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A GEOLOGY OF MEDIA

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JUSSI PARIKKA

Electronic Mediations, Volume 46



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1
MATERIALITY
GROUNDS OF MEDIA AND CULTURE

> The future is out there on the permafrost.
>
> —THOMAS PYNCHON, *THE BLEEDING EDGE*

> Technology . . . constitutes the abyss of the Anthropocene.
>
> —ERICH HÖRL

An Alternative Media Materialism

To label yourself a materialist does not necessarily by itself mean much. The term is something that demands explication, instead of explaining by its own powers. The long histories of materialism and idealism in philosophy are one reference point, but so are the everyday uses of the term: do we refer to it as the opposite of spiritual or ethical (as in expressions of disgust toward the materialist aspects of consumer society) or refer to the reality of machines and technology that structure our life. The Marxist legacy in political thought and theory has given us indication what historical materialism is, but so have scholars in media theory: media materialism refers to the necessity to analyze media technologies as something that are irreducible to what we think of them or even how we use them. It has come to refer to technology as an active agent in the ontological and epistemological sense. In other words, media structure how things are in the world and how things are known in the world. In fact, media analysis is an excellent way of "giving material specificity to

our descriptions of . . . abstract concepts"[1] of which materiality is oddly enough too easily one.

Cultural and media theory have benefited in the past years from an emergence of several accounts of materiality. In media theory, materialism has often been attached to the term *German media theory*—a term that has brought unity to a wider field of scholars engaging with material accounts of media culture in rather different ways.[2] Friedrich Kittler is the most famous reference in this context. Kittler inaugurated various provocations regarding computer culture, hardware, and the technological framing of our contemporary life, which implied a certain nonhuman perspective: the human being is primarily a "so-called Man" formed as an aftereffect of media technologies. At times, Kittler was even branded a media archaeologist because he picked up on Michel Foucault's archaeological and archival cultural history in a new way in his early work.[3] There's a truth to that label: Kittler was adamant that we need to make sure that Foucault's understanding of what governs our contemporary life—its archive—is not only about the statements and rules found in books and libraries. Instead, it is to be found in technological networks of machines and institutions, patterns of education and drilling: in the scientific-engineering complex that practices such forms of power that the traditional humanities theory is incapable of understanding or grasping if it continues to talk about hermeneutic meanings or persists to operate with traditional sociological concepts. Kittler was a *provocateur* in a theoretical psy-ops operation who believed that humanities scholars should work with technology. He himself did. Kittler left behind unpublished writings but also software manuals and hardware, to be part of his *Nachlass.* His early synthesizer from the 1970s was resurrected and included in an art performance by Jan-Peter Sonntag to demonstrate this metamorphosis of Kittler: the Goethe scholar turned synth-geek and tinkerer.

At times in accusing, pejorative ways, and at times in more celebratory tones, the likes of Kittler became an emblem of media materialism: to study media, you need to have a proper understanding of the science and engineering realities that govern the highly fine-structured computer worlds in which we live—without ignoring the fact that technical media did not start with the digital. Older technical media play an important part in the histories and genealogies, the archaeological layers conditioning

our present. Media archaeology has been one field to constantly emphasize this point.

For Kittler, media studies was never to be reduced to the play of interpretations, semiotic connotations, or modes of representation, which were only secondary effects, second-order phenomena. Media work on the level of circuits, hardware, and voltage differences, which the engineers as much as the military intelligence and secret agencies gradually recognized before humanities did. This mode of argumentation ignored, however, a wide range of politically engaged work that tried to make sense of why media govern us humans on a semiotic level too. Such creeping suspicions that any inclusive account of materiality definitely filtered out many competing ones triggers the question, what is being left out? What other modes of materiality deserve our attention? Issues of gender, sex, embodiment, and affect? Of labor, global logistics, modes of production? In other words, from where do our notions of materiality stem, and what is their ground?

What if there is another level of media materialism that is not so easily dismissed as we would think? What if media materialism is not something that hones in on the machines only? Where do machines come from, what composes technology in its materiality and media after it becomes disused, dysfunctional dead media that refuse to die? This book is structured around the argument that there is such a thing as *geology of media*: a different sort of temporal and spatial materialism of media culture than the one that focuses solely on machines or even networks of technologies as nonhuman agencies. It echoes John Durham Peters's point that the axis of time and space—familiar also from the Canadian media theory tradition of Harold Innis and Marshall McLuhan—is not restricted to traditional ideas about media as devices but can refer back to cosmology and geology: that the geological sciences and astronomy have already opened up the idea of the earth, light, air, and time as media.[4]

This is a green book—in the sense of referring to the ecological contexts in which we should make arguments about media technological culture—as well as a book covered in dirt and soil. Instead of leafy metaphors of animals, technology, and ecosystems, it insists on a particular aspect of this relation between media and the geophysical environment. Scholars such as Douglas Kahn have recently made the same point that

Kittler's agenda could have been more radical and continued from the circuits to what enables hardware: the environmental contexts, questions of energy consumption, and, one could add, the electronic waste that surround our contemporary worries of what transmission, calculation, and storage mean in a material context.[5]

The guiding conceptual ground of this book refers to geology: the science about the ground beneath our feet, its history and constitution, the systematic study of the various levers, layers, strata, and interconnections that define the earth. It implies the work of geoengineering and geotechnics as specific ways of interacting with the solidity of the earth but also the fine measurements that relate to a wider awareness of the environmental constitution of our lives. Hence geology is not only about the soil, the crust, the layers that give our feet a ground on which to stumble: geology is also a theme connected to the climate change as well as the political economy of industrial and postindustrial production. It connects to the wider geophysical life worlds that support the organic life as much as the technological worlds of transmission, calculation, and storage. Geology becomes a way to investigate materiality of the technological media world. It becomes a conceptual trajectory, a creative intervention to the cultural history of the contemporary.

Geology and various related disciplines and fields of knowledge, such as chemistry and, indeed, ecology, frame the modern world and give it one possible scientific structure. Such disciplines are strongly implied in the emergence of the technological and scientific culture, which feeds to our media cultural practices. It is in this sense that I am interested in finding strains of media materialism outside the usual definition of media: instead of radio, I prefer to think what components and materials enable such technologies; instead of networking, we need to remember the importance of copper or optical fiber for such forms of communication; instead of a blunt discussion of "the digital," we need to pick it apart and remember that also mineral durations are essential to it being such a crucial feature that penetrates our academic, social, and economic interests. Consider, then, lithium as such a premediatic media material that is essential to the existence of technological culture but also as an element that traverses technologies. This chemical element (Li) and metal is essential for laptop batteries as well as future green technologies (again, battery

technology, but for hybrid cars). Platinum-grouped metals might be familiar from jewelry but are as important for "computer hard drives, liquid crystal displays, and miniaturized electronic circuits"[6] as for hydrogen fuel cells. Lots of critical materials are in a crucial position in relation to a variety of civilian and military technologies, including what we tend to call just bluntly "media": screens, networks, computers, and more. Tracking chemicals, metals, and minerals is one aspect of this book, extending traditional notions of media materialism into a more environmental and ecological agenda.

Artist Robert Smithson spoke about "abstract geology," referring to how tectonics and geophysics pertain not only to the earth but also to the mind; abstract geology is a field where a geological interest is distributed across the organic and nonorganic division. Its reference to the "abstract" might attract those with a Deleuzian bent and resonate with the concept of "abstract machines." But before the philosophical discourse, Smithson's interest was in the materiality of the art practice, reintroducing metals (and hence geology) to the studio. What's more, Smithson was ready to mobilize his notion emerging in the artistic discourse of land art in the 1960s to a conceptualization of technology that we can say was nothing less than anti-McLuhanian: instead of seeing technology as extensions of Man, technology is aggregated and "made of the raw materials of the earth."[7] From our current twenty-first-century perspective approximately fifty years later, it starts an imaginary alternative media theoretical lineage that does not include necessarily McLuhan, Kittler, and the likes in its story but materials, metals, waste, and chemistry. These materials articulate the high-technical and low-paid culture of digitality. They also provide an alternative materialism for the geophysical media age.

So how does a media theorist turned pseudo-geologist operate? To where does such a hybrid and hyphenated scholar turn? At least in this book, this leads us to track the importance of the nonorganic in constructing media before they become media: the literal deep times and deep places of media in mines and rare earth minerals. It looks at aesthetic discourses and practices, such as psychogeophysics—a sort of speculative aesthetics for the connection of technology and society with a special view to the geophysical—that offer insights to earth media arts.[8] The amount of material would be endless if one were to start looking

meticulously at the work of national institutions and geological methods. Geological surveys have moved on from the early work contributing to agriculture and mining to being an essential part of global geopolitics. One can track specific genealogies of geology, politics, and technology even through single institutions, such as the influential scientific agency the U.S. Geological Survey.[9] Since its founding in the latter half of the nineteenth century, it has served an essential role in mapping the necessary natural resources part of nation building into a technologically advanced country—and now, one can see how the role has widened to a global scale; for instance, in Afghanistan, in parallel to the military operations of the war against terrorism, geologists are mapping the resource basis of the country. It promises, besides copper, iron, and gold, also lithium—even enough for Afghanistan to be branded the "Saudi Arabia of lithium." Old geological surveys and methods are being complemented with aerial surveys by geologists collaborating with the Pentagon by using new gravity and magnetic measuring techniques.[10]

To summarize the preceding preamble, this is a book about technical media culture—digital and analog—that starts from the geophysical. It investigates, employs, and mobilizes terms that refer to the geophysical—that is, not just geopolitical—spheres of media culture in a manner that is a combination of conceptually speculative but thematically and media historically grounded. In other words, a part of the book works through historical sources and examples, but with an emphasis on media arts. Indeed, it is the lens of media art practices and theoretical discourse that offers us a specific way to look at the recent years of climate change, the Anthropocene, and geophysics-embedded work: the ideas about deep time of the media,[11] psychogeophysics, e-waste, the Anthropocene, chemistry, and the earthly as a media history that works in nonlinear ways. This idea of media (art) histories as one of nonlinear strata pushes even the media archaeological agenda of media history to its extreme. Human history is infused in geological time.[12]

Temporality and Medianatures

Among the variety of theories and methods in media studies debates of the past years, media archaeology has become a way to multiply and bend traditional media historical methods to incorporate new ways of

grasping the history of oddities, losers, and, more generally, conditions of media culture. It maps the real imaginary of how fantasies of media become part of the real technological projects and how media aesthetics contributes to new forms of political design of culture. Media archaeological writings from Erkki Huhtamo to Wolfgang Ernst, Friedrich Kittler to Siegfried Zielinski, Thomas Elsaesser and many others have offered an exciting tool kit that expands what we even think of as media technologies.[13] But media theory relates to notions of temporality as well: the various different approaches are not only about material objects but how we think of (media cultural) temporality—media time that is recurring and based on topoi; the idea of deep times that will be addressed and radicalized in this book; the focus on microtemporalities that define technical media culture on the level of machines and technological processes; the recursive methodology of time and the expansions of new film history into media archaeology in ways that offer new sets of questions and bootstrap a new sense of media historical time. All of these are examples of media archaeology as executed media philosophies of time, which offer an important subcurrent to thinking about materiality.

In Wolfgang Ernst's media archaeology and media archaeography, the focus is on microtemporalities and time-critical aspects of especially computational media. Ernst's focus on the agency of the machine as a temporal regime that forces a reconsideration of media historical macronarratives works in alternative ways. The methodological mode of media history based on writing has to encounter the specific *Eigenzeit*[14] of the machine: how technological culture and its specific instance in machines are not just *in* time but also fabricate time. The revolution speeds of hard drives, clock times of computers, network pings, and so forth are examples of the temporalities in which machines themselves are embedded and which they impose on the human social world. Machines don't just write narratives: they calculate. In Ernst's words, the difference between this sort of media archaeology and media history is this: "A computing culture, from a media-archaeological view, deals not with narrative memory but with calculating memory—counting rather than recounting, the archaeological versus the historical mode."[15]

But then there is the other pole of extremely long durations. As we engage with in more detail in chapter 2, Zielinski's adoption of the concept

of deep time to media art discourse has offered a way to think and operate like a geologist of media art culture. For Zielinski, this concept has been a way to bypass the short-term "psychopathological" capitalist media discourse to understand that the interactions between media, art, and science have long roots. Indeed, Zielinski was after ways of modulating seeing and hearing before we historically rather recently thought to call them media.[16]

In stories of inventions by Empedocles, Athanasius Kircher, and many others, Zielinski uncovers the layered history that offers a way to engage with the past that is suddenly animated in front of our eyes and more alive than the repetitious advertising-based digital media innovations. Zielinski's deep time is a methodology that bypasses the narrative of definite origins and is interested in the quirky variations within media history. There is an archaeological urge to dig out the uncovered, the surprising, the anomalous, and in Zielinski's hands, this digging takes on the geological and paleontological concepts. But what if this notion based in geological time needs further radicalization? Indeed, what if we should think more along the lines of Manuel Delanda's proposition of thousands of years of nonlinear history and expand to a geology of media art history: thousands, millions of years of "history" of rocks, minerals, geophysics, atmospheric durations, earth times, which are the focus of past decades of intensive epistemological inquiry and practical exploitation as resources—things we dig from the (under)ground, the harnessing of the atmosphere and the sky for signal transmissions, the outer space for satellites and even space junk, as a new extended geological "layer" that circles our planet, like Trevor Paglen reminds us in his photographic performance/installation *The Last Pictures,* which takes place in the orbit around the Earth[17] (see Figure 1; see also chapter 5). If the emergence of industrialization since the nineteenth century and the molding of the environment with mines, smelting facilities, and sulfur dioxide from coal energy was addressed by poets who either in adoring ways or critically narrativized the dramatic aesthetic and ecological change, our contemporary technological arts do similar work, although often also engaging directly with the material world of geophysics in their practice.

This geophysical media world manifests itself in contemporary arts. This book covers examples of projects from Paglen to microresearchlab

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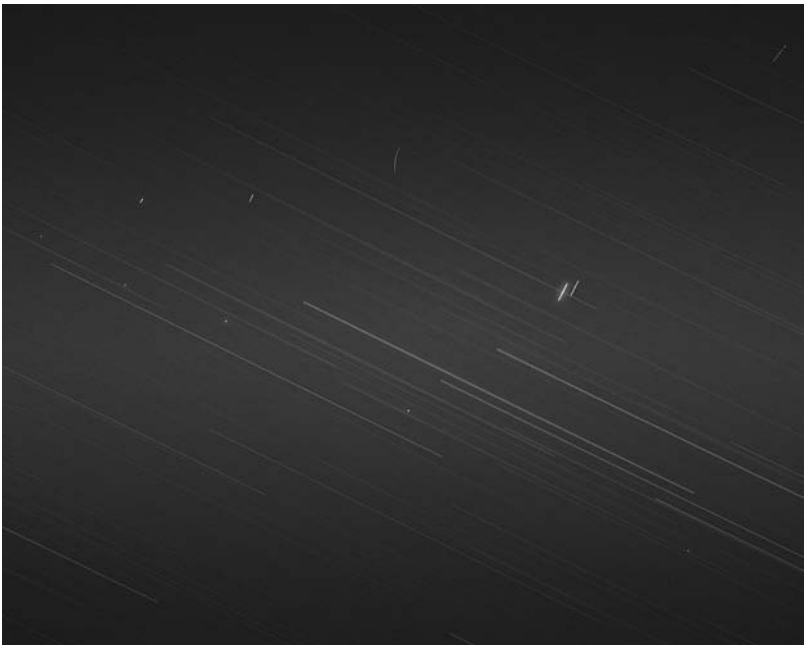


Figure 1. Trevor Paglen, *Spacecraft in Perpetual Geosynchronous Orbit, 35,786 km above Equator,* 2010 (detail, part 2 of diptych). The artist was also interested in orbital technologies as an extension of the geologic in his earlier *Artifacts* series. Courtesy of the artist; Metro Pictures, New York; Altman Siegel, San Francisco; Galerie Thomas Zander, Cologne.

(Berlin), from technological fossil installations to the work of earthquake sonification. Indeed, sound is one way to characterize the deep time media aesthetics and its epistemological background. The earth roars and has a sound. It was something realized already in the 1950s when Emory D. Cooke released his *Out of This World* vinyl LP containing earthquake soundscapes[18] and then later by media artists as well as theorists such as Kittler. The following quotation from Kittler illustrates that with the technologies of time-axis manipulation, also the long duration slowness of geophysics—often too slow, or otherwise working in frequencies inaudible and invisible for human perception—becomes part of our aesthetic experience:

> Take an earthquake like the one in Kobe with thousands of casualties, seismographically record its inaudible slow vibrations, replay

> the signals of the entire horrific day in ten seconds—and a sound will emerge. In the case of earthquakes that, like those in the Pacific, result from the clash of two tectonic plates, the sound will resemble a high-pitched slap, in the case of those that, like those in the Atlantic, are the result of the drifting apart of two continental plates, it will, conversely, sound like a soft sigh. Thus, the spectrum, that is, a frequency composition, gives the violent events timbre or quality: America becomes Asia. A short time ago I was privileged to hear the timbre of such quakes and I will not forget it for the rest of my life.[19]

Geophysics was already earlier adopted as part of the aesthetic practices and vocabularies of the avant-garde. With a meticulous documentation with a special emphasis on the electromagnetic, Douglas Kahn demonstrates how this connection of the earth and the avant-garde composers ranged from Alvin Lucier's experiments to Pauline Oliveros's *Sonospheres.* Electronic music studios became allies with nature—or at times also demonstrated the obsolescence before their time of even having the need for an electronic music studio: it's all existing already, in our brains, in nature.[20] An aesthetics that comes from the vibrations of nature is a theme running through certain Deleuzian-inspired accounts—foremost among them Elizabeth Grosz's[21]—but it is also a way to tap into the geophysical as an affordance for what we call "media." Indeed, no wonder that we can summon the ideas of such physical nature like the Schumann resonances—a concept that "ties low-frequency electromagnetic resonances of the entire earth"[22] with New Age discourse: the earth is a living entity with a specific frequency range. This obviously is one variation of the more scientific arguments for the Gaia hypothesis, which offers one important background for any conceptualization of the earth, of life, and which was preceded by the much older idea of terra mater: "From classical antiquity to the eighteenth century it was widely believed that stones and metals grow beneath the earth like organic matter."[23]

But still in our scientific worldview, the idea of organic and nonorganic life entwined resurfaces. In poetic words of paleontologists such as Richard Fortey—"life made the surface of the Earth what it is, even while it was Earth's tenant"[24]—we must underline the interaction of biological and physical determinants in molding the planet. We can also extend to a realization that pertains to cultural reality and media cultural practices

and techniques. Such are earth's tenants, and yet effectively contributing to the way in which the planet is being seen, used, and modified. We need to be aware how carefully grafted concepts are able to catch the variety of practices that work across traditional disciplines and connect issues of nature and culture. The effect of the planet earth as seen from space since late 1960s space travel started demonstrates how visual media contribute to scientific concepts. The planetary vision—of a holistic organism as much as an object of military and scientific technologies of transportation and visualization—was part of why scientists from James Lovelock to Lynn Margulis contributed to the wider discussions of feedback mechanisms. But it also signaled a shift from James Hutton's *Theory of the Earth* (1788) to media of the earth, executed by means of technologies and media—of visualization techniques revealing the earthrise from the moon but also the galaxy from new perspectives. What's more, the trip to the moon included the Apollo lunar module bringing back geological samples,[25] a dream not altogether disappeared: the promise of mining helium-3 important for another energy revolution could be seen only as a natural continuation of the planetary politics of nation-states and corporations such as Google into interplanetary dimensions.[26] Such speculative accounts have even spoken of Russian moon colonies established by 2030 as part of the current geopolitical race for resources.[27]

The mediated vision turned back on the earth itself was instrumental to a whole new range of social and scientific agendas. Visions of the earth from the moon since the 1960s but also the technological gaze toward deep space with Hubble were never *just* about space and its interplanetary objects but as much about mapping such entities as part of the corporate and national interest. Geographical surveys benefited from the developed lenses and image processing of satellite-enabled remote sensing.[28] The perspective back to the globe has prompted the existence of corporate maps such as Google Earth and a massive military surveillance system too. And in ecological contexts, it enabled a way to capture the Gaia concept's force as a way to understand the various layers where the biological and the geophysical mix. In Bruce Clarke's words,

> from the co-evolution of living systems with the totality of their terrestrial environment, Gaia emerged as a meta-system of planetary self-regulation maintaining viable conditions of atmospheric

> composition, temperature, oceanic pH and salinity, and of the global distribution of organic nutrients such as nitrogen, sulfur, and potassium. The biosphere performs like any living organism with a complement of homeostatic feedback mechanisms for maintaining geophysiological functions at healthy levels. Gaia theory is an indispensable framework for thinking about global climate change because it is only by recognizing Gaia's multi-systemic self-regulation that we can fully understand what we are now facing—the imminent failure of those regulating systems.[29]

From systems emblematic of the post–World War II cybernetic culture to earthquakes: what might be an unforgettable aesthetic experience for a German media theorist is an important epistemological framework for geophysical research. Such media and aesthetic methods prepare the earth to become knowable and intelligible. I want to underline the following argument: there is a double bind between the relations of media technologies and the earth conceived as a dynamic sphere of life that cuts across the organic and the nonorganic. It is also increasingly framed as standing reserve in the Heideggerian vocabulary: a resource for exploitation, and viewed as resource, *ordered* to present itself.[30] This is where dynamics of vibrant life meet with the corporate realities of technologized capitalism that is both a mode of exploitation and an epistemological framework.

Our relations with the earth are mediated through technologies and techniques of visualization, sonification, calculation, mapping, prediction, simulation, and so forth: it is through and in media that we grasp earth as an object for cognitive, practical, and affective relations. Geological resources used to be mapped through surveys and field observation, now through advanced remote sensing technologies.[31] They are in a way extensions of Leibniz's universal calculus, which offered one way to account for the order of the earth, including its accidents like earthquakes (such as the infamous 1755 in Lisbon). But as Eyal Weizmann suggests, this calculation of the earth is now less divine and more about the "increasingly complex bureaucracy of calculations that include sensors in the subsoil, terrain, air, and sea, all processed by algorithms and their attendant models."[32] Similarly, practices of meteorology are mediatic techniques that

give a sense of the dynamics of the sky;[33] geology is an excavation into the earth and its secrets that affords a view not only to the now-moment that unfolds into a future potential of exploitation but also to the past buried under our feet. Depth becomes time. A tape recorder tracks the slow roar of the earthquake—like already in the 1950s practices of measurement, fascinating in regard to the effects of nuclear detonations as well as earthquake trembles, making them a media object: "Through the tape recorder, earthquakes and explosions became portable and repeatable."[34] In some ways, we can also say that this means the portability and repeatability of the Real: the geophysical that becomes registered through the ordering of media reality.[35]

And conversely, it is the earth that provides for media and enables it: the minerals, materials of(f) the ground, the affordances of its geophysical reality that make technical media happen. Besides the logic of ordering, we have the materiality of the uncontained, and the providing, that is constantly in tension with the operations of framing. This double bind—which I call the sphere of medianatures—is the topic of this book, with a special focus on geology and the geophysical.

Despite some references, I am not really opting for the Heideggerian route, however useful his comments on standing reserve and ordering might be. Instead, medianatures is a variation on Donna Haraway's famous and influential concept of naturecultures.[36] The term is for Haraway a way to understand the inherently interconnected nature of the two terms that in Cartesian ontology were separated across the field of the infamous binaries: nature versus culture, mind versus matter, and so on. In Haraway's terms, we are dealing with a more entangled set of practices in which it is impossible to decipher such spheres separately. Instead, naturecultures implies the ontological need to take into account the co-constituted relationships in which

> none of the partners pre-exist the relating, and the relating is never done once and for all. Historical specificity and contingent mutability rule all the way down, into nature and culture, into naturecultures.[37]

This topological conceptualization that remains sensitive to "historical specificity" is an important way to talk about the related notions of "material-semiotic" and "material-discursive" spheres as underlined in

recent new materialism.[38] Medianatures is meant to incorporate a similar drive but with a specific emphasis on (technical) media culture. It is a concept that crystallizes the "double bind" of media and nature as coconstituting spheres, where the ties are intensively connected in material nonhuman realities as much as in relations of power, economy, and work. Indeed, it is a regime constituted as much by the work of microorganisms, chemical components, minerals, and metals as by the work of underpaid laborers in mines or in high-tech entertainment device component production factories, or people in Pakistan and China sacrificing their health for scraps of leftover electronics. Medianatures is a useful concept only when it scales down to the specific instances of material-discursive events.

Ties and relations of medianature are often revealed in some of the extreme contexts of exploitation and environmental damage. Electronic waste, resource depletion, and globally unevenly distributed relations of labor are such instances where art vocabularies turn to medianatures. This is a refashioning of the underground from avant-garde to geology, geophysics, and political economy. To use Sean Cubitt's words referring to planned obsolescence: "the digital realm is an avant-garde to the extent that it is driven by perpetual innovation and perpetual destruction."[39]

The underground is another important topographical site for geology of media (arts). The underground is the place of hell—itself defined in Western mythology by its chemistry: the smell of sulfur, and the killing poisons of carbon dioxide, which is why since Virgil's *Aeneid* the Underworld is marked by death to any animal approaching it.[40] The underground is at the crux of technological imaginary of modernity—a place of technological futures since the nineteenth century as well as the artistic avant-garde outside the mainstream.[41] Going underground happens in spy stories as well as in postapocalyptic scenarios, whether earlier ones such as Gabriel Tarde's *The Underground Man* (1904/1905)[42] or post–World War II nuclear anxiety. Lewis Mumford sees mining and the underground as ideal cases to understand modern technology: he names this turn toward nonorganic technological nature as paleotechnics. It starts so in the foundational scenes of modern capitalism, where mining is inherently linked to projects demanding extensive amounts of capital, as well as itself enabling the further buildup of significant technological

industries. Scenes of burrowing down to the earth and digging penetrate now also the urban sphere in constant upheaval, a constant rebuilding and opening of depths. Rosalind Williams points this out: "Between the late 1700s and early 1900s, the ground of Britain and Europe was dug up to lay the foundations of a new society. Subterranean images became familiar sights during that period: workers sinking picks into the soil, city streets slashed down the middle, whole industrial regions turned into minelike terrains."[43] A new infrastructural world was born, one that recircuits as part of the contemporary planetary moment, which weaves together labor and the earth.

For Mumford, paleotechnics refers specifically to the age of coal mining and its social and aesthetic consequences preceding the neotechnic age of electricity characterized by much lower energy transmission costs and a different scientific setup of society. However, one can say that in a different way, the paleotechnic persists from the eighteenth and nineteenth centuries into the twenty-first. New forms of energy distribution, synthetic materials with the advancement of chemistry, as well as the new methods in metallurgy that Mumford sees as a shift from the paleotechnic to the neotechnic gradually since the late nineteenth century and gradually during twentieth century[44] are still, I argue, grounded in the wider mobilization of the materiality of the earth as part of industrialization, technology, and also media technological culture.

As a perspective of the modern variations of the underworld as a place of hard work, approach it through Mika Rottenberg's video piece *Squeeze,* featured at the Istanbul Biennial 2013. The video is a single-screen narrative that unfolds into a spatial underground machine of sorts in which female workers of different ethnicities participate without direct relation or knowledge of each other. As a classic depiction of a capitalist mode of production and alienation, Rottenberg's video is effective. But it also engages with the materialities and spatialities in such a way to merit special attention: the work of lettuce pickers on the field leads through the lettuce rolls to an underground factory, where different departments, work practices, and surreal procedures (a tongue sticking out of the wall, just to be sprayed with water in regular intervals to keep it wet) combine into a machine articulating heterogeneous elements of an oddly functioning assemblage. The machine is itself a processing of materiality just to

produce it as a piece of waste in the end, consisting of blush, rubber, and lettuce. Here the underground becomes a spatial arrangement to highlight the separated sphere of production that underlies our feet and is detached from our direct perception but maintaining the everyday practices. The underground is the place of repetitious, exploitative, and even absurd work of arrangements and rearrangements of partial objects without a view of the big picture. Labor alienation is expressed in terms of aesthetics of odd parallel realities. It is the sphere of material processing, and both of the earth and the human labor as standing reserve. It is a gendered zone as well, and Rottenberg's work is an important guide and an analogy to what I pursue in *A Geology of Media*: starting the excavations of contemporary materiality of media arts from beneath your feet, from the Underworld.

Rottenberg's video constitutes a recap of something that was expressed in *Punch* magazine in 1843 in a satirical image "Capital and Labour," which shows what orchestrates the modern life: the hidden underground machinery of workers (Figure 2). It expresses a link between the imaginary of the underground in the nineteenth century and the more recent versions of aesthetics of labor and the down under. The visible reality is sustained by complex and absurd arrangements of work and infrastructure that is itself an arrangement of human and technological components. However, the underground of industrialization and capitalism rests as part of the geology of the earth.

The Anthrobscene

The Anthropocene is one of the leading concepts that brought a geological awareness to climate change discussions of the past years and decades. Suggested by the Nobel Prize–winning chemist Paul J. Crutzen more than ten years ago[45] and preceded more informally by Eugene Stoermer in the 1980s, the term is a sort of placeholder for the contemporary moment that stretches from the 1700s or the 1800s to the current time. It performs this cartography from a geological perspective, which argues for a sort of a holistic but analytical view to the changes in our life world. Following the Holocene, the accepted term for the geological period of the past ten thousand to twelve thousand years, the Anthropocene refers to the massive changes human practices, technologies, and existence

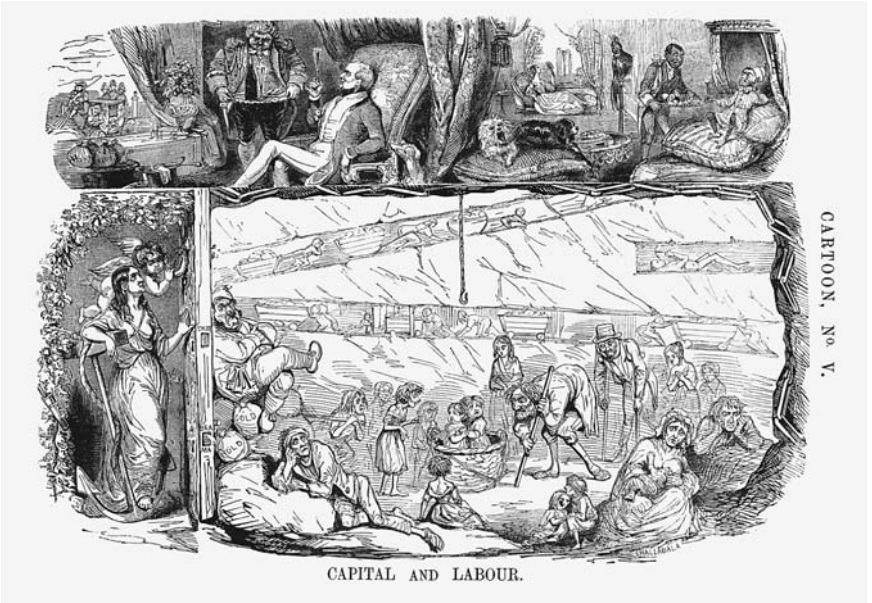


Figure 2. "Capital and Labour, Cartoon, No. V." A satirical image from 1843 in *Punch* (volume 5) underlines the ontology of labor as one of underground: capitalism works in the depths to find an infrastructural level that sustains the pleasant consumerized life above the ground and yet stays invisible. Reprinted with permission of *Punch* magazine.

have brought across the ecological board. The concept, which is not scientifically universally accepted,[46] takes aboard the cross-species and ecological ties human activity has been developing: the concept speaks to the relations with other animals—for instance, domestication of the dog—and the various techniques of living, primarily agriculture and fire, which have had massive influence over thousands of years. But the Anthropocene—or the *Anthrobscene,* to use a provocative combination of the term with the addition of a qualifying "obscene"[47]—starts to crystallize as a systematic relation to the carboniferous: the layers of photosynthesis that gradually were being used for heating and then as energy sources for manufacture in the form of fossil fuels. In China, the use of coal and the emergence of significant coal mines go back to the Song Dynasty (960–1279), only later followed up by key centers such as in England.[48] More significantly, the move from local and regional use of such resources emerges with industrialization and the triangulation of fossil fuels as energy source, technology,

and wealth creation related to the new capitalist order. The economic order was from its start an energetic one, reliant on the slowly accumulated resources of coal, oil, and gas. Fossil fuels such as oil were essential for the smoother and quicker planetary movement of energy compared to coal. In this sense, globalization, too, as a form of transported planetarization, has been based on logistics of energy.[49] In short, one could claim that capitalism had its necessary (but not sufficient) conditions in a new relation with deep times and chemical processes of photosynthesis:

> Hitherto humankind had relied on energy captured from ongoing flows in the form of wind, water, plants, and animals, and from the 100- or 200-year stocks held in trees. Fossil fuel use offered access to carbon stored from millions of years of photosynthesis: a massive energy subsidy from the deep past to modern society, upon which a great deal of our modern wealth depends.[50]

The concept of the Anthropocene features technology from the start: Crutzen starts with James Watt's steam engine as one key feature of the Anthropocene, illustrating how it is a concept where geophysics ties in with cultural techniques. What's more is the link of escalating proportions that one can follow up with technology and energy as some of the driving forces of geological proportions. This actually quickly cascades into realization of the economic and social ties but also toward the interlinks between energy, technology, and chemistry. Indeed, we should not neglect the list of chemical issues that the notion of the Anthropocene marches onto the stage, from Crutzen's first text moving swiftly from Watt to issues of methane, carbon dioxide, sulfur dioxide, nitrogen, nitric oxide, and more.[51] Indeed, the mythological smell of Sulfur of Hell is replaced by a twentieth- and twenty-first-century version of acid rain, consisting of sulfur dioxide that results, among other processes (including volcanic eruptions), from smelting of metal ores and the use of fossil fuel.[52]

I am fascinated with the possibilities of unfolding media and technology through chemistry: an elemental "periodic table" approach to modern scientific materiality. It is clearly one of the issues that any exposition of the relations of the Anthropocene and (media) technologies should take into account. This is a theme crystallized by Steffen, Crutzen, and McNeill:

> Fossil fuels and their associated technologies—steam engines, internal combustion engines—made many new activities possible and old ones more efficient. For example, with abundant energy it proved possible to synthesize ammonia from atmospheric nitrogen, in effect to make fertilizer out of air, a process pioneered by the German chemist Fritz Haber early in the twentieth century. The Haber-Bosch synthesis, as it would become known (Carl Bosch was an industrialist)[,] revolutionized agriculture and sharply increased crop yields all over the world, which, together with vastly improved medical provisions, made possible the surge in human population growth.[53]

The metal, chemical, and mineral agents of history become pushed from mere contextual insights to agents of a different sort of genealogy. Besides being observable through the scientific eye, and the apparatus of measurement, which gives verifiability to the analyses in geology, ecology, and the environmental sciences, such aspects have implications for how we approach technology in the humanities. In history-disciplines, the methodological and thematic expansion of topics has already included nonhuman issues through environmental concerns, primarily William McNeill's work, as well as John McNeill's.[54] Environmental themes become a way to articulate a global history that offers a complementary narrative to globalization, as told through the media technological and capitalist expansion of trade, travel, and communication routes over the past centuries, accelerating the past decades. And it offers a way to account for the scientific definition of media in the environmental disciplines: this completely different understanding of media of land, air, and water is, however, a necessary aspect of our more arts and humanities way of understanding media technologies, as this book demonstrates.

In more theoretical terms, I already mentioned the work of Delanda as a way of looking at the assemblages of nonhuman kind that work through Deleuze and Guattari's geological arguments. More recently, Dipesh Chakrabarty has influentially argued for a renewed and shared agenda between natural history and the more human-centered histories (which we could say include cultural history and media history). In Chakrabarty's words, it is crucial that we interrogate the horizon of the Anthropocene as having effects on our historical sense of being too.

This humanities approach is now also recognizing the importance of biological and geological contributions as part of the social collective. This includes the realization that humans are also biological and geological agents[55] but also that, to understand the wider patterns of the social, we need to resist the old-fashioned methodological dualisms haunting disciplinary thinking of the past. But Chakrabarty's elegant and important text includes a further twist that brings such insights into proximity with postcolonial critiques of globalization as well as analysis of the political economy of capitalism. In short, we need to be able to find concepts that help the nonhuman elements contributing to capitalism to become more visible, grasped, and understood—as part of surplus creation as well as the related practices of exploitation. This historical mapping of the environmental is also a mapping of the historical features of capitalism as a social and technological planetary arrangement.

This critical mapping is a matter of vocabularies we use (the insufficient manner of using the term *species* to refer to the human impact on the earth system) and the necessity for a specification of the scientific concepts too:

> At the same time, the story of capital, the contingent history of our falling into the Anthropocene, cannot be denied by recourse to the idea of species, for the Anthropocene would not have been possible, even as a theory, without the history of industrialization.[56]

The stories we tell imply more than just their words; they tell stories of media and mediation, of materiality and the earth. The stories are themselves of a scale of geological durations that are at first too slow to comprehend. This demands an understanding of a story that is radically different from the usual meaning of storytelling with which we usually engage in the humanities. This story is more likely to contain fewer words and more a-signifying semiotic matter[57] that impose a presence especially in the current era of crisis to which we refer as the climate change.

Concepts in crisis seek to make sense of change while signposting the necessity for different vocabularies.[58] Hence use of surprising perspectives as well as provocations is needed, as is the work of concepts that travel across disciplines.[59] One implicit concept behind this book is

Deleuze and Guattari's pre-Anthropocene notion of "geology of morals." It is part of the set of geophilosophy that the French duo mobilized as a way to offer nonlinguistic concepts for cultural reality entangled with other regimes of the material. More accurately, such sets offered ways to bypass the linguistic accounts of making sense of cultural reality with different concepts, including the abstract machine and the geologically tuned ones. Notions of strata, sedimentations, double articulations, and an alternative to the signifier-signified-model are introduced as a way for a postanthropocentric theory.[60] The geological thought that one finds in *A Thousand Plateaus* and later in *What Is Philosophy?* is a way of accounting for the material production of meanings in relation to their a-signifying parts: a sort of assemblage theory of material practices. Deleuze and Guattari's philosophy maps the geology of thought, which moves from the geophilosophical territories in which thinking happens in relation to the grounds, undergrounds, and territories where the immaterial events of thinking and affect are always tied to stratified assemblages.[61] "Thinking is neither a line drawn between subject and object nor a revolving of one around the other. Rather, thinking takes place in the relationship of territory and the earth."[62] Thinking is here stretched as more of a movement of multiplicities that pertains to territories rather than as a cognitive faculty restricted to already formed human subjects. This notion of geophilosophy attaches thinking to its conditions of existence, which are, however, always immanent to the event of thought itself.

Such geologically oriented ways of understanding thinking resonate with the wider thrust of "ecosophy" one finds in Guattari's writing and which has been mobilized in the recent media ecology discussions.[63] The notion of geology and (un)grounds has triggered important recent philosophical discussions from Deleuze and Guattari to the nineteenth-century thought born in the midst of emerging mining cultures, for instance, F. W. J. Schelling or the "chemical thought" of Friedrich Schlegel.[64] The early nineteenth century lived in an enthusiasm for the mine, mining, and the underground—both poetically across England and Germany and in political economy of mining.[65]

In philosophical terms, the geological becomes a way to interrogate in a material and non-human-centered way the constitutive folding of insides and outsides and the temporal regimes involved in (media) culture.[66] What

is interesting is how, across the various debates, in all their differences, what is being carved out is, besides a geological-ontology (geontology?), also something that can be rolled out as a methodology. For instance, in Iain Hamilton Grant's Schelling-focused writings, it is spelled out in a manner that relates it to a material stratification of genealogy turning geology:

> Thus the earth is not an object containing its ground within itself, like the preformationists' animal series; but rather a series or process of grounding with respect to its consequents. If geology, or the "mining process," opens onto an ungroundedness at the core of any object, this is precisely because there is no "primal layer of the world," no "ultimate substrate" or substance on which everything ultimately rests. The lines of serial dependency, stratum upon stratum, that geology uncovers do not rest on anything at all, but are the records of *actions* antecedent in the production of consequents.[67]

The seemingly stable groundedness of the earth reveals through the modern practices of mining (and one should not neglect their relation to the hypercapitalist exploitation of the earth itself on a massive technological level) another sort of an ontology that resonates with the logic of capitalism as articulated by Deleuze and Guattari: the shifting ungrounds that they call the axiomatics of capitalism, which work through a constant deterritorialization of established territories, like a massive geoengineering project burrowing through formed lands, territorializing them in novel ways. No wonder that the geological itself turns out to be more defined by its holes, mines, and the lack of one final determining stratum; instead, what one finds are the various "records of actions," which, in the case of this book, are translated as the epistemological and technological workings on/with the geophysical.[68]

The metallurgical is another geocentric concept Deleuze and Guattari mobilized as a form of "minor science" of new materialism that teases out the potentialities in matter. It is offered as a counterexample to the hylomorphic models where matter is expected to be inert and the form animating it immaterial. Instead, notions of vital materialism (Bennett), metallic affects (Delanda), and in general new materialism all assume a different sort of material assemblage.[69] The metallurgical refers to an ambulant,

nomad science that contrasts with the form-seeking Royal Science that extracts constants and categories from its observations. The metallurgist is a figure of someone who "*follows* the flow of matter"[70] and invests in giving a reality to the variations and potentials in the object. Metal is the privileged example and is inspiring to such vital materialists as Bennett because of its seemingly stable solidity, which, however, is in metallurgist perspective and practice revealed as teeming with material potentials that can be teased out in different constellations, temperatures, and conditions; this applies to the atomic level, where a metallurgist has a practical "know-how" relation to metal that applies to the wider role metals play in cultural assemblages as nonhuman agents.[71] Hence, to follow Bennett's adaptation of Deleuze and Guattari's ethological idea about bodies defined by their unfolding potential, where "ethology" refers to experimental relationality, "the desire of the craftsperson to see what a metal can do, rather than the desire of the scientist to know what a metal is, enabled the former to discern a life in metal and thus, eventually, to collaborate more productively with it."[72]

This stance should not be confused with a practice–theory division. Indeed, I want to insist that there is a metallurgical way of conducting theoretical work: ambulant flows, transversal connections, and teasing out the materiality of matter in new places, in new assemblages of cultural life in contemporary technological media.

The cartography of geocentric cultural theory is definitely not only about philosophical references. From the James Hutton of *The Theory of the Earth* to philosophy (Hegel, Schelling, and contemporary speculative realist discussions involving Grant, Graham Harman, and Steven Shaviro), we can also move toward the media geological contexts, which this book tackles. Despite references to the ongoing debates in theory, this book does not attempt to create a primarily philosophical argument; more accurately, it argues the case for a geology of media that tries to pin down the often rather broad notion of "nonhuman" agency to some case studies concerning the assemblages in which the grounds of media are ungrounded through the actual geologies of mining, materiality, and the ecosophic quest becoming also geosophic.

Indeed, the earth of media finds itself displaced from geography to geophysics. This is why Pynchon's latest book, *The Bleeding Edge* (2013),

refers to the future media landscapes of permafrost: the natural cooling systems of northern climates (or by rivers in abandoned paper mill factories acting as remnants of the industrial era serving as corporate housing for the server farms) are perfect for the servers and data storage that release heat. Data processing needs energy, which releases heat, of course. Data demand their ecology, one that is not merely a metaphorical technoecology but demonstrates dependence on the climate, the ground, and the energies circulating in the environment. Data feeds of the environment both through geology and the energy-demand. What's more, it is housed in carefully managed ecologies. It's like the natural elements of air, water, fire (and cooling), and earth are mobilized as part of the environmental aspects of data. Data mining is not only about the metaphorical big data repositories of social media.

In a great summarizing phrase in Andrew Blum's book *Tubes,* a Facebook data center manager speaks to this elemental part of data: "This has nothing to do with clouds. It has everything to do with being cold."[73] The manager summons the same world as a character in Pynchon's novel. Cool, cold data are not just a linguistic or visual metaphor, despite that elegant modernism that still lives inside the architectures of data—at least in the images Google released of its data server factories. Coolness is not a media theoretical attitude in this context but a media management issue that ties the earth to the escape velocity of data.

Data need air. "Cool outside air is let into the building through adjustable louvers near the roof; deionized water is sprayed into it; and fans push the conditioned air down onto the data center floor,"[74] explains Blum. Coolness of cyberpunk transforms from a rhetorical trope to the coolness of the building's climate control. Fans surround the terabytes of data. The manager of the data center continues about the building: "The air hits this concrete floor and roils left and right. This whole building is like the Mississippi River. There's a huge amount of air coming in, but moving really slowly."[75] It's important to notice the persistence of issues of ecology from air to the soil as well as noncognitive work: that we still talk of factories and rather physical processes having to do with our hardware and how we manage and work with data at their material level. Blum: "The cloud is a building. It works like a factory. Bits come in, they get massaged and put together in the right way and sent out."[76]

Such journalistic narratives as Blum's are useful in highlighting the alternative rhetoric to the cyberpunk immateriality, which has persisted since the 1980s up until the present day. Now a geopolitical turn is happening that takes into account that data have a material and legal territory and that we can speak of geophysics of information. This is another sort of a context that justifies the use of the hybrid expression "geology of media." This differs from the literary genre of steampunk that follows a cyberpunk aesthetics of the 1980s and 1990s and offers a literal steampunk for the twenty-first century: the steam of the data center somewhere up north, preferably on the permafrost, cooling down the heat of data crunching. The Anthrobscene logic: the North affords the Cool, the South provides the Cheap (labor).

The Chapters

The chapters of this book are strata themselves. They stratify and condense themes that intertwine and build on each other as dynamic apparatuses mobilizing different sorts of material: historical sources, theory, and, importantly, references to contemporary media art projects and practices.

One could call this approach a media history of matter: the different components, minerals, metals, chemicals, and other things involved in media are considered as essential to media history and archaeology. Media technologies can be understood as a long story of experimenting with different materials—from glass plates to chemicals, from selenium to silicon, from coltan to rare earth minerals, from dilute sulfuric acid to shellac silk, different crystals in telegraphic receivers, and gutta-percha for insulation in earlier transatlantic wired communication. Also Mumford notes this in his analysis of the emergence of modern materiality of technology: technological phases, or "epistemes" as Foucault might have it, are themselves functions of the ways in which materials and energy are channeled, appropriated, and exploited:

> Just as one associates the wind and water power of the eotechnic economy with the use of wood and glass, and the coal of the paleotechnic period with iron, so does electricity bring into wide industrial use its own specific materials: in particular, the new alloys,

> the rare earths, and the lighter materials. At the same time, it creates a new series of synthetic compounds that supplement paper, glass and wood: celluloid, vulcanite, Bakelite and the synthetic resins, with special properties of unbreakability, electrical resistance, imperviousness to acids, or elasticity.[77]

What for Mumford marks the passage from paleotechnics to neotechnics is for my purposes in *A Geology of Media* altogether a passage of different ways of mobilizing the earth into and as media. The march of aluminum came with its own material affordances of lightness, feeding into new forms of speed and transport. And rare earth minerals are not a discovery only of the digital media age: tantalum, tungsten, thorium, cerium, iridium, manganese, and chromium are among the materials that Mumford sees as essential to understanding the twentieth-century technological culture.[78] We can add that it is this list that also works as true "transmedia": useful elements from gadgets and systems of electricity to mechanical technology to digital media, essential in different ways.

Besides the materials of production, media history is a story of relations between the organic and nonorganic and the waste products emerging from the use and misuse of materials. Media history participates in stories of global expansion through colonialism and the rush for resources: the invaluable materials from minerals to oil and other energy sources such as uranium—a global mapping of territories increasingly exhausted.[79] Besides historical examples, we are living a new geopolitical rush now: military, corporate, and scientific operations hand in hand in the Arctic regions, dangerous areas of Africa, Afghanistan, and, for instance, the deep seas, looking for deeper hidden resources of petroleum and critical materials from metals to uranium.[80] Besides materials and waste, media deal and function through energy. The transistor-based information technology culture would not be thinkable without the various meticulous insights into the material characteristics and differences between germanium and silicon, not only in their "pure" state but mixed with just the right dose of impurities. Currently in the long networks of media operations—and media in operation—energy is an essential part of the circuit where the geopolitical race for resources meets the geophysical needs of advanced technologies.[81] This means shifting our focus with the

help of media arts and design projects to the other stuff of media materialism: the metals, minerals, and chemicals in which we can develop the aforementioned ecosophical and geosophical perspective.

This book aims to take up these issues in five main chapters. This chapter acted as a theoretical introduction to the context and the issues. In the next chapter, I focus on deep times. The concept has already been effectively used by Siegfried Zielinski in his take on the paleontology and geology of media arts, but my point is to remind of the need for an *alternative* deep time. In this account, we take deep times more literally and look at geology of media in and through the mines and (un)grounds.

The third chapter follows suit and continues developing specific aesthetic concepts for the geophysical media world. It picks up on the idea of psychogeophysics—a version of the Situationist psychogeography—and offers a radical aesthetics of the media technological world that maps the relations between subjectivity, capitalism, and the earth in long-term durations and geophysical assemblages. In the chapter, we focus on projects by the Berlin and London–placed microresearchlab, Martin Howse's earthcomputing, and the *Crystal World* project by Kemp, Jordan, and Howse: speculative media arts that addresses in assays and technological assemblages the substrate as part of our media systems.

Running through the book is the aim to talk about the variety of materialisms and temporalities of media. In the fourth chapter, I address these themes through a nonhuman particle: dust. Dust is carried forward as a rhetorical device too, mobilizing the entangled materialities of global labor and residue materialism. Dust is found as residue of polished iPads as well as attached to workers' lungs from coal mines to contemporary factories of information technology. The art projects by Yokokoji–Harwood (YoHa; from the United Kingdom) are good examples of addressing this notion of residue, from coal to aluminum. They reveal an alternative side to the discourse of cognitive capitalism: the world of hardwork and hardware that persists as a defining factor of digital media culture.

Chapter 5 picks up on (media) fossils. The paleontological insight to the history of the planet might put special interest on fossils, but similarly it is a figure that one finds resurfacing in Walter Benjamin's analysis of advanced capitalism as well as in contemporary projects such as Grégory Chatonsky's art and Trevor Paglen's extension of the geophysical

sphere of technological fossils to the dead media orbit of satellites circulating the earth. Issues of deep space become part of the geological agenda and expanded into thoughts about the temporality of the Anthropocene.

In addition to the main chapters, and after the meditations offered in the afterword, we decided to add an appendix because of its centrality to all the issues addressed in the book. "Zombie Media: Circuit Bending Media Archaeology into an Art Method" is a text cowritten with the artist–theorist Garnet Hertz. It stems from our shared theoretical interests in media archaeology and electronic waste as well as circuit bending and hardware hacking as practice-based design interventions into contemporary technological culture.

Throughout the book, I use art projects not merely as ways to illustrate the main thesis but also for the converse: many of the things and arguments in this book have been first mapped by artistic methods. I refer to projects such as iMine (by Baruch Gottlieb, Horacio González Diéguez, and Cocomoya); the microresearchlab group; Trevor Paglen's visual art, Katie Paterson; YoHa's work on aluminum and coal; various hardware-hacking and circuit-bending practitioners, including Garnet Hertz but also, for instance, Benjamin Gaulon's Recyclism; Grégory Chatonsky's art installations, Jonathan Kemp's and Ryan Jordan's work, Jamie Allen's, and David Gauthier's geosurveys of media infrastructures; and many more. It was initially through many of these projects that I gained insight into and inspiration for many particular aspects of the book. The artistic projects were able to demonstrate the issues of this new materialism of geophysical kind: a different sort of materiality and an alternative digital media arts culture, irreducible to the enthusiasm for software.

NOTES

Preface

1 Charles Lyell, *Principles of Geology* (London: John Murray, 1830), 1. Online facsimile at http://www.esp.org/books/lyell/principles/facsimile/.

2 Michael T. Klare, *The Race for What's Left: The Global Scramble for the World's Last Resources* (New York: Metropolitan Books, 2012), 29.

3 Ibid.

4 Karl Marx and Friedrich Engels, *The Communist Manifesto* (London: Pluto Press, 2008), 40.

5 Bruno Latour, *An Inquiry into Modes of Existence: An Anthropology of the Moderns,* trans. Catherine Porter (Cambridge, Mass.: Harvard University Press, 2013), 10.

6 "As we have seen, man has reacted upon organized and inorganic nature, and thereby modified, if not determined, the material structure of his earthly home. The measure of that reaction manifestly constitutes a very important element in the appreciation of the relations between mind and matter, as well as in the discussion of many purely physical problems." George Perkins Marsh, *Man and Nature: Physical Geography as Modified by Human Action* (New York: Charles Scribner, 1865), 8.

7 Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, Mass.: MIT Press, 2010).

8 Antonio Stoppani, "First Period of the Anthropozoic Era," trans. Valeria Federighi, ed. Etienne Turpin and Valeria Federighi, in *Making the Geologic Now: Responses to the Material Conditions of Contemporary Life,* ed. Elizabeth Ellsworth and Jamie Kruse (New York: Punctum, 2013), 38.

1. Materiality

1 Sean Cubitt, *The Practice of Light: A Genealogy of Visual Technologies from Prints to Pixels* (Cambridge, Mass.: MIT Press, 2014), 2. To quote Cubitt in full: "Mediation is the ground of relationship, the relationship that precedes and constructs subjects and objects. Media matter, both in the sense of giving material specificity to our descriptions of such abstract concepts as society and environment, and in the sense of the active verb: mediation comes into being as matter, its mattering constitutes the knowable, experienceable world, making possible all sensing and being sensed, knowing and being known."

2 As Geoffrey Winthrop-Young aptly notes, the term *German media theory* is an outsider construct. See Winthrop-Young, "Krautrock, Heidegger, Bogeyman: Kittler in the Anglosphere," *Thesis Eleven* 107, no. 1 (2011): 6–20.

3 Friedrich Kittler, *Discourse Networks 1800/1900,* trans. Michael Metteer with Chris Cullens (Stanford, Calif.: Stanford University Press, 1990).

4 John Durham Peters, "Space, Time and Communication Theory," *Canadian Journal of Communication* 28, no. 4 (2003), http://www.cjc-online.ca/index.php/journal/article/view/1389/1467. See also Sean Cubitt, *Digital Aesthetics* (London: Sage, 1998). Cubitt's recent book, an utterly important one, *The Practice of Light,* focuses especially on the modulations of light becoming media.

5 Douglas Kahn, *Earth Sound Earth Signal: Energies and Earth Magnitude in the Arts* (Berkeley: University of California Press, 2013), 23. See also Sean Cubitt, "Current Screens," in *Imagery in the 21st Century,* ed. Oliver Grau with Thomas Veigl, 21–35 (Cambridge, Mass.: MIT Press, 2011).

6 Klare, *Race for What's Left,* 152.

7 Robert Smithson, "A Sedimentation of the Mind: Earth Projects" (1968), in *Robert Smithson: The Collected Writings,* ed. Jack Flam (Berkeley: University of California Press, 1996), 101.

8 See also Kahn, *Earth Sound Earth Signal.*

9 The current mission of the agency is described as follows: "The [U.S. Geological Survey] serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life." http://www.usgs.gov/.

10 James Risen, "U.S. Identifies Vast Mineral Riches in Afghanistan," *New York Times,* June 13, 2010. For a short history of the U.S. Geological Survey, see

Mary C. Rabbitt, "The United States Geological Survey 1879–1989," U.S. Geological Survey Circular 1050, http://pubs.usgs.gov/circ/c1050/index.htm.

11 Siegfried Zielinski, *Deep Time of the Media,* trans. Gloria Custance (Cambridge, Mass.: MIT Press, 2006).

12 See also Timothy Morton, *Hyperobjects: Philosophy and Ecology after the End of the World* (Minneapolis: University of Minnesota Press, 2013).

13 On media archaeology, see Erkki Huhtamo and Jussi Parikka, eds., *Media Archaeology: Approaches, Applications, and Implications* (Berkeley: University of California Press, 2011). Jussi Parikka, *What Is Media Archaeology?* (Cambridge: Polity, 2012). In addition, the cultural techniques approach, pioneered by the likes of Bernhard Siegert, flags media analysis in relation to technologies of knowledge and discourse operators. Siegert, "Cultural Techniques: Or the End of the Intellectual Post War Era in German Media Theory," trans. Geoffrey-Winthrop Young, *Theory, Culture, and Society* 30, no. 6 (2013): 50.

14 Wolfgang Ernst, "From Media History to Zeitkritik," trans. Guido Schenkel, *Theory, Culture, and Society* 30, no. 6 (2013): 134–35.

15 Wolfgang Ernst, *Digital Memory and the Archive,* ed. Jussi Parikka (Minneapolis: University of Minnesota Press, 2013), 71.

16 Kittler argues that since Aristotle, there has been an ontological neglect of "media." For Aristotle, it was not part of the ontological sphere (reserved for things), which excluded "medium": *tòmetaxú* "is relegated to his theory of sensorial perception *(aisthesis).*" Friedrich Kittler, "Toward an Ontology of Media," *Theory, Culture, and Society* 26, nos. 2–3 (2009): 24.

17 Trevor Paglen, "The Last Pictures," *Journal of Visual Culture* 12, no. 3 (2013): 508–14.

18 Kahn, *Earth Sound Earth Signal,* 107, 146.

19 Friedrich Kittler, "Lightning and Series—Event and Thunder," *Theory, Culture, and Society* 23, nos. 7–8 (2006): 69.

20 "We no longer needed electronic music studios; we already had them in our brains." Oliveros, as quoted in Kahn, *Earth Sound Earth Signal,* 175.

21 Elizabeth Grosz, *Chaos, Territory, Art: Deleuze and the Framing of the Earth* (New York: University of Columbia Press, 2008).

22 Kahn, *Earth Sound Earth Signal,* 177.

23 Theodore Ziolkowski, *German Romanticism and Its Institutions* (Princeton, N.J.: Princeton University Press, 1990), 28–29.

24 Fortey, as quoted in Ian W. D. Dalel, "Vestiges of a Beginning and the Prospect of an End," in *James Hutton—Present and Future,* ed. G. Y. Craig and J. H. Hull (London: Geological Society Special Publications, 1999), 150.

25 Dalel, "Vestiges of a Beginning," 122–23.

26 John Shimkus, "Mining Helium-3 Will Transform the Dark Side of the Moon," May 9, 2011, http://www.energydigital.com/global_mining/mining-helium-3-will-transform-dark-side-of-the-moon.

27 "Russia will begin Moon colonization in 2030—a draft space program," May 9, 2013, http://rt.com/news/157800-russia-moon-colonization-plan/.

28 Cubitt, *Digital Aesthetics,* 45–49.

29 Bruce Clarke, "Gaia Matters," *Electronic Book Review,* November 30, 2006, http://www.electronicbookreview.com/thread/criticalecologies/looped.

30 Martin Heidegger, *The Question Concerning Technology and Other Essays,* trans. William Lovitt (New York: Garland, 1977), 17.

31 Samih Al Rawashdeh and Bassam Saleh et Mufeed Hamzah, "The Use of Remote Sensing Technology in Geological Investigation and Mineral Detection in El Azraq-Jordan," *Cybergeo–European Journal of Geography,* October 23, 2006, http://cybergeo.revues.org/2856.

32 Eyal Weizman, Heather Davis, and Etienne Turpin, "Matters of Calculation: Eyal Weizman in Conversation with Heather Davis and Etienne Turpin," in *Architecture in the Anthropocene: Encounters among Design, Deep Time, Science, and Philosophy,* ed. Etienne Turpin (Ann Arbor, Mich.: Open Humanities Press, 2013), 64.

33 See Edwards, *Vast Machine.*

34 Kahn, *Earth Sound Earth Signal,* 157.

35 For Kittler, the phonograph and in general the technical media of sound recording tap into the Lacanian Real. See Friedrich Kittler, *Gramophone, Film, Typewriter,* trans. Geoffrey Winthrop-Young and Michael Wutz (Stanford, Calif.: Stanford University Press, 1999).

36 Donna Haraway draws from the work of ethnographer Marilyn Strathern in this formulation that resonates with the emphasis on cross-species connections across a range of micropractices, interfaces, relationality: "Marilyn Strathern, drawing on decades of study of Papua New Guinean histories and politics, as well as on her investigation of English kin reckoning habits, taught us why conceiving of 'nature' and 'culture' as either polar opposites or universal categories is foolish. An ethnographer of relational categories, she showed how to think in other topologies. Instead of opposites, we get the whole sketchpad of the modern geometrician's fevered brain with which to draw relationality. Strathern thinks in terms of 'partial connections'; i.e., patterns within which the players are neither wholes nor parts. I call these the relations of significant otherness. To think of Strathern as an ethnographer of naturecultures; she will not mind if I invite her into the kennel for a

cross-species conversation." Haraway, *The Companion Species Manifesto: Dogs, People, and Significant Otherness* (Chicago: Prickly Paradigm Press, 2003), 9. On "medianatures," see also Jussi Parikka, "Media Zoology and Waste Management: Animal Energies and Medianatures," *Necsus–European Journal of Media Studies,* no. 4 (2013), http://www.necsus-ejms.org/.

37 Haraway, *Companion Species Manifesto,* 12.

38 Rick Dolphjin and Iris van der Tuin, *New Materialism: Interviews and Cartographies* (Ann Arbor, Mich.: Open Humanities Press, 2012), 90. Of course, one can argue, to quote Scott McQuire, that "defining the technological activates the border between nature and culture." McQuire, "Technology," *Theory, Culture, and Society* 23, nos. 2–3 (2006): 252. And at the same time, technology also is based on the crossing of the border between the two.

39 Sean Cubitt, interviewed by Simon Mills, *Framed,* http://www.ada.net.nz/library/framed-sean-cubitt/.

40 See Colin Dickey, "Review of *Why Hell Stinks of Sulfur: Mythology and Geology of the Underworld,*" *Los Angeles Review of Books,* July 14, 2013, https://lareviewofbooks.org/.

41 See Rosalind Williams, *Notes on the Underground: Essays on Technology, Society, and the Imagination,* new ed. (Cambridge, Mass.: MIT Press, 2008).

42 Tarde's short novel was originally published in 1904 as *Fragment d'histoire future* (Fragment of a history of future).

43 Williams, *Notes on the Underground,* 81.

44 Lewis Mumford, *Technics and Civilization* (1934; reprint, Chicago: University of Chicago Press, 2010), 228–29.

45 Paul J. Crutzen, "Geology of Mankind: The Anthropocene," *Nature* 415, no. 3 (2002): 23.

46 The International Commission on Stratigraphy should reach a decision on the formal acceptance of the designation by 2016.

47 The "obscenity" of the Anthropocene can be read as an ethical qualification of the term to underline the role of corporations and nation-states in a systemic exploitation of work and natural resources. The Anthrobscene is executed through engineered, scientific, and, for example, legislative means. But it has also implicit connotations to the ontological shift that Jean Baudrillard writes as the *ob-scene.* Even if the link to Baudrillard is not the engine for this concept, there is an element of obscene exposure and exploitative visuality that produces nature as a resource. On Baudrillard, see Paul Taylor, "Baudrillard's Resistance to the Ob-Scene as the Mis-en-Scene (Or, Refusing to Think Like a Lap-Dancer's Client)," *International Journal of Baudrillard Studies* 5, no. 2 (2008), http://www.ubishops.ca/baudrillardstudies/vol-5_2/

v5–2-taylor.html. In *The Geology of Media,* however, this implosion happens on the level of the material ob-scene: the myths of immateriality support the engineered depletion of crucial resources, energy crisis, and the corporate mobilization of the earth as part of the circuit of medianatures. The *pornographic* is evident primarily in the manner in which nature–ecology is viewed as a corporate resource, exposed down to its molecular intensities. The obscene is both a mode of exploitation and an epistemological framework. However, I want to underline that there should be no nostalgic longing for a connection of the earth in the mythological or Heideggerian sense but rather in a different sense of ecosophic relation across the spheres of economic, social, and environmental engineering and production.

48 Will Steffen, Paul J. Crutzen, and John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *Ambio* 36, no. 8 (2007): 615.

49 See Mumford, *Technics and Civilization,* 232–33.

50 Steffen et al., "The Anthropocene," 616.

51 Crutzen, "Geology of Mankind," 23.

52 John McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York: W. W. Norton, 2000), 52.

53 Steffen et al., "The Anthropocene," 616.

54 McNeill, *Something New under the Sun.*

55 Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35 (Winter 2009): 206–7.

56 Ibid., 219.

57 In the manner Félix Guattari uses and introduces the terms alongside "mixed semiotics" of material intensities and signifying structures entangled. For an elaboration, see Gary Genosko, *Félix Guattari: An Aberrant Introduction* (London: Continuum, 2002), 169–71.

58 A crisis demands a temporal framework that is able to premediate futures, even changing them: modeling climate change, for instance, is based on the hope that if we take such predictions seriously, we might be able to stop them from becoming true, to paraphrase Wendy Hui Kyong Chun. Chun, "Crisis, Crisis, Crisis, or Sovereignty and Networks," *Theory, Culture, and Society* 28, no. 6 (2011): 107.

59 See Mieke Bal, *Travelling Concepts in the Humanities* (Toronto: Toronto University Press, 2002).

60 See also Rosi Braidotti, *The Posthuman* (Cambridge: Polity, 2013).

61 Gilles Deleuze and Félix Guattari, *A Thousand Plateaus,* trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987), especially chapter 3.

Eric Alliez, *The Signature of the World: What Is Deleuze and Guattari's Philosophy?,* trans. Eliot Ross Albert and Alberto Toscano (New York: Continuum, 2004), 25.

62 Gilles Deleuze and Félix Guattari, *What Is Philosophy?,* trans. Hugh Tomlinson and Graham Burchell (London: Verso, 2009), 85.

63 See Matthew Fuller, *Media Ecologies: Materialist Energies in Art and Technoculture* (Cambridge, Mass.: MIT Press, 2005). See also Michael Goddard and Jussi Parikka, eds., "Unnatural Ecologies," special issue, *Fibreculture,* no. 17 (2011), http://seventeen.fibreculturejournal.org/.

64 Asko Nivala, "The Chemical Age: Presenting History with Metaphors," in *They Do Things Differently There: Essays on Cultural History,* ed. Bruce Johnson and Harri Kiiskinen, 81–108 (Turku: Turku, 2011).

65 Theodore Ziolkowski, *German Romanticism and Its Institutions* (Princeton, N.J.: Princeton University Press, 1990). See chapter 2 on mining in that book.

66 Ben Woodard, *On an Ungrounded Earth: Towards a New Geophilosophy* (New York: Punctum Books, 2013). Iain Hamilton Grant, *Philosophies of Nature after Schelling* (London: Continuum, 2006). Reza Negarestani, "Undercover Softness: An Introduction to the Architecture and Politics of Decay," *COLLAPSE VI: Geo/Philosophy,* January 2010, 382.

67 Iain Hamilton Grant, "Mining Conditions," in *The Speculative Turn: Continental Materialism and Realism,* ed. Levi Bryant, Nick Srnicek, and Graham Harman (Melbourne: re.press, 2010), 44.

68 This ungrounding and constituent exhumation is picked up by Reza Negarestani too: "If archeologists, cultists, worms and crawling entities almost always undertake an act of exhumation (surfaces, tombs, cosmic comers, dreams, etc.), it is because exhumation is equal to ungrounding, incapacitating surfaces ability to operate according to topologies of the whole, or on a mereotopological level. In exhumation, the distribution of surfaces is thoroughly undermined and the movements associated with them are derailed; the edge no longer belongs to the periphery, anterior surfaces come after all other surfaces, layers of strata are displaced and perforated, peripheries and the last protecting surfaces become the very conductors of invasion. Exhumation is defined as a collapse and trauma introduced to the solid part by vermiculate activities; it is the body of solidity replaced by the full body of trauma. As in disinterment—scarring the hot and cold surfaces of a grave—exhumation proliferates surfaces through each other. Exhumation transmutes architectures into excessive scarring processes, fibroses of tissues, membranes and surfaces of the solid body." Negarestani, *Cyclonopedia: Complicity with Anonymous Materials* (Melbourne: re.press, 2008), 51–52. It would

be interesting to extend and develop Zielinski's methodology of deep time and variantology of media in connection with such notes by geophilosophers from Woodard to Grant to Negarestani.

69 Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, N.C.: Duke University Press, 2010). Manuel Delanda, *Deleuze: History and Science* (New York: Atropos Press, 2010). Dolphjin and van der Tuin, *New Materialism.*

70 Deleuze and Guattari, *A Thousand Plateaus,* 372. "*There are itinerant, ambulant sciences that consist in following a flow in a vectorial field across which singularities are scattered like so many 'accidents.'*"

71 Bennett, *Vibrant Matter,* 58–60.

72 Ibid., 60.

73 Andrew Blum, *Tubes: A Journey to the Center of the Internet* (New York: HarperCollins, 2012), 258.

74 Ibid., 260.

75 Ibid.

76 Ibid., 259.

77 Mumford, *Technics and Civilization,* 229.

78 Ibid., 231.

79 And also increasingly an artistic and curatorial mapping. A good example is *The Oil Show* exhibition at HKMW, Dortmund (November 12, 2011, to February 19, 2012), curated by Inke Arns. See also Mumford, *Technics and Civilization,* 232–33.

80 For a good journalistic mapping of the issues of resources and geopolitics, see Klare, *Race for What's Left.*

81 Sean Cubitt's work-in-progress book project *Ecomediations* addresses these issues in detail. See also Cubitt, "Electric Light and Energy," *Theory, Culture, and Society* 30, nos. 7–8 (2013): 309–23.

2. An Alternative Deep Time of the Media

1 Seb Franklin, "Cloud Control, or the Network as a Medium," *Cultural Politics* 8, no. 3 (2012): 443–64.

2 See Ippolita, *The Dark Side of Google,* trans. Patrice Riemens (Amsterdam: Institute of Network Cultures), 2013, http://networkcultures.org/wpmu/portal/publication/no-13-the-dark-side-of-google-ippolita/.

3 "What the N.S.A. Wants in Brazil," *The New Yorker,* July 24, 2013, http://www.newyorker.com/online/blogs/newsdesk/2013/07/why-the-nsa-really-cares-about-brazil.html.

4 Williams, *Notes on the Underground,* 72.

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