From Furnace to Mine: An Ethnomineralogy of the Early Studio-Glass Movement

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Drawing on four weeks of fieldwork in 2023 at a glassmaking facility and at mines in the southeastern Appalachian region of the United States, this article asks how batchmaking (the mixing of the raw ingredients of glass) figured into early American studio glassblowing. In the 1960s and 1970s batchmaking materials were salvaged from both industrial glassmaking sites and mines, a practice that became increasingly obsolete as ready-made batch became available in the mid-1980s. This article draws from new materialism and critical Indigenous theory to explore a "symgeologic" account of becoming a glassblower and to critique persistent Cartesian-Newtonian tenets of studio-glass history. As an ethnomineralogy, this chapter asks: How are minerals alternatively "laid to waste" and recouped in the knowledge of glassmaking? How is the knowledge of batchmaking itself "laid to waste"? How do minerals, mines, and glassblowers co-become? What are the symgeological origins of studio glass and the stories thereof?

Spruce Pine Batch

From my early 2000s fieldwork on embodied knowledge in glassblowing, I well remember unloading deliveries of pallets of fifty-pound bags from the Spruce Pine Batch Company. Batch—that mix of raw ingredients used to make glass—is delivered ready-made to most contemporary glassblowing studios. As described by Eloise, a studio tech at the time:

> Delivery was once a week. The batch would come on a truck with a lift gate on the back. We would have to take the pallet jack and put it in the elevator and go and get it. It was like 100 percent of the elevator. Like exceeding the capacity of the elevator. It was thousands and thousands of pounds. The pallet would be perfect on the lift gate and then you have to push a button to lower. If it was wonky, it'd move around. There was one time that it wasn't straight and it fell off the side. We had to clean up toxic glass from the middle of the street.

I remember that day and the mounds of white powder. I helped to sweep it up, not giving much thought to either its composition or its origin. Nor did I think about the shifting symbolic-material meaning of the mound of mixed minerals as both the "toxic batch" on the street and the "good batch" in the furnace.

In the years that I conducted this field research, from 2003 to 2007, I made constant reference to the material properties of the medium of hot glass. My field notes describe batch deliveries, studio technicians charging the furnace, and moments of studio life when batch was in short supply, such that whispers of a hot-shop shutdown spread like wildfire. But so interwoven and identified was (and remains) studio life with the logic of production—making stuff—that it never crossed my mind to think beyond the ready appearance of those fifty-pound bags that made that life possible. Only through volunteering as a studio tech did I even learn the name Spruce Pine Batch.

But it is exactly by thinking toward and about batch and batchmaking that I believe an alternative history of American studio glassblowing is possible. Through attending to the hierarchies of minerals and medium and cycles of waste and reuse therein, a history can emerge that is accountable to today's environmental and social-justice mandates as well as to challenges to the systems of thought and being that undergird them.

Rethinking the Family Tree

The canonical and oft-cited history dates the birth of the studio-glass movement to 1962–64, when the Toledo Museum of Art announced a "seminar-workshop" in glass during the week of the University of Wisconsin's spring break—scheduled as such because that is where Harvey Littleton (1922–2013), then a ceramicist and the widely recognized "pioneer" of studio glassblowing, was teaching.[1] Also oft-cited is Littleton's use of Johns-Manville #475 marbles, which Dominick Labino, then vice president for research and development at Johns-Manville, had suggested after his multiple unsuccessful melting attempts. They worked, and early studio glassblowers melted the marbles into the next decade. From this inception the canonical history of the field unfolds through institution building—university art programs, exhibitions, galleries, juries, fairs, auctions, and networks of supply, production, and distribution—as revealed in the Harvey K. Littleton Papers, 1946–75, at the Smithsonian Institution's Archives of American Art.

Following Littleton's nascent institution building, the histories of studio glassblowing follow Dale Chihuly, the Rhode Island School of Design, and then the Pilchuck Glass Center, with but the briefest mention of Littleton's founding of the Spruce Pine Batch Company in 1985. Littleton's biographer notes the ubiquitous use of Spruce Pine Batch in "both individual studios and schools that include Penland and Pilchuck," but his retirement to Spruce Pine, North Carolina, in 1977 is treated simply as a bookend to his time in Madison.[2] As a narrative of experimentation and institution building, the history of the studio-glass movement branches out from the Toledo Workshops, asking newcomers to find a place on the family tree, largely white, male, and upper-middle class (fig. 1).

Twentieth-century philosopher Gilles Deleuze and psychoanalyst Felix Guattari point to the ubiquity of "tree-logic" in Western thought, which hierarchically unfolds from deep structure in an arborescent genealogy as reproduction of the same.[3] Such is evident in the canonical history of early studio glass. As an alternative, they propose the rhizome, as a structure of difference and heterogeneity.[4] What happens when we climb down from the family tree of human achievement and, instead, pursue the heterogeneous rhizomes of becoming?[5] What if we follow those becomings in difference as a matter of human and nonhuman entwinement?[6] Approaching studio-glass history from this vantage reveals the subterranean life of glass. In doing so, it shifts the meaning of *glass* from the medium—that homogenized substance—to the mineral agents of its becoming. This is not an ethnography accounting for how a glassmaker makes or interacts with batch but an ethnomineralogy that follows the co-becoming of glassblowers, glassblowing practices, and the broader field of studio glass from minerals and mines. Glassblowing is not simply a matter of hot glass and production, but also of silica, feldspar, and soda ash, among other minerals. What stories do these minerals have to tell in glassy co-becomings? What are the structures, both ontological and epistemological, of the canonical history such that this mineral

Fig. 1
"Glass Family Tree" from Finn Lynggaard, ed., *The Story of Studio Glass: The Early Years, a Historic Documentation Told by the Pioneers* (Copenhagen: Rhodos, 1998).

life is left untold? A turn from the medium of the furnace to the minerals of the mine allows questions that yield a new history, one activated by what political theorist Jane Bennett calls "vibrant matter," namely, an "active, earthy, not-quite-human capaciousness."[7] It is from such a turn that a symgeologic account (*syn*, "together" + *geo*, "earth") of studio-glass history can originate.

Appalachia: Minerals in the Making

A cursory interest in the mineral life of glass batch, pursued with a quick Google search on "Spruce Pine, North Carolina," readily reveals that Spruce Pine is a "gem of a city" in the "Spruce Pine Mining District." So ubiquitous are the minerals of the area that American journalist Elizabeth Kolbert begins her 2023 *New Yorker* article "Plundering the Planet's Resources" exactly in Spruce Pine. She notes that "without Spruce Pine . . . the global economy might well unravel."[8] Spanning a three-hundred-square-mile area of the North Toe River Valley and the Blue Ridge Mountains, the twelve-mile-wide by twenty-five-mile-long area in the northwest corner of the state is famed for its mica, kaolin clay, quartz, and feldspar.[9] Following the 1974 Brazilian embargo on quartz exports, it became one of the largest suppliers of high-purity quartz (used largely in information technology manufacture), as the global market sought new sources.[10] The living history of Spruce Pine's mineral abundance was primed for a ready connection to those mounds of batch that I had swept up from the middle of the street.

Driving to Spruce Pine from Asheville, North Carolina, one passes rock quarries, stone sellers, monster trucks with seven-foot-tall tires, and—up a switchback road that reveals the ancient age and beauty of the Blue Ridge Mountains within the larger Appalachian Highlands—billboards advertising gems, tourist mines, a museum of minerals, and descending semitrailers loaded with freshly quarried and milled rock. Northward, a mountain white with deforestation and extraction appears (fig. 2).

Quartz Corporation is one of the world's largest global conglomerates of high-purity quartz mining and a silica supplier for the crucibles in which semiconductor chips are made. On a residential side street near its headquarters in Spruce Pine, mining has carved uncanny piles of sand around telephone poles that are flanked by sandy cliffs dropping from scrubby woodland. The ground sparkles. I saw that glint elsewhere. Mica, mixed with feldspar in local pegmatite, has been so much part of the local mining industry that its shimmering silverfish flakes quite literally float in the air. It matters not whether it is the parking area of the glass batch company or a traffic intersection, where the stop-and-go vehicles kick up the long-accumulated dust from trucked freight. Mines, minerals, and the discarded stuff of their making permeate the everyday.

It is no surprise that Belgian-owned Sibelco, located across the street from Quartz Corporation, is currently investing $200 million to double its capacity for high-purity quartz production by 2025. Stressing the mineral abundance of the region, they note that "mining is in the DNA of Spruce Pine."[11] A mineral

Fig. 2
Quartz Corporation, Spruce Pine, North Carolina. Photo: Erin E. O'Connor.

legacy is written into the town's infrastructure, with street names like Amethyst, Opal, Diamond, and Crystal alongside those recalling a bygone timber industry. Local prosperity is not readily evident, however. The railway, built expressly to transport minerals once mined by family concerns but now by international conglomerates, continues to haul out of Spruce Pine's Mitchell County.[12] The glint that must have caught a settler colonist's fancy has been caught up in trademarks, nondisclosure agreements, and boxcars that, while once open, now allow only a cat's-eye view of the minerals inside.

On a sunny late August day, I drove with Greg Fidler, a contemporary studio glassblower and the operations manager of Spruce Pine Batch, just over North Carolina's border to eastern Tennessee. On a tract of land ceded by North Carolina to the federal government in payment for debts accrued during the War of Independence, we visited Silica Mountain, the mine from which Spruce Pine Batch sources some of its silica. Knowledgeable in sourcing materials and glass chemistry, and with undergraduate training in cultural anthropology, Fidler understood the value of seeing the mine firsthand; it was, as he well knew, a primary source of studio-glassmaking practices, but largely ignored. Of warm and welcoming disposition, with a smile to match, Fidler introduced me to Kyle, the sales representative with whom he works, who in turn introduced us to Bob, one of the company's mining engineers, who would be giving us a tour. With the four of us loaded into a heavy-duty four-wheel-drive truck, Bob began the steep ascent to the top of the mountain through scrub oak, pine, sumac, and rubble. Now and then a small footbridge would appear, connecting the road to a piece of still-forested land. The mine, Bob explained, does not own the land but rather leases the mining rights from its owners, who retain rights of access.

At the top of the mountain, shared with community-service radio towers for fire and police departments as well as public broadcasting services, it is easy to take in the valley's rolling beauty alongside Bob's geological explanation of

the mountains—a sandstone projection running down from Silica Mountain four hundred feet before rising again four hundred miles to the northeast in Virginia. Bob is a walking and talking encyclopedia of silica mining, and he inspired his son to take up the profession, albeit in copper. He drove us between the "benches," the man-made topography of leveled-mountain tiers. At one particular stop, he showed us holes drilled into the bench—about thirty—in preparation for, in industry lingo, "pulling the shot" later in the week—namely, dynamiting the bench to access the silica for processing. Next to the holes are small mounds of powderlike crushed rock brought up from drilling, not unlike the sawdust that accumulates around a drill bit when boring into even the most basic board. Bob picked up the powder and let it run through his hands by way of demonstration: "See, you can tell this is good. Look how white it is." They had pulled a shot that morning, reducing a large segment of the mountain in front of us into anywhere between nine and fifteen thousand tons of rubble (figs. 3–6).[13]

Parked, ready for the next morning's haul, was one of the many extraordinary earth-moving machines traversing the mountain: iconic yellow Caterpillar 530 excavators, 320 hydraulic excavators, 326 long-arm excavators, and 988 large-heel loaders, among others. After pulling the shot, the silica is collected and hauled, crushed, and sent down conveyor belts designed to process three hundred tons an hour, sifted and crushed again, washed, dried, and sent into the rod mill, where it is finished to one of the meshes (particle sizes) offered for sale.

Fig. 3
Benches, Silica Mountain. Photo: Erin E. O'Connor.

Fig. 4
Drilling silica, Silica Mountain. Photo: Erin E. O'Connor.

Fig. 5
The mountain after the mine "pulled a shot" the same morning, Silica Mountain. Photo: Erin E. O'Connor.

Fig. 6
Escalator belt toward jaw crusher, Silica Mountain. Photo: Erin E. O'Connor.

The cartography of Silica Mountain represents what anthropologist Kathryn Yusoff calls "white geology," that discipline that "makes legible a set of extractions from particular subjects and from the ecologies of place."[14] Isolating minerals of use at a moment, white geology designates the wanted as apart from the unwanted. This distinction finds analytic purchase in the now-classic work by anthropologist Mary Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* (1966), wherein Douglas employs the concepts of purity and danger to analyze and understand cultural norms, values, and social structure.[15] Tons of minerals, as well as the "overburden"—that top layer that needs to be removed to access the ore—land in stockpiles and trailing ponds of waste. Anthropologists of discard Max Liboiron and Josh Lepawsky draw from Douglas to argue that the transformation of "matter out of place" into matter that is well placed is achieved through labeling and organization; this maintains power by indicating that the waste problem has been addressed.[16]

My object here is not to set up the mining industry as a straw man or to "cancel" studio glassblowing or batchmaking because of resource extractivism; this would fail to attend to the complex and layered intricacies on which everyday life and minor industries like studio glass are reliant upon and through which they engage the global mining industry. The amount of finely ground silica quartz that Spruce Pine Batch purchases from the mine is minuscule in comparison to industrial consumption and available only because of the larger industrial demand. Scale, however, as Liboiron and Lepawsky, drawing on philosopher Graham Harman (2018), point out, is not simply a matter of less or more.[17] Instead, it is about asking what relationships matter in a "situated context."[18] In this vein, I want to understand how the visibility and invisibility of

minerals and mines—that white geology—"appear" in studio-glassblowing practice. How is it that minerals and mines, so salient to the everyday studio-glass life, are largely invisible to fire and furnace, crucible and hot glass, practice and production? What is the situated context? What systems of being and knowing must be in place such that the knowledge and practices of batchmaking, not unlike the mountains themselves, are "laid to waste"?[19] With these questions in view, I would like to consider the onto-epistemological structure of studio glass.

Settling Minerals: The Onto-Epistemology of the Medium

From the top of Silica Mountain, the beauty of the lakes below did not readily tell the story of their creation through damming by the Tennessee Valley Authority in the mid-twentieth century, let alone of the land's earlier settlement. In 1775 Daniel Boone and William Bean prospected the area for settlement, alongside the crossroads of the Wilderness Road (cut by Boone in the same year) and the Seneca Trail (dubbed the Great Indian Warpath by British traders).[20] Nearby is the Cumberland Gap, the fabled low-lying passage followed by Boone in 1769 and subsequently a quarter million western-bound settlers.

Settlement, postcolonial theorists argue, is defined by entitlement to land rather than pure resource extraction and economic exploitation (the latter exemplified by the British Empire in India).[21] Critical Indigenous theorists point out that the settler colonial relation to land is philosophically caught up in an early modern worldview, the two bedrocks of which are Descartes's dualist understanding of human and world and Newton's mechanistic theory of the physical world, authored in the seventeenth and early eighteenth centuries.[22] The combined Cartesian-Newtonian worldview allows man to understand himself as a discoverer and knower of the natural forces that move an inert physical world.[23] This yields a modern subject endowed with agency, who can both know, manipulate, and master that nature and deny that "natural" matter agency. Settler colonialism in North America bears this worldview in everyday ways of perceiving, being, and knowing.[24] It is with some critical distance on this worldview that we can begin to understand why and how that mineral life, so salient to everyday studio glassblowing, is largely absent—unused, neglected, and "laid to waste"—in both the everyday experience of production and the histories of the field.

In *Glassblowing: A Search for Form* (1971), Littleton, widely recognized as the "pioneer" of studio glassblowing, explicitly upholds the promise of glass as a *medium*: "Glass, an endlessly intriguing material, remains virtually undiscovered as a medium for artistic expression."[25] So, too, is *medium* found in those pages from the Smithsonian's Littleton Papers concerned with fundraising. Without coincidence, the use of *medium* in art discourse emerged in eighteenth-century aesthetic theory, within a culture and society still framed by onto-epistemological dualism and mechanistic science.[26] German philosopher Gotthold Ephraim Lessing (1776) used *medium* to designate the unique spatiotemporality of an audience experience with an artwork, while German idealist G. W. F. Hegel, used the term to designate the actual material of an artwork.[27] What is important to note is that in both cases, the medium—true to the term's Latin roots, meaning

"middle" or "intermediary"—mediates human experience and expression.[28] The medium serves, that is, as a mediator of discrete ontological beings—human and nonhuman. Moreover, it is distinctly understood as nonhuman—part of that inert world activated by human agency. In the "new" twentieth-century aesthetics of Littleton's time, artists sought to liberate a given medium from ideas, to express the immediacy of sensations and experience and the plasticity of materials.[29] Even so, this retains the dichotomy of human and nonhuman and bears a "disposition toward" material as a matter of mediation. Herein, the maker creates "in relation to" or "with" the material to produce work.

Consider the forging of the glass "medium." It emerges in the furnace crucible—that which historian of religions Mircea Eliade likened to a man-made uterus.[30] In Plato's *Timaeus*, this is the anachronism of creation, namely, a birth of the universe that follows originary matter.[31] This is not the radical immanence of materiality—what feminist classicist and architectural theorist Ann Bergren calls the "diathetic ambiguity" of originary elements becoming in heterogeneity and disequilibrium.[32] Instead, the anachronistic narrative asserts the container as primary.[33] When the amalgamated glass in the crucible is prior to the minerals of its making, the story of glassmaking performs this anachronism. The crucible and furnace are the architecture—the mastered and built beginning—of the radical immanence of mineral life. Glass, as Renaissance alchemists held, is *media mineralis*, namely, a "middle mineral" that appears "natural" while being "artificial."[34] The medium—a homogenized substance called "glass"—belongs to the man-made beginning of human time.[35]

This practical onto-epistemology is borne out in Littleton's recommendations: "The artist must know the glass as it is melting in the furnace—the amalgamation of the inert powders that make up its formulation into the clear glowing stuff he gathers onto his hot iron."[36] At the same time, "batchmaking," he notes, should neither be done "for its own sake" nor be "primary to the development of a form-sense in glass."[37] Instead, the glass artist could experiment with batch for a month, he suggests, so that he can achieve enough of an understanding "to exploit that particular glass as a medium of his own expression" or simply melt ready-made cullet.[38] Might the relation to glass as a medium lay to waste the mineral journeys of its becoming?

Studio glassblowers learn to not see the mine, to not see material agencies, and to not see vibrant matter. Insofar as the field is begotten from furnace and crucible, production and making take center stage. Discarding and forgetting are salient to this framework such that the knowledge of batchmaking is "laid to waste" like the mountain itself.[39] There is an onto-epistemological impulse, that is, interwoven into Western ways of being and knowing, that veils the mineral life and mines from the glory of the arena of production.[40] Having shed some light on how and why batch and its material life are absent and unseen even amid their ubiquity in studio life, we can now try to imagine how attention to minerals in the vein of new materialism might move concerns beyond the practical onto-epistemology of the medium and toward remembering those materialities laid to waste in the knowledge, histories, and practices of the field.

Unsettling a Mineral Imaginary: Chestnut Flat Quartz

In the winter of 1934 two scientists visited Chestnut Flat Mine in Ledger, a small community near Bakersville in the Spruce Pine region. The event has come to constitute a well-worn local legend known by nearly everyone with whom I spoke about the topic. Two scientists from the north show up in white lab coats and walk around Chestnut Flat Mine. They say they want the quartz, and all the miners laugh, wondering why in the world they would want that waste. Chestnut Flat Mine was one of the largest feldspar mines in the United States, feldspar being an aluminum silicate of found pegmatite, a granitelike compound rock consisting, in the Spruce Pine region, of approximately 65 percent feldspar, 25 percent quartz, and 10 percent mica. At Chestnut Flat, large veins of pure quartz ran sandwiched between pegmatite.[41]

At the same time, Ralph Connelly had been hired to load railcars by his friend Harry Bailey Sr., owner of the Carolina China Clay Company. The husband of Louise Penland, Bailey managed the 50,067 acres of Penland properties in the Spruce Pine area.[42] In keeping with a long history of landholding, dating from the landed-gentry family's thirteenth-century estates in Scotland to the arrival of John Penland (1623–95) at the royal colony of New Jersey, the Penlands had

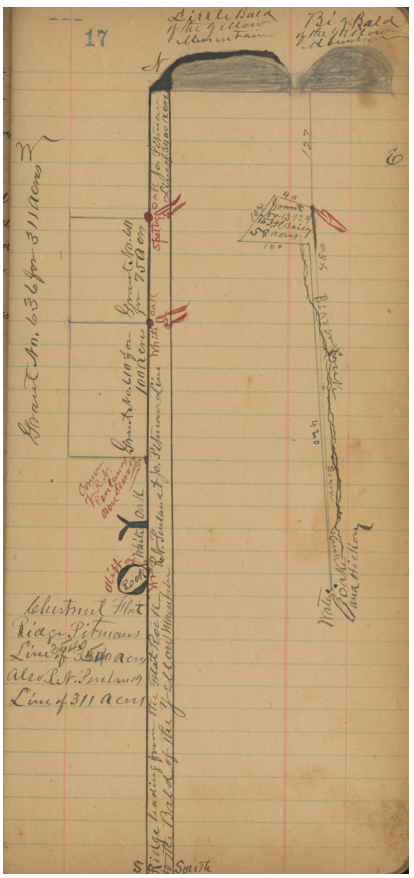

Fig. 7
Hand-drawn map of Chestnut Flat. Mitchell County Historical Society Archives.

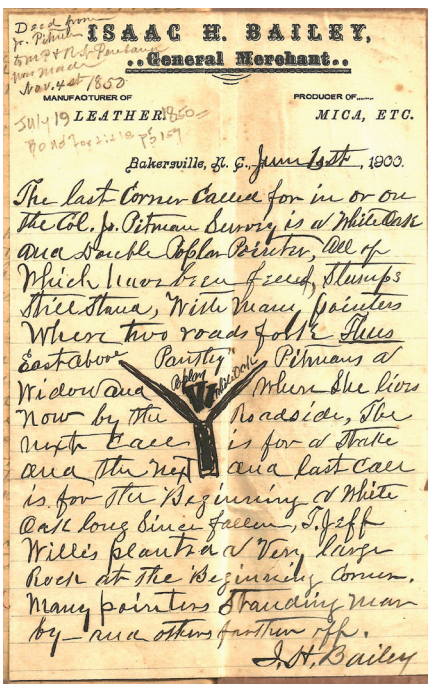
ISAAC H. BAILEY,
..General Merchant..
MANUFACTURER OF LEATHER.
PRODUCER OF MICA, ETC.
Bakersville, N. C., June 1st, 1900.
The last Corner Called for in or on the Col. Jo. Pitman Survey is a White Oak and Double Poplar Pointer, All of Which Have been Cut down, Stumps Still Stand, With Many Pointers Where two roads Forks Runs East above Pantley Pitmans at Widow and Where She lives Now by the Roadside, The next Corner is for a Stake and the Next and last Call is for the Beginning a White Oak Long Since Fallen, J. Jeff Willis planted a Very Large Rock at the Beginning Corner, Many Pointers Standing near by— and others further off.
J. H. Bailey

Fig. 8
Issac Bailey memo detailing origin deed to and further acquisition of Chestnut Flat, 1900. Mitchell County Historical Society Archives.

been acquiring land in northwest North Carolina since at least 1783.[43] Their land included Chestnut Flat, as shown in an undated hand-drawn map; the 1850 deed for it is referenced in the marginalia of a June 1, 1900, memo written by Harry's father, Issac H. Bailey (1842–1926; figs. 7 and 8).[44]

Two months into the job, Connelly found himself loading and classifying four fifty-ton cars of quartz flint that arrived at the Penland train station (formerly called the Bailey Station Depot after the family's adjacent mercantile and vibrant timber business), one four-ton truckload per hour, five days a week, from Chestnut Flat.[45] Connelly knew of the eighteen miners working Chestnut Flat, who hand-cobbed (hand-carved) the quartz seven hundred feet belowground. When the order was complete, he watched steam engine No. 407 depart with the quartz along the Clinchfield Railroad toward the Consolidated Feldspar Corporation in Erwin, Tennessee, where it would be milled and sent north by rail.[46] The destination? Corning, New York. Its purpose? To make the lens of the highly anticipated two-hundred-inch-diameter Palomar telescope lens, then the world's largest, earning it the name "Glass Giant."[47]

I do not know when the cars arrived at Corning, how the quartz was unloaded, further processed, and stored, or how the batch was mixed or charged, but a February 4, 1955, letter from Corning confirms that Chestnut Flat supplied the quartz for the lens and thanks Connelly for his contribution.[48] On Sunday, March 25, 1934, glassworkers used a trolley system that ran a ladle along a track to pour the lens in front of a ticketed audience. Among those present was Jesse Littleton, Harvey's father, who contributed to the development of borosilicate glass, from which the lens was made. Present, too, was Harvey Littleton himself.[49] On December 2, 1934, workers loaded the lens (it was successfully poured on the second attempt) onto a railcar before the fanfare of hundreds of spectators on a miserably cold and rainy day.[50]

Amid pulls of batch tests, bookshelves of glassmaking texts and papers, and dozens of objects related to studio glass and the batch company, I asked Tom Littleton, Harvey's son and owner of Spruce Pine Batch, what he thought about the connection between his father's early exposure to Spruce Pine quartz and Spruce Pine Batch Company.[51] A man of staid countenance and generous disposition, Tom's characteristic gold wire-frame aviators and classic brass pin-buckle glimmered as he succinctly replied: "The connection was art, not industry." I do not doubt this. Harvey's biographer also notes that he moved to Spruce Pine for the "community of artists around Penland School" and likened the environment to "Paris in the 1920s."[52] But permit me a thought experiment. It is known that "conversations around the supper table [at the Littleton household] frequently centered on glass"—conversations that Tom explained were so thoroughgoing that they extended to the stress fractures of Jell-O cut with a fork.[53] Could a ten- to twelve-year-old Harvey Littleton—soon to be, if not already, immersed in art lessons—have heard about the discovery of the pure quartz veins at Chestnut Flat at such a dinner table conversation? Could he have been present for the arrival of the boxcars of milled quartz from the Consolidated Feldspar Corporation in Edwin, Tennessee? Could he have been among the crowd bidding a cheerful bon voyage to the Palomar lens?

How could such an early contact with pure Spruce Pine quartz not be caught up in the eventual batching of studio glass in Spruce Pine? Recent neuroscience and archaeology show that the human mind is coextensive with matter; thinking happens with, through, and in the nonhuman.[54] "Vibrant matter," writes Jane Bennett, is not animated but rather is itself an "active principle" capable of catalyzing a person, a social world, a "public."[55] Humans, in other words, as described by posthumanist philosopher Rosa Braidotti, are quite literally a "matter" of becoming not simply coextensive but intratwined with living matter.[56] There is neither "human" nor "mineral," that is, but rather the co-becoming of humans and nonhumans. The glassblower is no exception, caught up in the agencies of quartz silica, soda ash, and limestone.[57] Humans, that is, are not only *symbiotic*—about 10 percent of cells in the "human body" are "occupied by human genomes" while the remaining "90 percent . . . are filled with the genomes of bacteria, fungi, protists and such"—but also *symgeologic*.[58] And, vice versa, so is the living Earth. Mineralogist Robert M. Hazen describes this as "mineral evolution," which accounts for the fact that Earth's development as a host of life is ongoing in symbiotic relationships.[59] An ethnomineralogy of studio-glass batchmaking urges a symgeologic account of the studio-glass movement as well as the knowledge and practices therein. This is not simply a matter of including minerals in the realm of human action but of opening the human narrative to their agency.[60] This means imagining how the Chestnut Flat quartz—which had an outsized national public visibility in the context of the Palomar lens—might have shaped those in proximity to it.

Canonically, the origin of studio glassblowing is dated to the Toledo Workshops in 1962, but can we not think of—or, better yet, with—Chestnut quartz as an agent in the mineral imaginary from which studio glass emerges? It would be over twenty years until the canonical beginning of the studio-glass movement and fifty until Littleton's venture into batchmaking in Spruce Pine. But I cannot help but wonder about the catalytic imaginary of the quartz. Pure and unadulterated, could the Chestnut Flat quartz not have inspired the standardized batch that provides the "medium" of hot glass so taken for granted today?[61] I am reminded of Marco Berreta's research on alchemy and ancient to early modern glassmaking, wherein glass is understood to be or emerge from substances that are already glass-like. The ancient Greeks, for example, posited that glass (*hyalos*) was solidified water, while crystal (*crystallos*) was thought to be melted earth.[62] Such a mineral imagination can be entertained in the case of Chestnut Flat quartz and the eventual Spruce Pine Batch. This is more importantly a matter of understanding how thinking and doing may be animated by minerals rather than empirical veracity. From this perspective of human and nonhuman co-becoming, it is worth recalling that pure quartz never "grows" alone but rather always with companions. Notably, in the case of Spruce Pine pegmatite, quartz becomes with feldspar and mica. Glass and glassmaking need not emerge from the pure, that is, but also may become along trajectories of difference and heterogeneity.

Unsettling a Mineral Practice: Kona Fines

In July 2023 I met Mark Peiser, an early Penland glassblower, at a local Spruce Pine cafe, specializing in hand-brewed single-origin coffees and baked goods made in-house from locally sourced ingredients. It is easy to imagine Peiser much younger than his eighty-something years. Bright-eyed, convivial, and insatiably curious, you can find him on any given day caught up in residencies, projects both unfinished and new, and conversations that convey his lifelong experience in glassmaking. Talking with him, I first heard of Kona: "There was a town called Kona, I don't know, ten, fifteen miles down the river," he began. "Years ago, you just went and said, 'Hey, I'm a glassblower at Penland' can I get a couple bags of sand?' and they said, 'Sure, take a bag.' I remember walking through a door of a dingy wooden shed and there was a guy in bib overalls at a counter. You know. It was a different world. It was probably in '69 or earlier." Peiser can't remember exactly how he learned of Kona but said by way of explanation, "You can't be here without coming into contact with the mining industry. It's a major part of the economy of the area. . . . I can see them out my window and can hear their goddamn machines." Even the Penland School of Crafts occupies the grounds of the Seven Springs Farm and Industrial School, built in 1905 on property donated by the aforementioned Penland-Baileys, the deed for which cedes the property to the school "reserving and excepting, however, all mines and minerals in, under or apart aiming the aforesaid tract, piece, or parcel of land" for heirs and their assigns.[63] Though a century later than the original school, the practical legacy of local mining around Penland must have been tangible in the practices and minds of the early studio glassblowers.

Depending on whom you talk to, Kona was a mine, a processing plant, or simply a storage facility. Others remember that Kona was once known as "Youngstown," after the local Young family, but became Kona—the idealized formula of feldspar as K (potassium), O (oxygen), and Na (sodium)—in 1916, five years following the first shipment of feldspar from the Deer Pine mine that marked the beginning of the mineral's mining in the Spruce Pine district.[64] A report written by the North Carolina Department of Conservation and Development in 1969 indicates that Kona began operation in 1946 as a processing plant for local feldspar run by the Consolidated Feldspar Department of the International Minerals and Chemical Corporation.[65] This was the first plant to commercially produce feldspar using the "froth flotation" process (discovered by the US Bureau of Mines in 1939), which introduces various chemicals and minerals to fine-grained pegmatite (alaskite) and through agitation and washing variously "floats" and "sinks" wanted and unwanted minerals.[66] Alex Glover is a local geologist with extensive experience in and knowledge of mining, whose passion for rocks readily renders the deep time of their formation palpable. Eager to unpack Kona's figurative history, he explained its flotation process: "Mica floats [and is removed first], then iron floats [and is removed], then the last float cell is where the feldspar floats, and the quartz sinks [in the same cell]."

Reflecting on Kona's industrial history, Peiser remarked, "'Feldspar' just wasn't in my lexicon. The sands we were getting were just called 'fines.'" "Fines," it turns out, refers to exactly those minerals that sink to the bottom—waste (fig. 9).[67]

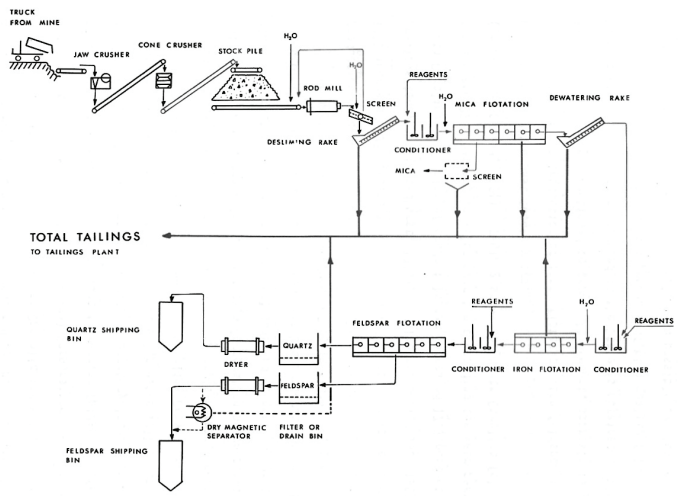

Fig. 9
Kona Flowchart. Illustrated in Jerry L. Bundy and Alberg Carpenter III, "Feldspar Resources of North Carolina," Information Circular 20 (North Carolina Department of Conservation and Development, 1969).

The local feldspar industry boomed following the introduction of this technology. By the mid-twentieth century, North Carolina had become responsible for 50 percent of the domestic production of feldspar, 56 percent of which was consumed by the industrial glass industry.[68] In the late 1960s and 1970s, the stockpile of silica "fines" available for local Penland studio glassblowers must have been abundant.[69]

When Fritz Dreisbach arrived in Penland in 1967, he remembers Peiser experimenting with batchmaking: "I don't know who it was who first tried the Spruce Pine fines, but I assume it was Peiser. It was local. Spruce Pine. I remember driving down [to Kona] with my truck to get bags of sand. To the shipping dock—it was the place with the bags. It was an extra problem for them. They just did it to support the local community." Dreisbach remembers the clear crystal that the fines made.

Peiser also clearly remembers the crystal-clear glass: "A lot of us who were melting glasses [around Penland then] were getting [the fines]. . . . It was very easy to melt. It was brilliant. I remember the Glass Art Society conference in 1971. I had a tank in my studio that the people coming to the conference spent a day blowing glass. Everyone would look in and say, 'Oh my god, I can see the bottom of the tank,' which was a different experience from the marbles, which you couldn't see through." Following Peiser's lead, after folks had advised him to get "sand" from "Texas, Philadelphia, or somewhere in Canada," Richard Ritter (b. 1940), who also lives in the Spruce Pine area, would go to Kona when they were dumping the sand into bags: "They had very pure silica. It made very, very, very beautiful clear glass. The manufacturers were very generous. I used to get bags of sand from them down by the river there. It was a little heavy. It wasn't like 300. I mean, you know, particle size. But it was small enough. Maybe 180."[70] Kona burned to the ground in 2005 or 2006 at the hand of an arsonist and was closed by the Environmental Protection Agency.[71] Ritter happened to be serving as a

volunteer firefighter at the time and recalls seeing all the bags of minerals burning and thinking, "This is all going to waste!" He was not able to salvage it.

Early studio glassblowers salvaged both Kona fines and cullet. To understand how the Kona fines and cullet contributed to and shaped the early studio-glass movement, however, it is not enough to simply identify their similarity in terms of human use.[72] To perceive an affinity between Kona fines and industrial cullet errs exactly toward that anthropocentrism expressive of a Cartesian-Newtonian framework: emphasizing the user, it ignores material agency.[73] It was the unknown presence of feldspar, a remnant of that granitelike pegmatite, in the silica fines of Peiser's early batchmaking, for example, that augmented the melt. Both the potassium and the sodium oxide of feldspar are fluxing agents; they both lower the melting temperature, while potash improves the brilliance and luster.[74] This is a testimony to the co-becoming of feldspar, quartz, mica, and other elements both nonhuman and human.[75] With Peiser's batchmaking, the symgeologic co-becoming of glassmaking unfolds as creation.

Reflecting on this time, Peiser wondered aloud, "Feldspar is just silica mixed with other stuff that you want in glass. You want that—it leads to a lower melting point of the batch, which is desirable. [*Pause*] I'm trying to think. . . . Maybe there was something else in the sand that made it easy to melt. I believe that they called it buying sand. What'd I know back in 1969 or 1967." The Kona fines—discarded as contamination from the purified feldspar—were full of material vitalism for those with the attention to hear and see it. What would become known as Penland glass, or "Mark's formula," emerges not from purity, that is, but from impurity—from the contamination of the fines that mixed silica and feldspar. This co-becoming differs from the "pursuit of form" that Littleton advocated for in the early seventies—something that is arguably linked to the medium imaginary of pure quartz from Chestnut Flat. Deleuze and Guattari define the artisan as one who "follow[s] a flow of matter."[76] As folks in Spruce Pine readily point out, Peiser's batching is a process of following mineral life toward the creation of work (a matter of following material flows), rather than of creating work from batch (a matter of following a medium toward a form). "Every mine," Deleuze and Guattari continue, in their meditation on artisans, "is a line of flight."[77] Human becoming is always caught up in mines and their minerals, that is—and vice versa, mines and minerals with the human. This is not the human pursuit of form but the co-becoming of mineral, batch, glass, glassblower, and work.

Peiser speaks of being drawn to Penland for the beauty of its mountains and the openness of its people—a contrast to his hometown of Chicago, where he felt frustration in his corporate career in industrial design, his pursuit of becoming a classical pianist, and the murder of two friends. Could Peiser's attention and openness to the mountains have instructed him? Her shrouds of fog, lush rhododendrons, and quicksilver brooks and rivers as equally as her open wounds? Writing about "human-lithic" enmeshment, literary theorist Jeffrey Jerome Cohen calls on art and science to discover "the continuities between humans and stones, their congruence and coinhabitance."[78] It is without coincidence that Peiser opens a 1968 poem written in Penland with, "What do mountains

say."[79] When we reach beyond the furnace and crucible to the material life of batch—to minerals and mines—we begin to follow such continuities. This performs that paradigm shift required to break from a Cartesian-Newtonian worldview and its settler colonial legacies. Hereby, we can begin to recoup those mines and minerals, and the knowledge thereof, laid to waste in the mediation of the medium with symgeologic tales.

Science-studies scholar Bruno Latour poignantly observed, "We have never been modern."[80] At first blush obscure and perplexing, this statement is actually incredibly obvious: the Cartesian-Newtonian worldview of the "modern age"—that period of approximately 1600–1800—forged a separation of man from nature, self from world, of forces from matter that, while seeking to account for lived experience in eternal, unchanging reason and truth, never "captured" the lived polycorporeal experience of everyday life. "We have never been modern" points to the fact that while modern philosophy asserted man's primacy and dominion over nature, lived experience defies this.

From the symgeologic perspective, the Chestnut Flat quartz and Kona fines can be understood as having animated two different trajectories of the development of studio glassblowing. The former—the purest quartz to be found—informed the production of batch as a consistent and reliable medium from which to pursue form. The latter—impure waste fines of feldspar and more—led to batching as a method of following mineral life toward the creation of a work. Decolonizing the history of studio glassblowing is not only about the obvious need to move on from the language of the "pioneer," "maverick," and "trail-blazer," each of which conceptions originated with settler colonialism, often through violent means. It is also about taking up a view on nature, land, and resources that dispenses with dualisms, hierarchy, and anthropocentrism, such that studio-glass practice can understand itself as having emerged with the non-human—in this case, the quartz and fines of the Spruce Pine region.

Conclusion

I think back to that day sweeping up the spilled batch in the street, where it appeared "toxic." "Matter out of place," the batch was neither bagged nor stacked in the storage room, nor was it put to melt in the furnace crucible—spaces that symbolically organize the "stuff" of the glassblowing studio into a moral order of the well-placed.[81] But, as we have seen, "vibrant matter" can never be contained by semiotics.[82] In the middle of the street, the spilled batch took on a new life, caught up in the glassblower's sensibilities of purity and danger—sensibilities we have seen to be historically carrying the burden of a Cartesian-Newtonian onto-epistemology via settler colonialism.

In my attention to glass as a medium while learning how to blow glass and then writing about it, the co-becoming of the batch minerals and myself was lost, laid to waste like the mountain from whence it came. In the words of early studio glassblower Henry Halem, who wrote the field's tome on the technical side of glassmaking, *Glass Notes* (1993): "I never went to the Kona mine, but I saw the

mountain disappear over years. They just bagged the mountain up and shipped it out to whoever needed it."[83] Mediation, the creation of the medium, bears those ready gouges and gaps in the glassblower's knowledge of glassmaking, that chasm between the "middle mineral" and the mine.
■

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31 Ann Bergren, *Weaving Truth: Essays on Language and the Female in Greek Thought* (Cambridge, MA: Harvard University Press, 2008), 260–65.
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36 Littleton, *Glassblowing*, 13.
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39 Liboiron and Lepawsky, *Discard Studies*, 44–45.
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64 Bundy and Carpenter, "Information Circular 20," 7, 18.
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70 These numbers refer to the "mesh" of the mineral, the size of mesh screen through which a given granule will fit.
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81 Douglas, *Purity and Danger*, 36.

82 Bennett, *Vibrant Matter*, 5.

83 "Kona" designates both a town and a now-defunct mill, but not a local mountain. It is not empirical veracity that is of import here, however, but rather both the real and symbolic absence of Kona from studio-glassblowing histories.