control, but [to] keep on trying." [69] Caring for otherworldly beings necessitates not only a response-ability in the present moment but also space for beings to breathe and grow—even when they have yet to take shape.

Within the context of more totalizing notions of "world," including the Anthropocene, [70] microcosmic design can be appreciated as a world-building project that emphasizes practical activities while hinting that alternate, extraordinary arrangements of life are possible. These designs are speculative in that they gesture toward what has been left out or even toward "all that (dis)appears beyond" the ontological limits of our known worlds. [71] But looking back at how terrariums were embroiled in colonial violence—histories that are often left out of terrarium guides and online forum discussions—we see that design as "a tool is never neutral." [72] Garden boundaries and glass envelopes remind us that the political a/effects of world-building activities, even at the small scale, ripple through spaces and times. Because such design techniques are sensitive to the ways that bodies and environments relate and coproduce one another, they are well placed to explore how untold realities are performed, sustained, and extinguished. Perhaps future scholarly research-creation might examine other expressions of these little spaces, whether in the form of dioramas or dreams. In constructing and caring for these ecologies, we begin to cultivate many small gardens: a microcosmos in continuous formation.

68 Whitehead, *Process and Reality*, 338.

69 Annemarie Mol, *The Logic of Care: Health and the Problem of Patient Choice* (New York: Routledge, 2008), 93.

70 See Anna Tsing et al., eds., *Arts of Living on a Damaged Planet: Ghosts of the Anthropocene* (Minneapolis: University of Minnesota Press, 2017); and Marisol de la Cadena and Mario Blaser, eds., *A World of Many Worlds* (Durham, NC: Duke University Press, 2018).

71 Marisol de la Cadena, *Earth Beings* (Durham, NC: Duke University Press, 2015), 276. See also, Ben Anderson and John Wylie, "On Geography and Materiality," *Environment and Planning A: Economy and Space* 41, no. 2 (2009), 318–35.

72 Isabelle Stengers, "Introductory Notes on an Ecology of Practices," *Cultural Studies Review* 11, no. 1 (2005), 183–96, here 185.

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