Archive of Lost Mountains

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The *Archive of Lost Mountains* is a collection of drawings and models that document the impacts of mountaintop removal coal mining in Appalachia. Specifically, it recreates the peaks destroyed by mining, and assembles data concerning permit holders, raw material extraction, labor hours worked, and other details. By using architectural conventions to represent these landscapes, the archive seeks to establish deeper connections between the practice of architecture and the sites of its material extraction.

> Now, they are back with draglines and dozers,
> performing dime store mastectomies
> to cure their fear of the dark
> removing and discarding her tops
>
> Excerpt from Frank X. Walker, "Nyctophobia," *Appalachian Heritage* 37, no. 3 (Summer 2009): 104

INTRODUCTION

Despite the steady decline of coal consumption in recent years, the effects of its extraction and combustion are persistent and widespread.[1] And despite the rhetoric of sustainability and climate change resilience in architecture, the field is yoked to coal insofar as buildings use electricity and is built using steel, concrete, aluminum, and countless other byproducts. In the production of steel, for example, metallurgical coal is converted to coke, which is used to fuel the blast furnace. To make concrete, coal is used to create clinker, which is then mixed with gypsum to make cement. Aluminum production, while not dependent on the thermal qualities of coal, consumes an extraordinary amount of energy, much of which derives from coal-fired power plants.

The entanglement of coal and architecture deepens as the accounting extends to the energy industry. In 2019, coal accounted for nearly 40% of global energy production, and the building sector accounted for nearly 40% of global energy consumption.[2] However, the oft-cited statistics that rely on simplifications by sector are woefully narrow in scope, as Michelle Addington has recently pointed out.[3] In short, the connections between coal and architecture are deeply entrenched, and a more detailed understanding of their connection grows increasingly relevant as the climate continues to change.

One way to gain a more detailed understanding of the connection between coal and architecture is to trace the supply chains that constitute its production. For example, a recent tour through the supply chain of an everyday building product reveals an expansive network of not only sites of material extraction and environmental destruction, but also "elusive networks of financial power and political influence."[4] Understanding architecture as a material process constituted by its variegated supply chains, then, requires a thorough accounting of its multifaceted production, including the territories impacted by the extraction of raw material.[5] Through this lens, the dominant sites of architectural intervention in urban and suburban landscapes become inextricable from their corresponding interventions in zones of extraction.[6]

Historically, Appalachia has been the source of immeasurable extraction, yet discourses in architecture concerned with climate change and its spillover effects rarely mention it. What are the implications of such oversights? Precisely how are these sites connected? Might the theory and practice of architecture shift with a framework more attuned to the accumulation of material and immaterial impacts in the supply chain of design? This paper takes these questions as a point of departure to examine a specific landscape mined for a specific commodity, catalogued in the *Archive of Lost Mountains*.

BACKGROUND AND CONTEXT

In the late nineteenth century, mining rights in Appalachia were predominantly covered by broad form deeds, which "gave the mineral owner…access to the minerals in any manner 'deemed necessary or convenient.'"[7] At the time, mining methods involved an elaborate system of tunneling beneath mountains to access seams of coal, impacting the surface only at points of ingress and egress. As demand rose and technology advanced, however, these methods began affecting the landscape in increasingly violent ways, culminating in what is known as mountaintop removal. (Figure 1)

Combined with the protections to use any means "deemed necessary or convenient" with the fact that hundreds of miners could be replaced with "a few men armed with explosives

Figure 1. Map of mountaintop removal mines in Appalachia (left); view from a mountaintop removal site in eastern Kentucky (right).

and bulldozers," mountaintop removal gained widespread popularity in the mid-twentieth century.[8] As the Appalachian landscape was being systematically flattened, the Surface Mining Control and Reclamation Act (SMCRA) of 1977 sought to regulate these practices; however, mining industry influence and weak enforcement mechanisms meant that many of the mines continued to operate unabated.[9] In practice, many reclamation projects did little to rehabilitate the site. For example, photographer Rachel Watson critiqued the SMCRA provision of restoring the land to its "approximate original contour" by documenting a range of rehabilitation projects on mountaintop removal sites, often resulting in an "alien appearance in the surrounding landscape."[10] In rare instances, reclamation efforts have taken on creative new uses, and there is no shortage of speculative reimaginings of extractive landscapes.[11] However, the vast majority of sites have been reclaimed using loopholes that allow for the continued degradation of the landscape and their surrounding communities.[12]

True to its name, mountaintop removal describes the process of blasting away peaks to access buried coal, what the poet Frank X. Walker has called "dime store mastectomies."[13] A recent feature in the *Washington Post Magazine* described the practice as "a hyper-efficient mix of explosives, draglines, and dozers that undoes hundreds of millions of years of geology in minutes."[14] Morphologically, mountaintop removal creates deep geological disturbances. A 2016 study by a team of Duke University researchers used geospatial analysis tools to compare premining and postmining topography in Appalachia, finding "the physical effects of mountaintop removal…much more similar to volcanic eruptions, where the entire landscape is fractured, deepened, and decoupled from prior landscape evolution trajectories, effectively resetting the clock on landscape and ecosystem coevolution."[15] Whether analogized as a botched operation in an amateur surgery or compared to a cataclysmic geologic event, the process of extracting coal in Appalachia has wreaked havoc on the physical landscape.

Politically, mountaintop removal has had similarly significant impacts in Appalachia. Unsettling the outworn narratives of economic independence that often accompany political analysis of coal mining communities, public historian Elizabeth Catte highlights the generations of corporate welfare flowing into the region, which amounts to mining companies being able to "to shirk their tax burdens, hoard land, and wield enormous political influence while local communities suffer."[16] Beyond generic corporate welfarism, Catte has identified an especially insidious characteristic specific to mountaintop removal

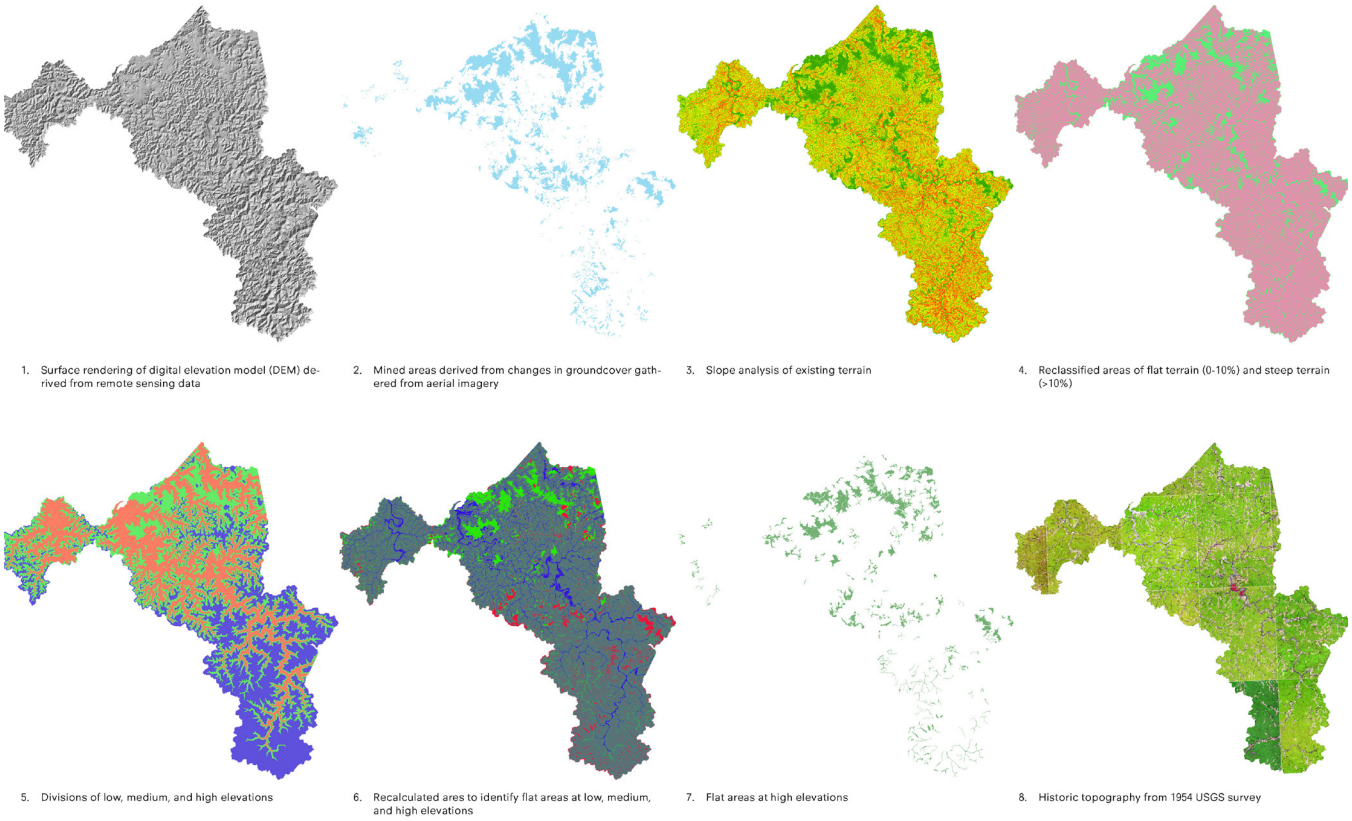

Figure 2. Process of identifying lost mountains using geospatial analysis tools in Perry County, Kentucky.

mining, one that renders "both mountains and miners into abstract and disposable commodities."[17] Recognizing the multidimensional impacts, Catte asserts, "It's difficult to overstate the degree to which mountaintop removal has changed life and work in parts of Appalachia."[18]

Mountaintop removal mining has also reshaped the social and cultural landscape in Appalachia. For sociologist Rebecca Scott, "the practice is enmeshed in contradictory national discourses of hierarchical difference, progress, and citizenship… [and] is therefore able to be an object of contention in various projects around the control of private property, claims to full American citizenship status, and visions of the future."[19] Precisely because of its extraordinary tactics, mountaintop removal "also generates a radical critique of [the] conceptualization of the human relationship to nature."[20] Interpreted through the extractive logic of mountaintop removal, Scott argues that many of the social and environmental phenomena in Appalachia are not simply reflective of one another, but rather, coproduced. Leaning on an ecofeminist critique, Scott argues, "People construct themselves through their interaction with the environment, and they do this not only in terms of gender but also through nationality, race, region, and sexuality."[21] In recent years, mountaintop removal has impacted nearly every dimension of social and biological life as the coalfields of Appalachia continue to be exploited by an extraction method that "buries headwater streams, causes erosion and flooding, degrades water quality downstream, kills a lot of aquatic life, shakes the walls and cracks the foundations of nearby homes, and wipes away huge portions of an extremely diverse ecosystem."[22]

While the damaging effects of mountaintop removal are unavoidable and highly visible in most parts of Appalachia, wider public perception is limited by several intersecting forces. First and foremost, mining companies fear retribution for what they know to be threatening knowledge; as Wendell Berry notes, "The coal companies, knowing well what an abomination surface mining is, have gone to considerable trouble to hide it from public view."[23] In addition to being lost to public perception through corporate strategy, the mountaintops remain lost to the state sanctioned recordkeepers of topographic information. For example, a peak named Cow Knob appears unaltered in the 2019 USGS US Topo map series, yet the 2011 lidar data indicate a smooth plateau nearly 300 feet lower.[24] According to mining permits, Cow Knob was erased from the landscape by a subsidiary of the International Coal Group and the Sunny Ridge Mining Company beginning

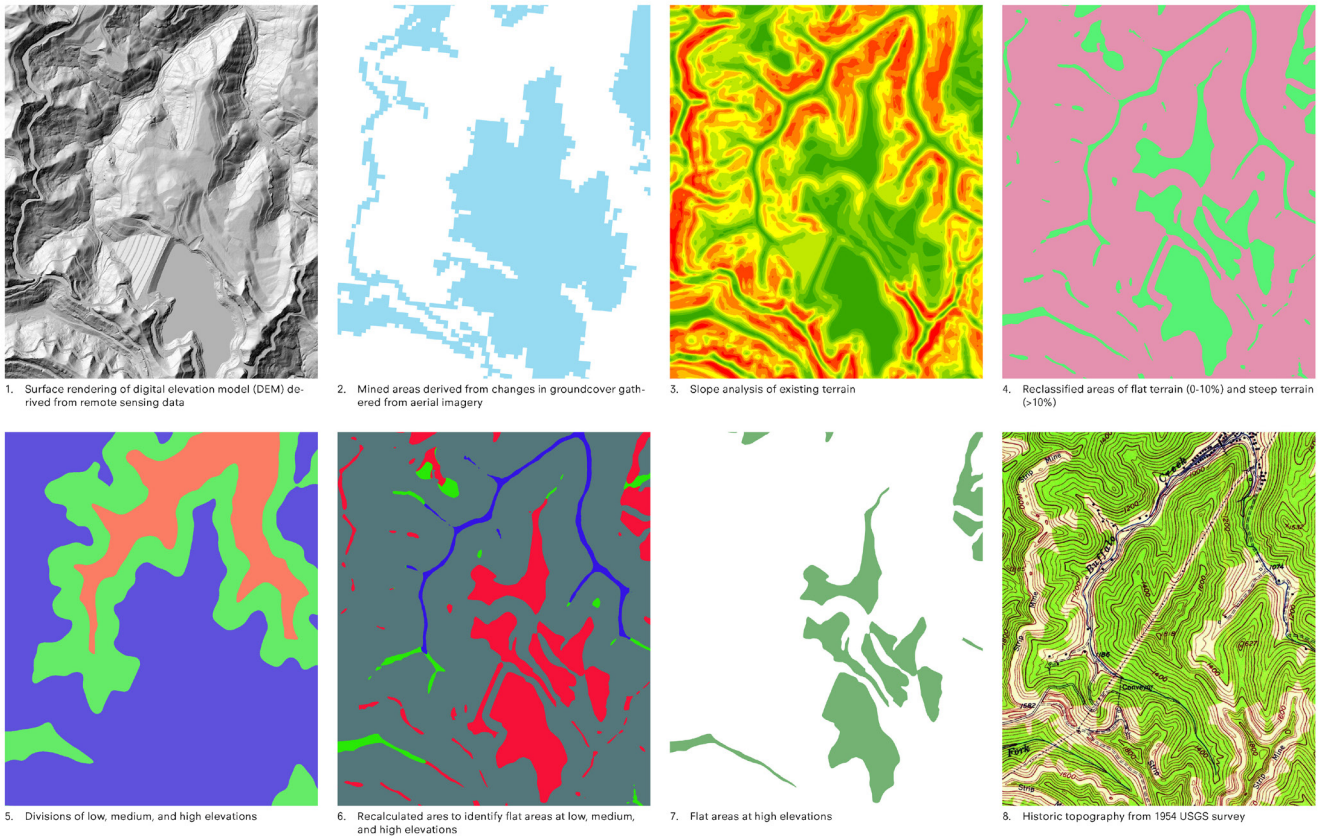

Figure 3. Detailed process of identifying lost mountains.

in 2005, yet the USGS has not registered its destruction in the topographic record.

Such invisibilities are not uncommon, and much recent scholarship has grappled with how to conceptualize them. For the editors of *Arts of Living on a Damaged Planet*, Anna Tsing, Heather Swanson, Elaine Gan, and Nils Bubandt, the task is to "pay better attention…[which] will allow us to stand up to the constant barrage of messages asking us to forget—that is, to allow a few private owners and public officials with their eyes focused on short-term gains to pretend that environmental devastation does not exist."[25] In their volume of collected essays and analyses, readers are encourages to notice the ghosts and monsters that occupy the attempted erasures. "Ghosts," write the editors, "point to our forgetting, showing us how living landscapes are imbued with tracks and traces."[26] Critically observing the landscape and its attendant forces occupies the core of *Arts of Living on a Damaged Planet*, ultimately prompting the question, "How can we repurpose the tools of modernity against the terrors of Progress to make visible the other worlds it has ignored and damaged? Living in a time of planetary catastrophe thus begins with a practice at once humble and difficult: noticing the worlds around us."[27] Taking on this prompt, the *Archive of Lost Mountains* seeks to notice the features and forces that elide visibility in the extractive landscapes of Appalachia.

To draw together landscapes of production and consumption not only renders spaces of extraction visible, but it also politicizes them in consequential ways. Rania Ghosn has called such compressions a "geographic perspective on energy," which "opens up and materializes the compressed space between the resource hinterland and the metropolis, and by doing that, addresses the political significance of such missing spaces." Ghosn highlights the reinscription of missing spaces into the material narrative, writing, "Once no longer defined by erasure, the space of corporate imaginaries continuously unfolds into a complex re-representation of energy's spatial condition."[28] Embracing a "geographic perspective on energy" renders coal mining in Appalachia an eminently architectural issue, and in so doing, mobilizes a cascade of effects in the process of design. The *Archive of Lost Mountains* uses an assortment of tools and techniques germane to the practice of architecture to draw additional connections between design and its affected territories.

PAPER

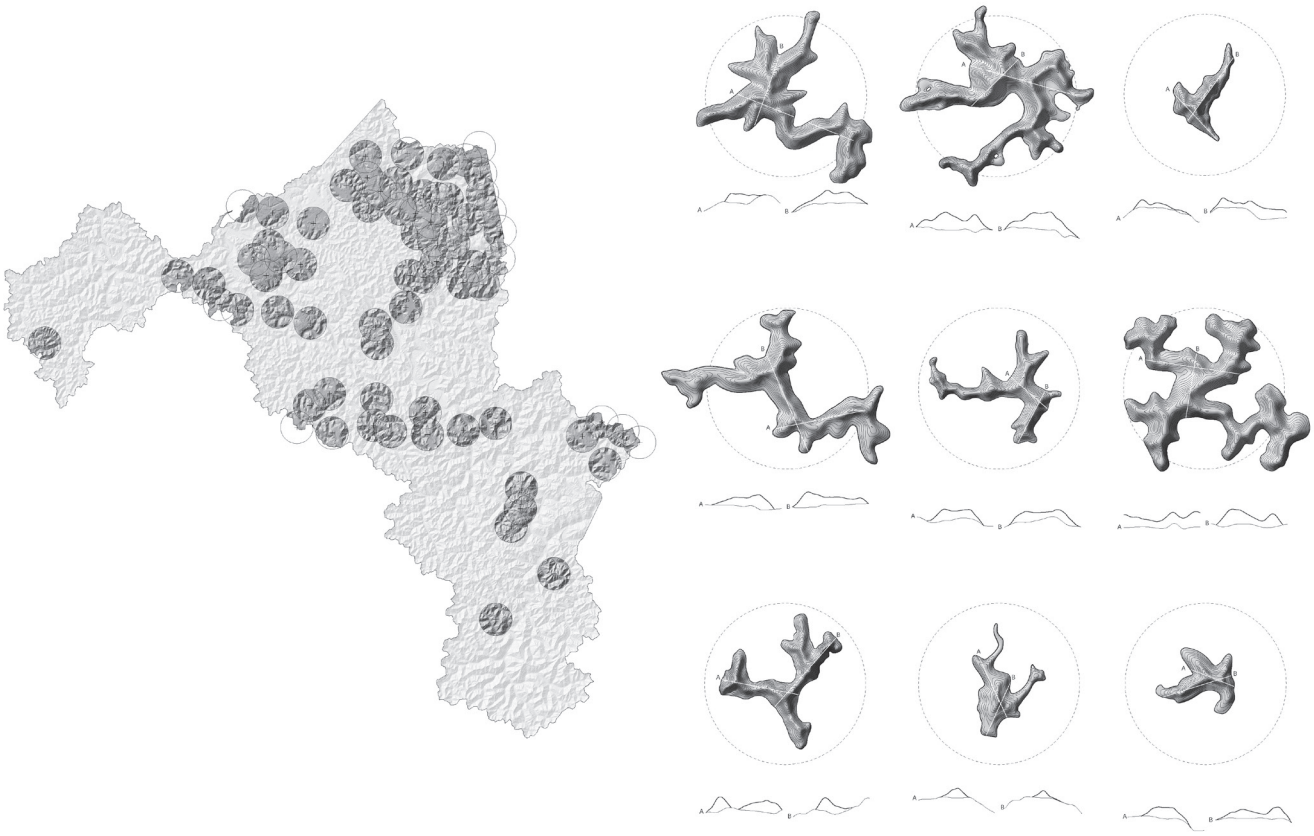

Figure 4. Results from geospatial analysis in Perry County, Kentucky (left); sample of reconstructed peaks from historic topography (right).

METHODOLOGY AND PROCESS

The *Archive of Lost Mountains* is an ongoing project to preserve the memory of landscapes destroyed by mountaintop removal mining in Appalachia. In Kentucky alone, nearly 600,000 acres on 300 mountaintops have been stripped of their soils, vegetation, and minerals, leaving a scarred landscape in desperate need of repair. Efforts to rehabilitate these sites are ongoing, but their scale is dwarfed by the still-barren landscapes that populate central Appalachia. Part public history, part geological specimen, the *Archive of Lost Mountains* exposes the scars of mountaintop removal and establishes tangible relics for the preservation of place and memory. The archive seeks what Caitlin DeSilvey calls "new ways of storying matter," consisting of a growing catalog of drawings and models that artificially recuperate the landscape to its original contours.[29]

Beyond mere catalog entries, the archive brings character and dimension to the lost mountains, treating them as Ursula K. Le Guin might describe as "kinfolk."[30] For example, a timeline of mining activity for each entry gives it an age, an approximate volumetric calculation of displaced terrain gives it a size, and a summary of fines and violations incurred in its mining gives it a temperament. A complete listing of companies involved in the mining of each lost mountain, alongside a tabulation of total labor hours logged, serves as a reminder that the process ultimately relies on the exploitation of labor in a game of winning and losing sides.

As an archive specifically geared toward the impacts of coal mining, it builds on questions posed by James Graham in his recent tour of coal mining exhibitions: "What forms will that history take? Where will its archives be kept, and what goes in them? Can they illuminate that complex 'web of exploitation' that has shaped the region for the past 150 years? What of the places, and the people, involved in that history? How might atmospheric data, settler colonialism, labor struggles, geology, extractive corporate capitalism, folk culture, and a remarkable landscape be read through one another?"[31] Taking these questions as a point of departure, the *Archive of Lost Mountains* introduces another approach to memorializing and characterizing the mountains lost to the extraction of coal.

To begin assembling the archive, the lost mountains first needed to be found. Ironically, the key to finding them lay in the very loopholes that the mining companies used in their reclamation process. Since a destroyed peak cannot be restored to its "approximate original contour" as SMCRA stipulated,

Figure 5. Fly ash collection (left, image courtesy of Jim Hower); cast concrete model of reconstructed peak using fly ash for pigment (right).

the leftover plateaus were designated as "wildlife habitats" that bore little resemblance to the surrounding topography. However, the coal-bearing regions of Appalachia possess no flat, natural terrain outside of its valley floors. Graham describes the morphology as a "forested piece of aluminum foil that was balled up and stretched out again, high slopes locally but a relatively low relief across the whole."[32] In another account, a premining analysis of regional topography found less than twenty percent of the total land area to be slopes less than ten percent.[33] Of that area, none of the flat terrain is naturally found at upper elevations. Therefore, if a plateau exists, it signifies an unnatural landform created by mountaintop removal mining, and acts as a harbinger for finding the lost mountains.

Technically, the process of finding the lost mountains and reconstructing their original contours leveraged three publicly available datasets, culled to individual counties: a digital elevation model (DEM), a groundcover change analysis, and a collection of historic topographic maps. From the DEM, a series of geospatial analyses generated a map showing the hallmark geomorphology of mountaintop removal mining—flat areas at high elevations. (Figure 2, Figure 3) The process involved five steps. First, a slope analysis created a heatmap of slope intensity. Second, the slopes were reclassified as either flat (0-10%) or steep (>10%). Third, elevations throughout the county were categorized as low, medium, and high. Fourth, an algorithm was used to identify flat areas at high elevations, and culled by an area threshold. Fifth, the resulting flat areas at high elevations were cross-referenced with the groundcover change analysis and historic topographic maps to find the mountaintops that had been lost to mining.[34]

Once the flat areas at high elevations had been identified, the process of reconstructing the peaks involved a separate workflow, consisting of three steps. (Figure 4) First, a half-mile radius was drawn around the former peak from within the plateau area. Second, a digital model of the premining and postmining topography was created using several modeling tools. Third, the former peak was reconstructed by trimming the premining surface with the postmining surface. From these reconstructed peaks, both two- and three-dimensional representations were produced.

Plan and section drawings show the relative scale and volume of what had been removed by mining. Where peaks once existed are now plateaus, which are rendered in high contrast to better illustrate the scars left behind. The elevation change

between these plateaus and the former peaks often measure hundreds of feet, and the volume of displaced material amounts to millions of cubic yards, much of which has been deposited in neighboring valleys. Some of the peaks have official names, but many do not. Regardless of the geographic record, each peak meant something to someone, and likely had several unrecorded names. Much like ghosts, the drawings offer a fleeting glimpse of something once existent, now erased from view.

The physical models in the archive offer an additional layer of association with the lost mountains, seeking to activate the landscape in ways two-dimensional representations cannot.[35] (Figure 5) To better capture the figural qualities of the peaks, the model heights are exaggerated to align with how Luis Callejas and Charlotte Hansson argue, "in order to communicate the mountain as a totality, intensifying detail for living matter and topography."[36] Some of models are small enough to fit in one hand, and others are large enough to require several pairs of hands to lift. To build the models, the reconstructed surface of each peak was CNC milled to create a mold, into which a concrete mixture was poured. Tinted with the fly ash remnants of a coal-fired power plant, the models take on the qualities of the commodity for which they were destroyed. The color of the models, therefore, derives from byproducts of the same coal that was extracted from beneath the mountaintop, establishing chemical, material, and elemental connections between the model and the object of its representation. Beyond mere representation, the physical models play an affective and agentive role in the archive, drawing on what Donna Haraway calls "a work object; a model is not the same kind of thing as a metaphor or analogy. A model is worked, and it does work."[37] The physical presence of ghost-like features intends to resonate beyond what two-dimensional representations can accomplish, and in doing so, the models create stronger associations with the landscape and its material history.

In addition to drawings and models, the *Archive of Lost Mountains* includes historical data for each peak. Building on records kept by the Mine Safety and Health Administration branch of the US Department of Labor and the Coal Data Browser from the US Energy Information Administration, each peak grows more animated with information about who mined the mountain, how many labor hours went into, and what specific consequences unfolded along the way. Mining permits, for example, show the boundaries of state-issued mining licenses and the names of the license holder. These names represent what Harry Caudill called the "phalanx of interlocking interests and powers that dominate the political life of every state any part of which falls within the Appalachian coalfields" and offer an inroad for deciphering the complex property rights that blanket mines, often multiple layers deep.[38] Together, the reconstructed peaks and their associated histories serve as tools for critically observing a decimated landscape, ultimately contributing to a curiosity from which new futures might be envisioned.

CONCLUSION

The *Archive of Lost Mountains* is a collection of drawings and models that document the impacts of mountaintop removal coal mining in Appalachia. Specifically, it recreates the peaks destroyed by mining, and assembles data concerning permit holders, raw material extraction, labor hours worked, and other details. By using architectural conventions to represent these landscapes, the archive seeks to establish deeper connections between the practice of architecture and the sites of its material extraction. Future research will include an oral history component, working with collaborators in Appalachia to archive stories related to the lost mountains. Through these multiple modes of representation, the goal is to better capture the scale of intervention on the landscape, and to gather narratives that explain how these mountains were destroyed and who suffered the consequences.

ACKNOWLEDGEMENTS

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ENDNOTES

1. In the United States, coal consumption has only recently been surpassed by sources of renewable energy; U.S. Energy Information Administration, "U.S. renewable energy consumption surpasses coal for the first time in over 130 years" (May 28, 2020) https://www.eia.gov/todayinenergy/detail.php?id=43895 (accessed June 1, 2020)
2. International Energy Agency, *Global Energy Review 2020* (Paris: IEA, 2020) https://www.iea.org/reports/global-energy-review-2020 (accessed October 14, 2020)
3. Addington writes, "the true energy impact of building construction has been shielded by the measurement of embodied energy in the industrial sector, as very different entities review the data and enact policies for industry's management and mitigation than would occur if accounted for in the building sector;" Michelle Addington, "Location: Attributional, Contingent, Phenomenal," in *Embodied Energy: Making Architecture Between Metrics and Narratives*, David Benjamin, ed. (Zurich: Lars Muller, 2017), 54
4. Brent Sturlaugson, "What You Don't See," *Places Journal* (September 2018) https://placesjournal.org/article/the-supply-chain-of-architecture/ (accessed November 6, 2020)
5. For a summary of critical engagement with supply chains in architecture and related fields, see Brent Sturlaugson, "Supply Chain Materialism," *Association of Collegiate Schools of Architecture Conference Proceedings* 108 (Washington, D.C.: ACSA Press, 2020)
6. Jane Hutton has assembled a range of these material narratives, organized in what she terms "reciprocal landscapes;" Jane Hutton, *Reciprocal Landscapes: Stories of Material Movements* (New York: Routledge, 2020)
7. In her essay on the broad form deed, historian Stephanie M. Lang quotes from a 1903 document used by John C. C. Mayo, one of Appalachia's most prolific mineral speculators; Stephanie M. Lang, "'Titles Must Be Perfect': The Broad Form Deed, Politics, and Landownership in Eastern Kentucky at the Turn of the Twentieth Century," *Register of the Kentucky Historical Society* 33, no. 1 (Winter 2015): 27-57
8. Erik Reece, "Death of a Mountain," *Harper's Magazine* (April 2005), 49
9. *Surface Mining Control and Reclamation Act*, 30 U.S.C. § 1201 (1977)
10. Rachel Watson, "Approximate Original Contour," *Cabinet* 21 (Spring 2006)

11. For a glimpse of these speculative reimaginings of extractive landscapes, see Alan Berger, "Reclaiming the American West," *PRAXIS* 4 (2002): 82-93; Bradford Watson, "An Urban Mining Ecology: Butte, America," *Association of Collegiate Schools of Architecture Conference Proceedings* 105 (Washington, D.C.: ACSA Press, 2017); Alan Berger, ed., *Designing the Reclaimed Landscape* (New York: Taylor and Francis, 2008); Shane Reiner-Roth, "University of Kentucky and Somewhere Appalachia Want to Transform Coal Mining Sites into Arts Spaces," *The Architect's Newspaper* (April 6, 2020) https://www.archpaper.com/2020/04/university-kentucky-somewhere-appalachia-coal-mining-arts/ (accessed November 3, 2020)
12. In late 2016, President Obama signed the Stream Protection Rule, which sought to close many of the loopholes in SMCRA, but in early 2017, President Trump signed a bill to kill the rule, effectively encouraging the destructive workarounds that had transpired in the forty years since SMCRA went into effect; "Stream Protection Rule," *Federal Register* 81, no. 244 (December 20, 2016): 93066-93445
13. Frank X. Walker, "Nyctophobia," *Appalachian Heritage* 37, no. 3 (Summer 2009), 104
14. Gabriel Popkin, "The Green Miles," *The Washington Post Magazine* (February 13, 2020)
15. Matthew Ross, Brian McGlynn, Emily Bernhardt, "Deep Impact: Effects of Mountaintop Mining on Surface Topography, Bedrock Structure, and Downstream Waters," *Environmental Science and Technology* 50 (2016), 2071
16. Elizabeth Catte, *What You Are Getting Wrong About Appalachia* (Cleveland: Belt Publishing, 2018), 13-14
17. Ibid, 117
18. Ibid, 118
19. Rebecca R. Scott, *Removing Mountains: Extracting Nature and Identity in the Appalachian Coalfields* (Minneapolis: University of Minnesota Press, 2010), 20
20. Ibid, 220
21. Ibid, 221
22. Erik Reece, *Lost Mountain: A Year in the Vanishing Wilderness* (New York: Riverhead Books, 2006), 28
23. Wendell Berry, "Foreword," in *Lost Mountain: A Year in the Vanishing Wilderness* by Erik Reece (New York: Riverhead Books, 2006), xv
24. U.S. Geological Survey, *Matewan Quadrangle, West Virginia, Kentucky* [map], 1:24,000, 7.5 Minute Series (Reston: United States Department of the Interior, USGS, 1999)
25. Anna Tsing, Heather Swanson, Elaine Gan, Nils Bubandt, eds., *Arts of Living on a Damaged Planet: Ghosts of the Anthropocene* (Minneapolis: University of Minnesota Press, 2017), 1
26. Ibid, 6
27. Anna Tsing, Heather Swanson, Elaine Gan, Nils Bubandt, eds., *Arts of Living on a Damaged Planet: Monsters of the Anthropocene* (Minneapolis: University of Minnesota Press, 2017), 7
28. Rania Ghosn, "Where Are the Missing Spaces? The Geography of Some Uncommon Interests," *Perspecta* 45, eds. Kurt Evans, Iben Falconer, Ian Mills (Cambridge: MIT Press, 2012), 114
29. Caitlin DeSilvey, *Curated Decay: Heritage Beyond Saving* (Minneapolis: University of Minnesota Press, 2017), 6
30. Le Guin elaborates on the possibilities for affectual connection with mountains, writing, "One way to stop seeing trees, or rivers, or hills, only as "natural resources" is to class them as fellow beings—kinfolk;" Ursula K. Le Guin, "Deep in Admiration," in in *Arts of Living on a Damaged Planet: Monsters of the Anthropocene*, Anna Tsing, Heather Swanson, Elaine Gan, Nils Bubandt, eds. (Minneapolis: University of Minnesota Press, 2017), 6
31. James Graham, "Making Coal Historical (A Road Trip)," *Avery Review* 35 (December 2018), http://www.averyreview.com/issues/35/making-coal-historical (accessed November 5, 2020)
32. Ibid
33. James Wickham, Petra Bohall Wood, Matthew C. Nicholson, William Jenkins, Daniel Druckenbrod, Glenn W. Suter, Michael P. Strager, Christine Mazzarella, Walter Galloway, John Amos, "The Overlooked Terrestrial Impacts of Mountaintop Mining," *BioScience* 63, no. 5 (May 2013), 338
34. The creators of the surface change dataset acknowledge its limitations, stating "We merely offer our model results here to indicate approximately when and where mining activity was occurring;" Andrew Pericak, Christian Thomas, David Kroodsma, Matthew Wasson, Matthew Ross, Nicholas Clinton, David Campagna, Yolandita Franklin, Emily Bernhardt, John Amos, "Mapping the yearly extent of surface coal mining in Central Appalachia using Landsat and Google Earth Engine," *PLoS ONE* 13, no. 7 (2018) https://doi.org/10.1371/journal.pone.0197758 (accessed November 3, 2020)
35. Recognizing the shortcomings of two-dimensional representation in illustrating the impacts of mountaintop removal, the Duke researchers argue, "Maps of environmental change can create false equivalencies between quantitative and qualitatively different impacts." Rather, they contest "that we account for the full three-dimensional scale of environmental impact;" Ross, McGlynn, Bernhardt, "Deep Impact," 2071
36. Luis Callejas, Charlotte Hansson, "Pelagic Alphabet: Islands as a Model of the Ocean," *Architectural Design* 90, no. 1 (2020), 49
37. Donna Haraway, "Symbiogenesis, Sympoiesis, and Art Science Activisms for Staying with the Trouble," in *Arts of Living on a Damaged Planet: Monsters of the Anthropocene*, Anna Tsing, Heather Swanson, Elaine Gan, Nils Bubandt, eds. (Minneapolis: University of Minnesota Press, 2017), 29
38. Harry Caudill, *My Land Is Dying* (New York: E.P. Dutton, 1971), 122