PETRIFIED MEDIA

Stephen Cornford

One story beneath street level in central Bristol, minute mineral samples traverse the five thousand kilometer depth to the Earth's inner core. For the last three years in one small room of this basement, scientists working on "Disequilibrium" (a volcanology project funded by the National Environment Research Council) have been constructing a high-pressure, high-temperature rheometer to measure the viscosity of basaltic magma, an igneous composition of rock found in more than half of Earth's volcanoes. Their research aims to provide a model for disequilibrium processes: periods when temperature and pressure are in constant flux, namely eruption. Their methodology is somewhat remarkable in volcanological circles due to their use of "in-situ" microtomography in which samples are heated, pressurized, and rotated in the path of a high-energy X-ray beam at the UK's synchrotron facility, Diamond Light Source. For the scientists involved this provides a first opportunity to observe and measure the process of magma crystallization occurring in real time.[1]

Touring the basement labs of Bristol University's School of Earth Sciences "from the surface to the core"—according to the depth of the terrestrial processes their apparatus was designed to synthesize—two trends become apparent: an increase in abstraction and artificiality and a decrease in sample size. These tendencies converge in a laboratory where temperatures and pressures equivalent to those in the planet's outer core can be synthesized by compressing a sample to a thickness of just a few microns between two diamonds while heating it with a laser. Processes that occur in a subterranean layer more than two thousand kilometers thick are emulated in

Cultural Politics, Volume 18, Issue 3, © 2022 Duke University Press
DOI: 10.1215/17432197-9964899

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

laboratories in approximately the area of a single pixel of your phone's screen.

In November 2019 I began what was intended to be a six-month Earth Art Fellowship alongside this project. My proposal was to spend these months exploring the relationship between the metals in their apparatus and the minerals in their samples—the relationship between technical media and earth media. The volcanologists are concerned with the formation of pyroxene and plagioclase crystals within magma, both of which are silicates. The camera imaging their tomographic experiments has a silicon sensor, and the 3D rendering and analysis is conducted by the silicon CPU chips of their desktop PCs. The chemical materiality of their instruments and their samples is near-identical. Silicon forms both the subject and the means of scrutiny, the molten media studied and the technical media of interpretation, the phenomenon observed and the instrument of observation. We could summarize the material trajectory of this experiment in a single phrase: minerals are melted into machines to analyze minerals while they melt.

Indulging in this productive confusion of volcanic silicates and computational silicon allows us to see the continuity between terrestrial and technical thermal processes. It's not only the furnaces in the Bristol basement that externalize earth processes but also the furnaces of semiconductor manufacture in which pure silicon is melted into cylindrical ingots at temperatures equivalent to those of a magma chamber before being sliced into wafers and baked again. The manufacture of computational media is dependent on a literally volcanic intensity of combustion. As Nicole Starosielski has also noted, "Minerals, themselves formed through the heating and cooling of the Earth are extracted using thermal technologies" (2016: 294). The instruments required to image and compute the behavior of earth media are manufactured under the same thermal conditions as those the rocks they analyze were created in.

The central problem addressed by "Disequilibrium" seemed to me to be the development of a methodology to photograph a rock while it is melting. *I turn these words around in my head and resolve that my response should be to melt the camera. For me, making the camera the subject and observer of the experiment is a way to echo the circularity of silica in volcanology, while also reflecting on the afterlife of our obsolete media, how their complex materiality might persist and metamorphose when subjected to the extreme temperatures found deep in the Earth and in the smelting processes that precede the recycling of their metals.*

Heating a contemporary media device to a temperature at which the melting points of its components are surpassed reveals its underlying materiality. Melting breaks down its temporary configuration into a functional whole, forcing apart alloys and rearranging elements according to their physical properties rather than their electronic schematic. Anode and cathode seep together. Neat squares of metallic microcomponents, arranged to control electrical currents flowing between them, now flow together, recrystallizing with one another in a matrix of molten aluminum that previously enclosed them in commodity form. To melt a phone in a geological furnace is to project its materiality through an externalized earth process. Taking at face value the ability of these laboratories to synthesize subterranean conditions, their facilities could be used to force a phone

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

into the lithosphere, to imagine the material transformations this object would undergo as it is subducted into the Earth's mantle. To melt a phone is to manufacture a speculative technofossil.

In the last two decades what began as a semantic debate among geologists has become a defining issue of our historical moment. The conception of an Anthropocene epoch has led to much speculation about what will survive through deep time to mark late-capitalist human civilization: a sudden increase in the concentration of atmospheric CO_2, novel nuclear isotopes, a preponderance of chicken bones, or the petrified remains of our subterranean urban infrastructures? As Katherine Yusoff (2013) points out, the rise in atmospheric carbon dioxide has a cyclical relationship with fossilization as it is driven by the combustion of materials petrified over millennia since the Carboniferous period. The many technical and scientific discoveries of the last century—including the high temperature furnaces required for both volcanology and semiconductor manufacture—are founded on the energetic intensity provided by the combustion of fossil fuels. Given the proliferation of technical hardware with which we now surround ourselves, it is inconceivable that some of these numerous items of digital media will not also become fossilized in the stratigraphic record of the planet. As Yusoff writes, "In unearthing one fossil layer we create another contemporary fossil stratum that has our name on it" (784). A molten phone, baked in the subterranean heat of a nearby magma chamber, is one potential future.

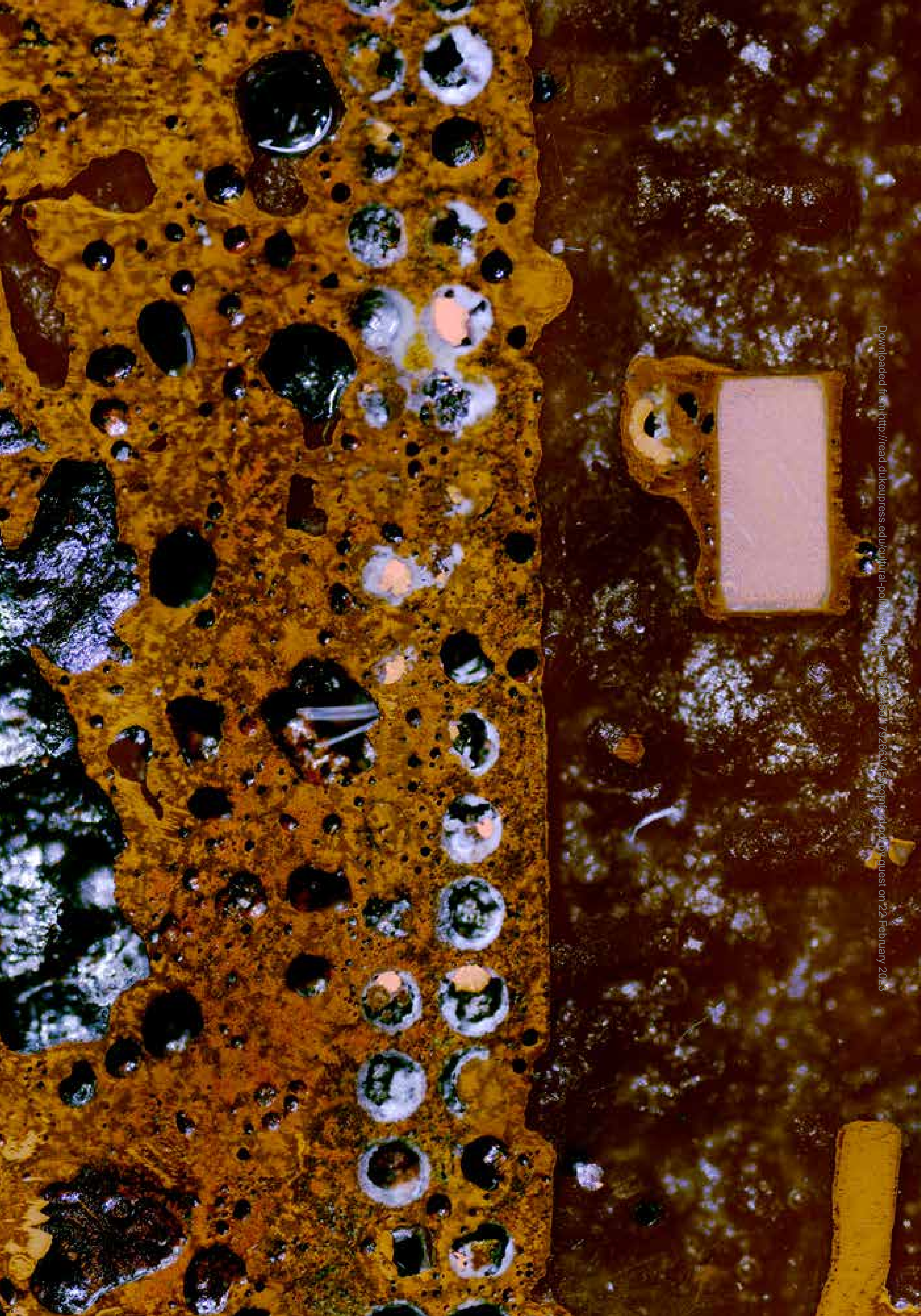
Paleobiologist Jan Zalasiewicz has written extensively about contemporary technofossils, the likely traces of our epoch that will remain in the planetary stratigraphy across millennia. Among these hypothetical transformations of our discarded material culture he notes that "humans produce artefacts from materials that are either very rare in nature or are unknown naturally" (Zalasiewicz et al. 2014: 36). This ability to refine and alloy elemental metals in exact quantities is a defining material characteristic of digital technologies which are dependent on the affordances of by-product metals. In the iPhone5 melted here, for example, the miniaturization of its central A6 processor chip is achieved by doping the silicon with either Zirconium or Hafnium. Such novel or highly refined materials exist in digital media in concentrations and combinations not occurring naturally, and it is reasonable to assume that the "anthropogenic lithologies" that they will petrify into might be no less remarkable among the predominantly silicate crust. (36)

According to Zalasiewicz the key variables that will shape the long remineralization of our waste are moisture, temperature, oxygen content, and pH. If fossilized in landfill, the human propensity to dispose of rubbish in plastic bags produces numerous microenvironments within the lining that surrounds the whole:

> Placed in a bag with discarded food, a watch will soon stew in acid leachate and may corrode away completely. However, if placed together with some discarded plaster or concrete it could rapidly become encased in newly crystallized calcium carbonate. (Zalasiewicz 2016)

How the plastic casings, printed circuit boards, glass screens, and ceramic and metallic components of contemporary media will fare under these myriad subterranean conditions may be almost as

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023



Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/[illegible]/1792663/45[illegible].pdf by guest on 22 February 2023

variable as the diversity of brands and model numbers under which they are now manufactured. Some percentage of the plastics and polymers may ultimately percolate through the surrounding rock to form new oilfields. Some of the metals are likely to erode fairly quickly, oxidize, and recombine with other surrounding minerals, while others, particularly the industrially hardened types of steel, may well last long enough to leave an inscription of their shape in the surrounding rock. But the materials which Zalasiewicz considers most resilient are silicon and quartz, which aren't corroded by any organic acid and are so inert they could well defy the chemical weathering of deep time. There is then a significant probability that the slim rectangular chips now ubiquitous in media technologies and internet-of-things devices could survive interred in the lithosphere through millennia and that the microelectronic paths etched into them might retain or imprint their form in the surrounding bedrock.

The microscopic details of fossilized graptolites have survived to the present as the hollow spaces left by their skeletons were filled with pyrite (also known as "fool's gold"). Once pyritized, these structures are remarkably resistant, surviving the extreme pressures through which mudrock transforms into slate. So although when exposed to oxygen and water pyrite weathers away, the cavity remains intact. In commenting on the likely candidates for pyritization among our current urban detritus, Zalasiewicz (2008: 182) identifies "the interiors of any of the myriads of tiny metal and electronic gadgets that we now produce in their millions . . . for these in themselves contain iron, one of the ingredients of pyrite." In Zalasiewicz's opinion then, the chances of our current media persisting as fossilized traces of our technological culture are high. The media technical trinkets of today may even petrify as remarkable combinations of improbably geometric pebbles of pure silica surrounded by glistening pyritized cavities. Unearthed from the planetary strata, such petrified media will coincide with an increase in atmospheric carbon dioxide, and, as Sy Taffel writes, "will be accompanied by a major reduction in global biodiversity, the sixth mass extinction event in the stratigraphic record" (2016: 367). The connections between combustion and consumption, emissions and extinctions which are so apparent to those working in climate science and protesting in the streets today are likely to remain equally legible in the fossil record. As Zalasiewicz concludes: "Part of the detritus of human civilization will certainly bear the sheen of fool's gold" (2008: 182).

Slices of iPhone approximately one centimeter wide were cut on a circular-wheel rock saw and subsequently heated to temperatures corresponding to the range used in volcanology experiments. Below 1000°C there is surprisingly little difference: the glass melts first, and balls of molten metal start to exsolve from the wrapped strata of battery. By 1100°C anode and cathode transform into interwoven ripples of glistening pumice and a profusion of yellow-green needle-shaped crystals erupt from various components on the circuit board, covering some surfaces densely with thorny, glassine moss. At 1200°C the battery begins to char, and the chartreuse crystals already to wither. Fine white flakes form along the aluminum-cased edges. The screen glass has now puddled, permeating the alumina

Figure 1 *Technofossil A6-1000.*

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459comford.pdf by guest on 22 February 2023

crucible and binding the unfolding melt to it. At 1300°C tinges of rich cobalt emerge from the battery, and by 1400°C this blue has spattered the crucible's surface as microstalagmites bubble up out of the glistening gray mass. At 1500°C any definition between individual components vanishes as the last melting points are surpassed, collapsing into a gun-metal agglomeration.

Even from the brief discussion of the futurity of media objects above it is clear that these samples bear no resemblance to the real effects of deep time on today's electronic waste. Isolated from the hydration and oxygenation between subsoil and lithosphere, and dramatically accelerated in comparison to centuries or millennia of gradual baking and compression, the furnace is a blunt instrument whose results are in no way comparable to the speculative future I am seeking to materialize. Yet this is also how science operates, by removing samples from their natural context and simulating the forces upon them in a controlled environment. To manufacture a technofossil in a laboratory is to remove it from the contingencies of the real and the materialities of its surroundings.

Jussi Parikka speaks of A Geology of Media *to draw our attention to the deep time planetary processes that produce the ores extracted in the service of our industries and sciences (2015). The pounding of waves that has ground and sifted monocrystalline quartz for centuries before sand is scooped into furnaces and stretched into fiber optics, the coursing of thermal springs through volcanic pumice that precipitates a lithium-rich brine now pumped from beneath the Atacama Desert for our phone batteries. But in practice the dark gray ingots of no-longer smartphone are relatively unyielding to the experimental tools of petrology that I use to grind and polish them for microscope imaging.*

To identify a rock using the traditional method of optical mineralogy it must be sliced and polished to a thickness of thirty microns (0.03 mm). At this thickness it becomes translucent and its index of refraction can be measured by the interference pattern of polarized light shone through it. To identify a rock, then, it must first be turned into a lens. The rock is incorporated into the body of the camera: earth media becomes technical media. The screen of a phone is similarly polished, buffed smooth to the molecular level using the rare-earth element Cerium. But the refined metals contained in my slices of manufactured future fossil are too opaque and reflective to be identified by optical mineralogy. For those working in the material aftermath of technology perhaps what is required is less a geology and more a metallurgy *of media.*

In the wake of the Anthropocene debate, geologist Peter Haff (2014a: 126) has proposed that in addition to acknowledging the anthropogenic nature of the crisis, we should also consider the "quasi-autonomous" role played by technological systems. Haff conceives of the *technosphere* as a planetary paradigm with equal impact to that exerted by the atmosphere, lithosphere, hydrosphere, or biosphere. However, Haff (2014b: 301) writes, "The technosphere has not yet evolved the ability to recycle its own waste streams."

One of the main causes of volcanic activity is the geological process of subduction. This takes place at tectonic boundaries where one plate is pushed beneath

Figure 2 *Technofossil B2-5003.*

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

the edge of another, forcing the softer of the two down into the Earth's mantle and triggering the release of magma. Subduction zones are sites of geological recycling, where portions of the crust are folded back into the planetary metabolism. These areas are also rich in metals, with most major terrestrial metal deposits occurring at historic or current plate boundaries. Subduction is simultaneously destructive and generative. Benjamin Bratton (2019: 33) describes the emergence of any technology in similar terms: "as a folding of the planet into particular forms that do particular things." But, unlike the cyclical motion of minerals and metals in the lithosphere, the trajectory of material in the technosphere tends to be linear and unidirectional. As a result, the processes instantiated by technological systems generate materials of increasing refinement and purity. As Parikka (2015: 110) writes, "Elements become isolated, analyzed, synthesized and enter into circulation as deterritorialized bits of information." In recent decades this isolation of elements has been a key driver of technical progress across all fields. The continued advances of synchrotron science employed on "Disequilibrium" and the portable digital media melted here are both built on the operationalization of by-product metals and rare earth elements within their components.

Among the temporalities of geological processes such as sedimentation, compaction, metamorphosis, and deformation, the assembly of a mobile digital technology in the early twenty-first century represents a radical rematerialization of terrestrial resources in both speed and geographic reach. We might even describe these mutually alien timescales as existing in a state of *disequilibrium*. Yet, as Parikka points out, the explosive force of tectonic activity can also invert this temporal relation between geological and technological durations: "Instead of the sudden apocalypse brought about by Vesuvius," he writes, "our future fossil layers are piling up slowly but steadily as an emblem of an apocalypse in slow motion" (119). A smartphone is made from as many as forty different metals, mined from multiple continents, refined and combined through a supply chain that is dizzyingly complex yet brutally efficient, not to mention energy intensive. Our media hardwares are pinched together in a geological nanosecond by an industry whose reach encompasses the planet and delves deep into its crust. In the current absence of an internationally scalable program of disassembly, a few years later, discarded and perhaps partially stripped for parts, the terrestrial temporalities of oxidization, erosion, and crystallization take over again. This disequilibrium between the planetary capacity to regenerate material and the technosphere's capacity to produce waste causes technological flotsam to pile up in "sacrificial zones" across multiple continents (Klinger 2017: 12).

Haff's (2014a: 134) sixth rule for the operation of the technosphere is "the rule of provision." For any large-scale system to remain viable, it must provide an environment that sustains its constituent parts. The technosphere supports its human population through the provision of basic needs such as shelter, food, and water as well as by catering to human desires. Such desires, Haff argues, can serve to expand the productive capacity of the technosphere into geographic or

Figure 3 iPhone circuit board heated to 1100°C.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

temporal zones in which it previously had no influence. Here Haff offers the example of "the emergence of a pervasive app market in the wake of expanding adoption of smartphones" (134). He goes on, however, to identify the environmental consequences of "high-metabolism technology" as "rais[ing] the question of whether the technosphere may eventually fail the rule of provision, on which civilization and its own existence depend" (134). As climate science clearly demonstrates, the ongoing expansion of the current unidirectional model of technospheric production places it on a collision course with the other planetary paradigms, threatening the capacity of the atmosphere and hydrosphere to support the animals and plants that maintain their metabolisms.

For the scientists designing volcanological instruments, the magma flows caused by subduction can be divided into their constituent factors and recreated in the laboratory. Processes of bubble flow-dynamics, crystallization, degassing and viscosity can also be isolated, analyzed, synthesized and deterritorialized from their volcanological whole in the same way that the metals they produce are. And the results of these experiments can be combined computationally to holistically model the behavior of silicates in a magma chamber. But this endeavor of knowledge production appears to be incapable of achieving the circularity of material regeneration of the earth system it studies.

To disassemble a complex technology into its constituent elemental metals requires considerable energy expenditure, involves toxic processes, and will never recover all of the materials. In a 2018 paper titled "Limits of the Circular Economy," Reuter et al. model the recycling of metals from a Fairphone 2 by three different routes: smelting the phone in its entirety, dismantling and selectively smelting its modules, and shredding, sorting, and metallurgical processing. Of these three techniques, the second has both the smallest environmental footprint and recovers the highest quantity of critical materials. However, even though as much as 80—98 percent of valuable metals such as gold, copper, silver, cobalt, nickel, palladium, gallium, indium, and zinc were recovered, the total percentage of material recycled was only 28 percent. The circular economy is currently proffered across industry and public policy as a silver bullet to the problems of finite resource and exponential waste, but when at looked at from the perspective of holistic commodities, there will always be a remainder—perhaps as much as 70 percent—which constitutes slag that cannot be recovered industrially.

The main reason for this inefficiency is that the metallurgical principles governing the relationships between by-product metals and bulk metals persist beyond initial extraction and refinement. As one of the scientists writes to me: "Gallium follows aluminum around in many natural processes." It is impossible to smelt a complex technology and distill all of its constituent metals. For this reason, Reuter et al. (2018: 71) insist upon the importance of a product-centric approach that takes into account the specific alloys and combinations of materials and elements within actual devices, as opposed to what they describe as "the usual over simplistic material-centric approach" which, by assuming metals as separable, inevitably

Figure 4 iPhone battery heated to 1400°C.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

fails to understand "the losses created in the system" and "the risks of residues." But the product-centric approach they espouse is also problematic as it assumes that products enter the recycling stream whole and identifiable, whereas, as Sean Cubitt (2017: 123) writes, "A central truth of the waste cycle is that it does not deal in things . . . waste deals in disassembled matter: in pieces, elements, and decomposition." Municipal scale collections of e-waste do not only contain the recent digital media addressed here or in Cubitt's book, but chaotic assortments of hoovers, hairdryers, hi-fis, and other assorted domestic electronics. The product-centric approach they model would require not only for the entire infrastructure of waste collection to be reorganized around principles either of granular sorting or return to source but also for manufacturers to meticulously account for and publicize the constituent materials used in their products.

Technologies are internally awash with circular systems, feedback loops, and recursive processes. But science is yet to design an apparatus for the recrystallization of media into minerals, hence there is no means to metabolize all the "integral waste" (Cubitt 2017: 114) of the technosphere. We can turn rocks into cameras, but we cannot turn cameras into rocks. Having folded the planet into urban environments, scientific apparatus, and media technologies, the question remains as to how we might selectively *unfold* those actions. Might the adoption of imperatives such as "right to repair" and "design for disassembly" begin to force a technospheric circularity?

In his essay "Ecologies of Disassembly" Pierre Belanger identifies several emerging models of demanufacturing industries and urban landscape metabolisms, offering the example of resource recovery plants and case studies in Denmark, Nigeria, and Japan (2017). Through processes such as "energy cascading" (in which waste energy from one industry provides the source for another), "downcycling" (where one material is recycled into one of lesser quality) and its inverse "upcycling," Belanger (2017: 217, 239) gestures toward a potentially circular movement of resources, where waste streams are regarded as valuable sources of raw materials rather than externalities to be discarded. However, the longer-term risk of such practices becoming widespread and industrialized is that they create an ongoing demand for waste, perpetuating extractive and myopic patterns of consumption, while providing the appearance of having cured them.

In his critique of the governance and economics of waste, Cubitt (2017: 128) uses the word *inert* in an economic context, describing the effluvia of recycling as "inert economically." But in chemical and environmental terms these materials are far from inert. The toxic emissions and effluents released by the extraction of valuable metals from obsolete media have been well documented. The folding of technical instruments from mineral resources begins with chemically inert ores from which conductive and reactive metals are refined into functionality, accelerating processing speeds or aiding miniaturization. But often the larger volume is the collateral of unstable and toxic leftovers, tailings, and discards. The recovery of valuable metals from obsolete media repeats this process, separating complex compounds into two parts, the smaller of which can be folded back into the technosphere's metabolism, the larger of which remains: economically inert but ecologically volatile.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

In 2021, as my residency came to an end, work was completed on the Viridor Resource Recovery Centre in Avonmouth, six miles northwest of the furnaces in Bristol's School of Earth Sciences. Although its name obscures it, this new, strikingly brutalist building combines a waste incinerator and plastics reprocessing plant, feeding unrecyclable waste from the latter into furnaces that generate electricity that is fed back into the national grid. The site aims to process 320,000 tons of waste plastics annually, producing 307 gigawatt hours of energy, enough—it estimates—to provide for its own energy consumption and power an additional 84,000 homes. Heat alone is a crude tool for the petrification of media but, when it comes to dematerializing the excessive debris of current patterns of consumption, it is a necessary one.

Every juncture in the formation, transformation, and deformation of minerals and media discussed here is shaped by intense thermal energy. From the production of metal-rich magmas in subduction zones to their scientific synthesis in the laboratory furnaces, from the notional technofossil of my molten smartphone to the selective smelting of e-waste recycling: these thermo-critical processes are all powered either by the "high-temperature internal heat source of the planet," or by the cheap, widespread availability of geologically fossilized sources of fuel (Haff, 2012: 149). Even in the currently science-fictional proposition of a completely circular economy, the maintenance of the technosphere would remain dependent upon such energy intensive combustion to de- and remanufacture its component parts. Only time will tell if these demands can become sufficiently limited that their planetary side effects no longer preclude the ability of the biosphere to provide a habitable environment for its remaining constituent organisms.

Note

[1] The EarthArt Fellowship was funded by the Natural Environment Research Council grant "Quantifying disequilibrium processes in basaltic volcanism" (NE/N018567/1).

References

Belanger, Pierre. 2017. *Landscape as Infrastructure: A Base Primer*. London: Routledge.

Bratton, Benjamin. 2019. *The Terraforming*. Moscow: Strelka.

Cubitt, Sean. 2017. *Finite Media: Environmental Implications of Digital Technologies*. Durham, NC: Duke University Press.

Haff, Peter. 2012. "Technology and Human Purpose: The Problem of Solids Transport on the Earth's Surface." *Earth System Dynamics* 3: 149–56.

Haff, Peter. 2014a. "Humans and Technology in the Anthropocene: Six Rules." *Anthropocene Review* 1, no. 2: 126–36.

Haff, Peter. 2014b. "Technology as a Geological Phenomenon: Implications for Human Well-Being." In *A Stratigraphical Basis for the Anthropocene*, edited by Colin N. Waters, Jan Zalasiewicz, and Mark Williams, 301–9. Special publication 395. London: Geological Society London.

Klinger, Julie. 2017. *Rare Earth Frontiers: From Terrestrial Subsoils to Lunar Landscapes*. Ithaca, NY: Cornell University Press.

Parikka, Jussi. 2015. *A Geology of Media*. Minneapolis: University of Minnesota Press.

Reuter, Markus A., Antoinette van Schaik, and Miquel Ballister. 2018. "Limits of the Circular Economy: Fairphone Modular Design Pushing the Limits." *World of Metallurgy—ERZMETALL* 71, no. 2: 68–79.

Starosielski, Nicole. 2016. "Thermocultures of Geological Media." *Cultural Politics* 12, no. 3: 293–309.

Taffel, Sy. 2016. "Technofossils of the Anthropocene: Media, Geology, and Plastics." *Cultural Politics* 12, no. 3: 355–75.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

Yusoff, Katherine. 2013. “Geologic Life: Prehistory, Climate, Futures in the Anthropocene.” *Environment and Planning D: Society and Space* 31: 779–95.

Zalasiewicz, Jan. 2008. *The Earth after Us: What Legacy Will Humans Leave in the Rocks?* Oxford: Oxford University Press.

Zalasiewicz, Jan. 2016. “A Legacy of the Technosphere.” *Technosphere Magazine*, November 16. https://technosphere-magazine.hkw.de/p/A-Legacy-of-the-Technosphere-c9Qay2W4g4kLAs37V636nB.

Zalasiewicz, Jan, Mark Williams, Colin N. Waters, Anthony D. Barnosky, and Peter Haff. 2014. “The Technofossil Record of Humans.” *Anthropocene Review* 1, no. 1: 34–43.

Downloaded from http://read.dukeupress.edu/cultural-politics/article-pdf/18/3/459/1792663/459cornford.pdf by guest on 22 February 2023

Stephen Cornford is a media artist and researcher based in Bristol, UK. He is currently senior lecturer in fine art at Oxford Brookes University.