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12 ALGORITHM MAGIC

GILBERT SIMONDON AND TECHNO-ANIMISM

Betti Marenko

Apparatus always function increasingly independently from their programmer's intentions.

VILÉM FLUSSER[1]

Introduction

This chapter examines the peculiar technical object "algorithm" from the perspective of its enchanting and incantatory potential. It puts forward the idea that the way algorithms perform may be less rational than may be conventionally believed. Instead, it proposes algorithms as magical utterances whose power to make things happen is rooted in the unknown, indeterminate, and unforeseeable space of contingency. If this seems counterintuitive—Isn't the algorithm a logical series of steps undertaken to accomplish a defined outcome?[2]—the chapter brings together three different perspectives to unpack its central thesis: that a new algorithmic magical universe is in the making in our contemporary computational world.

The first perspective locates the algorithm within a genealogy of the relationship between technology and magic, a link that has never been severed. On the contrary, as media theorist Siegfried Zielinski reminds us: "it is of vital importance to know that a magical approach toward technology continues to be possible and to be reassured that investment in it is meaningful."[3] Framed within this lineage, the algorithm becomes a magical object, a spell with the power to create worlds. To sustain this argument, the chapter then shows how algorithms operate on the basis of growing margins of openness. Following philosopher Luciana Parisi, the argument is that incomputability and uncertainty are now found at the very core of computation. Algorithms perform in increasingly inscrutable ways, their agency no longer graspable by human cognition, but rather more mysterious and more similar to forms

of nonhuman intelligence.[4] Finally, the chapter examines selected facets of French mechanologist Gilbert Simondon's thought to validate the case put forward. Specifically, it looks at Simondon's vision of the primitive magical universe—the original and harmonious mode of being of the human in the world prior to any distinction between subject and object.[5]

By examining the algorithm through the triangulation of these theoretical strands, it appears more clearly how our present algorithm-driven computational environment may be read as laboring toward a new type of magical universe. If algorithms possess elements of uncertainty and mystery, then these will feed into the world-building and sense-making power that algorithms exercise already.

Moreover, this framework of analysis of the algorithm extends to the computational environment humans inhabit (and are made of). The fundamentally immersive experience that computation creates, far from representing or simulating reality, actively constructs it. Indeed, it *is* reality itself. Computational *aesthetics* in particular—the sensibilities, perceptions, and affects emerging from the computational experience—"is not produced by the social but is social. Similarly, it is not the result of a certain culture; it *is* culture."[6]

Can this aesthetic experience of computation be understood through Simondon's magical unity where humans are immersed in a totalizing and harmonious universe?[7] Simondon's magical unity is described later in the chapter. For now, suffice it to say that the magical phase is the simplest and most fundamental way in which the environment of living beings can be structured. According to Simondon, the environment appears as "a network of privileged points of exchange between the being and the milieu"[8] through which humans are directly integrated with the world. These key points are "places of contact and of mixed, mutual reality, places of exchange and of communication because they form a knot between both realities."[9] Together, they create a *reticulation* of "thresholds, summits, boundaries and crossing points that are connected to one another by their singularity and their exceptional nature."[10]

Whereas Simondon was thinking about natural points such as mountains, valleys, and forests, I wish to push this image further and postulate that the black mirrors of our digital screens are the portals into a *new magical reticulation*, with algorithms as the salient points. If this intuition is valid, then algorithms must be investigated to verify whether their increasing autonomous agency and resulting digital uncertainty can effectively be leading to a new magical universe.

I will start by looking at algorithms to discuss how uncertainty is constitutive of their functioning. Once framed within a lineage of the relationships between technology and magic, this digital uncertainty acquires magical connotations. To support this idea, the chapter will then turn to Simondon's explanation of how the primitive magical universe shifts into producing technicity and new types of networks. Here is where my key argument comes into focus. Algorithms create a new reticulation that enables unmediated connections between the human and its planetary computational milieu: a new kind of magical universe. To elucidate this, let us begin by looking at the algorithm itself.

Algorithms, Incomputability, and Whispered Spells

Algorithms are everywhere, and not just because they have become synonymous with digital culture. Indeed, algorithms can be executed not only by machines, but also by human actors. Food recipes, for instance, are often given as an example of what an algorithm is: the procedure of transmitting and processing information to achieve a certain result. Philosopher of media Yuk Hui, however, counters that the comparison between an algorithm and a recipe is imprecise because it pays no attention to the difference between automatization of instructions (pure repetition) and automatization through recursion, where functions are (partially) self-defined. For Hui, "if we define instructions as sequential step-by-step schematization, and understand them as one pole of the algorithm, then the other pole of the algorithmic spectrum would be recursive and non-linear operations."[11] Put differently, instructions such as recipes are instrumental and their simple "automation through repetition" does not take into account the unknown. As "automation through recursion," on the contrary, the algorithm becomes modulated by a horizon of contingency: what is neither known, nor present, yet.

Furthermore, algorithms "bear a crucial, if problematic, relationship to material reality."[12] Andrew Goffey's formula "Algorithm = Logic + Control"[13] tells us that while "logic" concerns the problem and the abstract formulation and expression of a solution (*what* is to be done), "control" concerns the problem-solving strategy and the instructions for processing the logic (*how* it should be done).[14] Thus, there is more to algorithms than logically consistent form.[15] As a statement of intent within a machinic discourse, not only does the algorithm make things happen; it also problematizes the distinction between theory and practice, natural and artificial; it brings to fruition a double-pronged power to utter and to generate. "Algorithms do things, and their syntax embodies a command structure to enable this to happen,"

writes Goffey.[16] Crucially, algorithms function *also* because they draw on contingency. "Algorithms act, but they do so as part of an ill-defined network of actions upon actions, part of a complex of power–knowledge relations, in which unintended consequences, like the side effects of a program's behavior, can become critically important."[17] In this sense, algorithms are made of an unknown component too. It is by relying on this mystery that they perform like incantations.

If the algorithm is both abstract and pragmatic, then computation at large must be similarly understood as a technique of abstraction and yet as a technology of material agency that makes the world happen.[18] As said, computation is not merely constitutive of reality, but *is* reality.

Parisi's analysis of algorithmic cognition and its capacity to respond to, adapt to, and learn from both environmental and recursive inputs is useful here. Algorithmic automation foregrounds the emergence of an autonomous, purposeless, and impersonal mode of thought indifferent to human qualities.[19] Drawing on mathematician Gregory Chaitin's algorithmic randomness—the idea that in every computational process the output is always greater than the input—Parisi argues that algorithmic procedure signals the irruption of a nonhuman thought, able to modify its initial conditions and profoundly alien.[20] By provoking irreversible changes in algorithmic rules, computation becomes an incomplete affair constantly *open* to revision.

This notion of the algorithm as open is indebted to Simondon, for whom openness is the key characteristic of the postindustrial technical object. In the short text *Technical Mentality*, discovered after his death and written probably around 1970, he discusses the openness of technical objects as the condition of their perfectibility.[21] The object possesses both a stable core and a layer that can be worked upon, expanded, amplified, and upgraded "because it is made up of elements that are all similar, impersonal, mass-produced by industry and distributed by all the networks of exchange. It is through participation to this network that the technical object always remains contemporary to its use, always new . . . The object is not only structure but also regime."[22]

The object's openness is the prerequisite for achieving technical perfection through continuous work, improvement, and expansion. Crucially, for the object to be sensitive to outside information and adapt accordingly, a margin of indeterminacy is necessary. The entire history of technical objects can be seen as a movement toward increasing degrees of openness and, consequently, of uncertainty.

Technology Is Magic by Other Means

For anthropologist Marcel Mauss, magic and technology are inextricably interwoven. By providing efficacy through ritual, magic shapes needs and prefigures techniques, and through these methods it satisfies human desires and expectations.[23] This view is echoed by anthropologist Alfred Gell, for whom magic is a craft activity representing the technical domain in enchanted form.[24] The goals of magic are therefore aligned with the goals of technology: both aspire to control and change the natural environment by artificial means. Even more, magic is "the ideal technology which orients practical technology and codifies technical procedures at the cognitive-symbolic level."[25] This is why it haunts technical activity like a shadow. Technical innovation itself, Gell reminds us, happens "not as a result of attempts to supply wants, but in the course of attempts to realize technical feats heretofore considered 'magical'."[26] Technology is, therefore, magic by other means.

The persistence of magic in the shaping of technologies and, broadly, in the history of modernity is well documented, in particular how the development of modern techno-science is connected to the tradition of natural magic.[27] Historian Anthony Grafton, for instance, uses the expression "technological brand of magic" to describe the work of military experts, clockworks makers, engineers, and architects like Filippo Brunelleschi, who, in fields as diverse as optics, hydraulics, pneumatics, and warfare, used innovation as a technological spell to harness and outdo the forces of nature, while inducing awe and amazement in their audiences.[28] The undercurrent of mathematical and artificial magic that traverses the Western history of technology, although overlooked, remains vividly present.[29] This counters Theodor Adorno and Max Horkheimer's argument that the Enlightenment project meant fundamentally the disenchantment with the world.[30] Things were robbed of their power to enchant. They famously wrote: "animism had endowed things with souls; industrialism makes souls into things."[31] Granted, both magic and techno-science are concerned with goals. However, while magic pursues its ends through mimesis, science does it by establishing a distance from its object of study and autonomy of thought. This is the prerequisite for an all-embracing technology replacing the practices of the magician (or the medicine man, or the shaman).

But what if the power to enchant never went away? What if magic never really disappeared but was actually incorporated within technological innovation?

Anthropologist Michael Taussig's evocative blend of fiction and criticism is particularly apt to elucidate this point. For Taussig magic consists in

knowledge *and* words, when these words have the power to effect things: "We are talking about the marketing of a theory of signification and of rhetoric, indeed, not just of knowledge but of what is in a deeply significant sense the knowledge of knowledge that has to remain inaccessible for that knowledge to exist."[32] What he emphasizes is the combination of efficacy and the mysterious expertise manifest in the form of "whispered spells." In a magic formula the whole spell sequence associated with a procedural sequence creates a full cognitive plan; only the exact sequence, or part of it, may be unknown. Besides, for Taussig, magic is an art form with the "stupendous ability to blend aesthetics with practicality."[33] What matters is not only the efficacy and pragmatic of magic, but its aesthetic capacity to impact the realm of the sensible, to produce sensations, and to affect the human sensorium, whether in a conscious or unconscious way.[34] Taken together, the three components of magic—efficacy, mystery, and aesthetic—feed into its intensified computational version, what this chapter calls techno-magic.

Techno-Magic, Technological Unconscious, and Animism 2.0

I use the term *techno-magic* to describe not only the entanglement of technology and magic I have outlined but the current digital manifestation of this entanglement. What is known as planetary computation—the Earth-wide impact of digital technologies and infrastructures on human cognitive, affective, and perceptual spheres—is characterized by a radical increase of the speed and intensity affecting all human senses: cognition, affect, and perception.[35] At the core of this process we find the algorithm. By reading this intensification through techno-magic we see how the efficacy, mystery, and aesthetic of magic find expression within the algorithm.

Can it be, then, that algorithms perform an intensification of techno-magic? After all, both imitative magic (concerned with copy and replication) and contagious magic (concerned with connection and material transfer) are expressed through algorithms. If we consider the perceptual and sensorial impact of algorithms, we realize how this is way more pervasive than what mere rule-based logic might do. Largely unregistered by human perception, algorithms shape, regulate, affect, and build our own human reality. Think about how automated communications, interactive technologies, and information flows produce a nonhuman universe of signification where cognitive operations keep on running in the background—unseen, unheard, unknown, and incommensurable to human scale.

Already in the nineteenth century, the invention of technologies of optical reproduction had generated new perceptions holding a nonhuman dimension—unseen by the human eye and unsensed in habitual ways. What is more, it privileged the tactile over the optical, as if the optical had now dissolved into touch.[36] As Taussig remarks, such rewiring of seeing as tactility is a fundamental aspect of how technological innovations propel new sensibilities.[37] He points out that this also concerns the historical evolution of enchantment. It is through tactility that earlier forms of religious and cult-like magic were displaced and "a sort of technological or secular magic was brought into being and sustained,"[38] initiating a process where demystification and reenchantment paradoxically cohabit.

This cultural framing helps us to understand the aesthetic experience induced by computation, where the production of new sensibilities takes place in the interaction with machines and is mediated by algorithms. This interaction demands to be negotiated anew as the hybrid outcome of human and nonhuman ecologies encountering each other. For digital media theorist Anna Munster, recognizable (human) fields of perception collide with the imperceptible, thus engendering unheard-of sensibilities and novel techno-aesthetic experiences.[39] The role of algorithms in this process is crucial. By directly acting on human neuroperceptual capacities, modulating responses, and anticipating possible choices, by substituting search for sort,[40] and by questioning what counts as human, algorithms generate new forms of aesthetic power. An example of this dynamic is the normalized logic of Google search, whose page ranking and algorithmic curation determine the kind of information prioritized on any user's accessed content, preferences, and social media profiles.[41]

The milieu of techno-aesthetic sensibilities, computation, and human–nonhuman entanglements can also be described as *technological unconscious*. Italian artist Franco Vaccari coined this expression in the late 1960s to signal the autonomous capacities of the machine to produce a memory independent from human awareness.[42] The technological unconscious evokes humans increasingly constituted by computation, software, and codes; and electronic objects recursively reshaping the world.[43] For sociologist Nigel Thrift, the technological unconscious constitutes a new kind of immersive milieu where humans and computation feed into and adapt to each other. As computing flows in the environment, filling every interstice, the technological unconscious becomes the operation of powerful and unknowable information technologies that generate "a pre-personal substrate of guaranteed correlations, assured encounters and therefore unconsidered anticipation."[44] In doing so, they keep on producing everyday life.

I suggest that this scenario can be also read through animism—the notion that objects and other nonhuman entities possess a soul, life force, and qualities of personhood. After all, animistic responses emerge when technologies connecting objects become simultaneously smarter and more pervasive yet more invisible. Cultural critic Erik Davis, one of the first to popularize the notion of techno-animism or digital animism, writes that a degree of animism is "a psychologically appropriate and imaginatively pragmatic response to the peculiar qualities of the information jungle. We associate intelligence with what reads and writes, and nowadays everything electronic reads and writes."[45] It is not a coincidence that the last decade has seen animism being redeemed from its nineteenth-century anthropological roots[46] and reevaluated as a strong theoretical contender for an imaginative understanding of the human–digital milieu.[47] Whereas positivism, with its rational view of social phenomena, empiricism, and faith in techno-scientific progress, saw animism as a failed epistemology, an error or, at best, an immature stage in the development of individual and society,[48] contemporary animism problematizes the boundaries between the social world of the human (the animate) and the material world of the nonhuman (the inanimate). Influenced by new materialism, agency theory, and the "animistic turn" in radical anthropology,[49] this *Animism 2.0* prompts a rethinking of the ontological distinction between the living and the nonliving, thus offering insights into human interaction with increasingly sentient smart objects.

What is remarkable about this animistic approach, and what makes it so attractive, is that it can perform at multiple levels. While it foregrounds theoretical debates on the relations between the human and the nonhuman, it also informs practical strategies of engagement with digital objects. For instance, in what is known as *animistic design*, animism is taken as a fiction-building tool to think differently about interaction: "neither from the perspective of the user, nor from the perspective of the object but from the ongoing modulation of their less-than-predictable interaction."[50] Some of the work done in this field explores how ecosystems of connected objects can express degrees of personality, yet carefully refraining from anthropomorphism.[51] The idea is to foster a curated uncertainty around the outcomes of interaction—both as a speculative method of investigation and as a research-and-development tool. Although stemming from similar concerns, this animistic design approach differs from Davis, who, in the afterword to the new edition of his classic *TechGnosis*,[52] remarks how an animistic worldview is never far away from paranoia as the logical outcome of attempting to explain our hyper-mediated world. For him, the invisible agency of devices becomes an ominous yet unavoidable threat against which the only antidote is esoteric fabulation. Paranoia,

however, has no place in the unfolding of an Animism 2.0, predicated on algorithmic magic.

Aesthetic Thinking and Simondon's Magical Universe

Simondon presents us with a suggestive view of the linkage between technology and magic. In the beginning is magic, the harmonious integration of the human in the world prior to any separation between subject and object. Humans are immersed in the world and an integral part of it. Likewise, the world is an integral part of the human. No separation exists; rather, a profound sense of completeness permeates the relationship between humans and their magical universe. In this original primitive unity humans and world mutually affect each other. Their connection and exchange are manifest through a network of key points and key moments in space and in time.

Animistic influences seem to surface when Simondon mentions the "summits of mountains or certain narrow passes . . . the heart of the forest and the centre of a plain"[53] as privileged key points where special exchanges happen between the living being and the milieu. Effectively conceived as portals into different levels of reality, they are linked with each other through their own singularity and their own exceptional character, and they express the forces of the ground that supports them. It is the distribution of key points, their reticulation, that creates a distinction between figure and ground, a dynamic equilibrium where key points draw their force from the ground, yet they are not separate from it. Any of these points—a forest, a mountain, a gorge—concentrates in itself the power to govern the surrounding environment while catalyzing human effort.

Eventually, says Simondon, a de-phasing of this magical universe takes place. Technicity and religion emerge from this unfolding. As this happens, the figure-and-ground relationship is split, too, and the reticulation wanes. Key points detach from the ground as free figures and lose their power on their surroundings. They become technical objects, ready to be abstracted from the milieu and to be active only instant by instant. Simultaneously this process frees the ground. While key points become objectified as tools and instruments, the ground powers are subjectified, acquiring personification under the guise of the divine and the sacred (this is the birth of gods, heroes, priests). Technical objects incur in a process of technical objectification: they retain only the characteristics of the figure, and lose the ground. Religious subjects incur in a process of religious subjectification: they retain only characteristics of the ground, and lose the attachment to the figural (i.e., the *hic et nunc*). This is the instauration of object and subject as separate entities,

which in turn produces a distance between humans and world. Clearly, the first object is the technical object; the first subject is a divinity. Both float away from their milieu; both acquire a concrete dimension; both, now detached and estranged from one another, become "mobile, divisible, displaceable, and directly open to manipulation because disconnected from the world."[54]

The relationship between human and world is now mediated in two distinct ways: objectified as technicity and subjectified as religion. Although they both emerge from the division of the original magical unity, technicity and religion are neither degraded forms nor relics of magic. Rather, they are the heirs of magic, but on the condition that they are taken together as a coupling of two symmetrical and contrasting mediations. This symmetry also explains why they are both equally related to magic. While technical thinking operates "point by point and step by step; it localises and multiplies the schemas of mediation, always remaining less than the unity," "religious thinking finds the opposite equilibrium: in it, the totality is more stable, more powerful, and more viable than the element."[55] Simondon describes their relationship as producing "aesthetic thinking," a constant reminder of the original magical universe. In this sense, then, the original magical universe does not stop producing effects; on the contrary, the creation of magic is continuous. The charge proper of the magic phase keeps on insisting and persisting, as an energy that constantly vivifies the dynamic between technicity and religion.

More than a phase, aesthetic thinking is a moment that, while constantly reminding us of the rupture of the initial magical universe, drives us toward a future unity. As it generates nostalgia for the magical world, aesthetic thinking tends toward magic as if persistently reanimating it. This is why aesthetic objects like artworks provide continuity with the primitive magical unity: because they have the power to evoke it through perceptual analogy. The power of an artwork, and, more broadly, the aesthetic character of an action, an event, or a thing, resides in its being at the same time subject *and* object, thus creating the sensation of surpassing the division ensued after the first de-phasing. Aesthetic objects, in other words, work toward a recomposition of that split. Even though they cannot really reconstitute the magical universe, still they can recall it. They can make it felt. They can evoke it. This is what artworks have in common. Whether it is the oldest human-painted images ever found[56] or contemporary work challenging established notions of what art can be,[57] the aesthetic experience alters the contours of what can be sensed.

It is telling, therefore, that for Simondon anything—be it an action, an event, or a moment—has the capacity to become a significant key point in a new reticulation of the universe. Indeed, every culture selects those acts, situations, places, and moments that are more suitable to this aim. This

explains how, after having detached themselves during the initial phase shift, technical objects (retaining now only the traits of figures) return into the world to establish new alliances with it. This is how technicity becomes concrete. It attaches itself to the world through new key points, for instance cement and rocks, cable and valley, pylon and hill. Novel reticulations are created, this time chosen by technicity. Nonetheless, because of the localized nature of technical objects, even if they keep on multiplying, the original primitive unity of the world cannot be regained. No matter the extent to which technical objects go on reproducing themselves, they cannot recapture the original magical thinking.[58]

Elsewhere, however, Simondon states:

> It is the natural structures themselves that serve as the attachment point for the network that is being developed: the relay points of the Hertzian "cables" for example rejoin with the high sites of ancient sacredness above the valleys and the seas. Here, the technical mentality successfully completes itself and rejoins nature by turning itself into a thought-network, into the material and conceptual synthesis of particularity and concentration, individuality and collectivity—because the entire force of the network is available in each one of its points, and its mazes are woven together with those of the world, in the concrete and the particular. The case of information networks is so to speak an ideal case where the success is virtually complete, because here energy and information are united again after having been separated in the industrial phase.[59]

It can be argued that, had Simondon lived long enough to witness the stratospheric expansion of computation and its planetary reach, he might have agreed that the algorithmic architecture of computation constitutes precisely the type of information networks where "energy and information are united again" and where "technical mentality rejoins nature by turning itself into a thought network." Through its proliferation, pervasiveness, and immediation, the technical object algorithm is not attached to one place and one moment only, but is enveloping with simultaneous connectivity the entire "ground." An obvious instance of this is the way Google Earth operates, blending visual representation and constructed simulation, and effectively constructing the world-as-map and the map-as-world.[60] As the localization and particularization of this specific technical object is superseded by a simultaneity of presence, a scenario emerges where such technical proliferation (not a mere "adding") gives birth to a new phase that brings together figure and ground,

religion and technicity. A new kind of magical unity rises, based upon the development of the thought-network Simondon had foreseen.

The Digital Murmur of Algorithm Magic

As they embody infinite recombinatory, perfectible technicity, and are open to unbounded possible futures, algorithms are the epitome of the postindustrial technical objects. They are not just mere mechanical calculations, but nonhuman agents possessing increasing degrees of animation, soft intelligence, and autonomy, relationally entangled with humans in complex, variable, and emergent ecologies. No longer mere tool or instrument, accessory to the establishment of meaning, algorithms become the hinge of new forms of sense-making that are relational, milieu-based, and postcognitive. Sense-making shifts from being the mere outcome of subjective act to emerge "from the non-signifying collaborative practices of humans, objects, and machines."[61] Algorithms operate a radical ontological reorganization as they mediate the encounter between extensively cyberneticized, heterogenic subjectivities and the nonhumanity of planetary networked computation. From this encounter new animistic techno-aesthetic sensibilities develop. A new enchanted milieu is generated from the triangulation of pragmatic efficacy, contingent unknown (incomputability), and techno-magic. This is the milieu we humans inhabit, where the incantatory digital murmur spoken into things makes the whole universe resonate—and us within it. It may not be the harmonious magical milieu of human and world evoked by Simondon, but this animistic algorithm magic is an exquisitely close approximation. It certainly is the only one we live by.

Notes

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4. Will Knight, "The Dark Secret at the Heart of AI," *MIT Technological Review* 120, no. 3 (May/June 2017): 54–63.
5. Gilbert Simondon, "On the Mode of Existence of Technical Objects," *Deleuze and Guatarri Studies* 5, no. 3 (2011): 407–424. See also Pascal Chabot, *The Philosophy of Simondon: Between Technology and Individuation* (London: Bloomsbury, 2013), 127–144.
6. Beatrice M. Fazi and Matthew Fuller, "Computational Aesthetics," in *A Companion to Digital Art*, ed. Christiane Paul (Chichester, UK: John Wiley & Sons, 2016), 284; emphasis added.
7. Simondon, "On the Mode of Existence of Technical Objects," 410.
8. Ibid., 411.
9. Ibid., 412.
10. Ibid., 414.
11. Yuk Hui, "Algorithmic Catastrophe. The Revenge of Contingency," *Parrhesia* 23 (2015): 122–143 (quote is at 134).
12. Andrew Goffey, "Algorithm," in *Software Studies: A Lexicon*, ed. Matthew Fuller (Cambridge, MA: MIT Press, 2008), 15–20 (quote is at 16).
13. Ibid., 15.
14. Rob Kitchin, "Thinking Critically About and Researching Algorithms," The Programmable City Working Paper 5 *SSRN*, 2014, http://ssrn.com/abstract=2515786.
15. Goffey, "Algorithm," 19.
16. Ibid., 16.
17. Ibid., 19.
18. Fazi and Fuller, "Computational Aesthetics," 286.
19. Luciana Parisi, "Instrumental Reason, Algorithmic Capitalism, and the Incomputable," in *Alleys of Your Mind: Augmented Intelligence and its Traumas*, ed. Matteo Pasquinelli (Luneburg, Germany: Meson Press, 2015), 125–137 (quote is at 129).
20. Algorithmic automation can no longer be understood within Turing's discrete computational machine, based on a priori instructions (mechanism of first-order cybernetics; i.e., a closed system of feedback). Today's "combination of environmental inputs and a posteriori instructions proposed by the interactive paradigm embrace second-order cybernetics and its open feedback mechanisms" (Ibid., 129).
21. Gilbert Simondon, "Technical Mentality," *Parrhesia* 7 (2009): 17–27; reprinted in Arne de Boever, Alex Murray, Jon Roffe, and Ashley Woodward, eds., *Gilbert Simondon: Being and Technology* (Edinburgh: Edinburgh University Press, 2012), 1–15.
22. Ibid., 24. The notion of the object being not merely structure but "regime" evokes Félix Guattari's late-1970s writings on integrated capitalism as a phenomenon of semiotization expressed through a sort of "collective calculator," a definition that predates the current FANG (the high-performing tech stocks Facebook, Amazon, Netflix and Google). Félix Guattari, *Il Capitale Mondiale Integrato* (Bologna: Cappelli, 1982).

23. Marcel Mauss, *A General Theory of Magic* (London and New York: Routledge, 2001), 175.
24. Alfred Gell, "The Technology of Enchantment and the Enchantment of Technology," in *Anthropology, Art and Aesthetics*, ed. Jeremy Coote and Anthony Shelton (Oxford: Clarendon, 1992), 40–66 (quote is at 59).
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26. Ibid., 8.
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28. Grafton, "Magic and Technology in Early Modern Europe."
29. Betti Marenko, "Filled with Wonder. The Enchanting Android from Cams to Algorithms," in *Encountering Things. Design and Theories of Things*, ed. Leslie Atzmon and Prasad Boradkar (London: Bloomsbury, 2017), 19–34.
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31. Ibid., 21.
32. Michael Taussig, *Shamanism, Colonialism, and the Wild Man: A Study in Terror and Healing* (Chicago and London: University of Chicago Press, 1987), 262.
33. Michael Taussig, *The Nervous System* (New York and London: Routledge, 1992), 145.
34. Gilles Deleuze, *Francis Bacon: Logic of Sensation* (London and New York: Bloomsbury Continuum, 2003).
35. Benjamin Bratton, "The Black Stack," *e-flux* no. 53 (2014); Benjamin Bratton, "Outing Artificial Intelligence: Reckoning with Turing Tests," in *Alleys of Your Mind: Augmented Intelligence and Its Traumas*, ed. Matteo Pasquinelli (Luneburg, Germany: Meson Press, 2015), 69–80.
36. The tactile optics is what Benjamin describes as the physiognomic aspect of visual worlds. The emphasis on touch is strikingly apt to describe the prominence of contemporary touch-based interactive devices. Walter Benjamin, "A Short History of Photography," in *One Way Street* (London: New Left Books, 1979).
37. Taussig, *Nervous System*, 144.

38. Ibid.
39. Anna Munster, *An Aesthesia of Networks: Conjunctive Experience in Art and Technology* (Cambridge, MA: MIT Press, 2013).
40. Mario Carpo, "Big Data and The End of History," *Perspecta: The Yale Architectural Journal* 48 (2015): 46–59.
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AFTERWORD

RELIGIOUS AND DIGITAL IMAGINARIES IN PARALLEL LINES

Carole M. Cusack, Massimo Leone, and Jeffrey Sconce

Written from a cross-disciplinary perspective to interrogate the relationship between digital media and the supernatural, this book challenges established boundaries within fields and areas of expertise. In this afterword, the editors asked three leading scholars, whose work explores the intersections of media, communication, and religion from different viewpoints, to enter in dialog on the subject. Carole Cusack is a historian of religion and the author of groundbreaking works about the relationship between religion, imagination, and popular culture; Massimo Leone is a semiologist whose work has stretched the boundaries between the study of religion and the study of signs, both linguistic and nonlinguistic; and Jeffrey Sconce is a scholar in film and media studies whose pioneering monograph, *Haunted Media* (2000), placed the theme of the supernatural at the forefront of studies in media and communication. Their responses provide a map of potential trajectories to further explore the connections between digital media and the supernatural.

Cusack: It is tempting to start by quoting Arthur C. Clarke's memorable line, "Any sufficiently advanced technology is indistinguishable from magic," but that is only true in certain descriptive ways. That is, magic has internal logics and in systematic forms possesses a "rational" quality, but actually technology involves hardware skills that evolve and build upon earlier discoveries, whereas magic involves apparent physical changes or results that are caused by conceptual or symbolic means rather than mechanical or scientific advances. I think that magic has a much longer history than the